Financial Institutions and Efficiency of Financial System: Evidence from Montenegro

Vasilije ĐUROVIĆ – Predrag BJELIC** – Petar RAICEVIC****

Abstract

This paper examines the impact of the Montenegrin development financial institution (DFI) – Investment and Development Fund of Montenegro (IDF) on development dynamics and the overall efficiency of the financial system in Montenegro. The research was conducted using the unrestricted (reduced-form) vector autoregression (VAR) model in levels. This study shows that the Investment and Development Fund of Montenegro has a significant short-term influence on the interest rates of commercial banks, with the effect fading over time as the financial system matures. The IDF did not crowd out private borrowing. Findings highlight the valuable contribution of DFI in fostering competition in the emerging financial system. Limitations include the focus on small and underdeveloped financial system and the absence of analysis in larger and more developed systems. Future research should address these limitations, extending the scope for a more comprehensive result. The findings provide insight for policymakers regarding the DFI role in fostering development and efficiency on small and underdeveloped financial systems. This study contributes novelty by analysing the development impetus of DFIs on the incipient financial system, providing valuable insight for policymakers and guiding future research directions.

Keywords: *development financing, the Investment and Development Fund of Montenegro, interest rates, VAR, commercial banks*

JEL Classification: E43, E44, C32, H30

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Introduction

In small, emerging, and underdeveloped financial systems such as Montenegro's, access to finance for micro, small, and medium enterprises (MSMEs) is a critical factor for economic growth and development. An underdeveloped financial sector impedes growth by limiting access to funds, especially to small entrepreneurs (Sriram and Chaturvedi, 2012). Financial constraints due to costly external financing are more pronounced in underdeveloped financial systems. (Khurana, Martin and Pereira, 2006) However, due to unilateral euroization and the absence of conventional monetary policy instruments, Montenegro faces unique challenges in regulating its financial system and influencing lending conditions. In this context, Development Financial Institutions (DFIs), such as the Investment and Development Fund of Montenegro (IDF), play a key role in bridging financial gaps and promoting economic competitiveness. Public development banks are the main category in the DFI family that includes guarantee and equity-focused financial institutions carrying out a public policy financing mission on behalf of the state (Xu et al., 2021).

The primary purpose of a DFI is to tackle market failures such as lack of long-term financing, inadequate financing for underserved regions or groups that private commercial banks (PCBs) may be unwilling or unable to serve, and limited support to high-risk sectors such as new technologies or the MSMEs.

A clear distinction is warranted between a development finance institution (DFI) and a publicly owned commercial bank (POCB). A DFI is legally mandated to maximise social welfare, subject to financial-sustainability constraints, whereas a POCB maximises profit and shareholder value despite state ownership (WBG and WFDFI, 2018). Because DFIs price social returns, they usually complement private lenders, crowding-in finance where markets fail. On the other hand, POCBs tend to compete on the same terms as private banks. DFIs accept longer maturities and higher project risk, fund themselves chiefly via multilateral lines, capital market or guaranteed bonds, and often display higher but mission-consistent NPL ratios. POCBs rely on retail deposits and operate within standard risk limits.

Despite the recognized importance of DFIs in facilitating access to finance, there is limited empirical research examining their direct impact on commercial credit interest rates and volume of private sector loans to the commercial sector, especially in small and euroized economies. Existing literature primarily focuses on the role of DFIs in addressing market failures and supporting sectors underserved by private financial institutions (Diamond and Raghavan, 2010; Thorne

and du Toit, 2009). However, the dynamics between DFIs and PCBs in influencing interest rates and volume of loans to the commercial sector remain insufficiently researched.

This paper aims to fill this gap by investigating how the IDF's interest rate policy affects the PCBs' credit rates in Montenegro and volume of commercial loans. Specifically, we analyse the dynamic relationship between the IDF's and the PCBs' weighted, effective, and direct interest rates over the ten-year period from December 2012 to December 2022. By applying an unrestricted VAR model in levels, we capture the interdependencies and feedback mechanisms between these institutions.

The examined period is particularly significant due to two key factors. First, the initiation of lending by the European Investment Bank (EIB) via the IDF in Montenegro, provided concessional and subsidized funds[1] under the auspice of the state guarantee, strengthening the IDF's capacity to influence lending conditions. Second, during this period, the Montenegrin financial system went from less to more developed, characterized by reduced systemic risk, less asymmetry of information, improved regulation, better protection of creditor's rights, and increased transparency in terms of economic sectors and economic potential.

Understanding the relationship between the IDF's and the PCBs**'** interest rates is critical because it illustrates how changes in the IDF's rates affect broader credit market conditions and stability, which in turn influence competitiveness and economic resilience by tackling access-to-finance problems faced by businesses in Montenegro.

Based on the identified research gap and objectives, this paper tests the following hypotheses:

- H1: *Changes in the IDF's effective active interest rates have a significant and immediate impact on the commercial active interest rates of commercial banks in Montenegro, with the effect being more pronounced in periods when the credit market is less developed.*
- H2: *The IDF's below-market interest rates do not significantly affect the volume of commercial banks' commercial lending, suggesting that the IDF's operations do not crowd out the private sector.*

The rest of the paper is further structured as follows: section 1 provides an overview of the relevant literature on the role of DFIs and their interaction with PCBs; section 2 gives insights into Montenegrin financial environment; following that, section 3 presents the data and methodology used for the econometric analysis;

[1] Loans that EIB extended to IDF were subsidized due to benefiting from EU guarantee under the auspice of EIB's External Lending Mandate, reducing the risk spread. However, lower risk spread was always transferred to final beneficiaries by lowering their interest rate as a contractual obligation. Funds were also concessional due to benefiting from sovereign guarantee.

the 4th section discusses the empirical results of the VAR model; finally, in the last section we conclude with a discussion of the findings, policy implications, and suggestions for future research.

1. Literature Review

In the academic literature, DFIs are often defined as specialized financial bodies established to promote economic development by providing financial services to sectors underserved by traditional PCBs (Diamond and Raghavan, 1982; Thorne and du Toit, 2009). They aim to address market failures by offering financing solutions that the private sector may be unwilling or unable to provide, such as long-term financing, support for high-risk sectors such as new technologies or MSMEs, and financing for regions or groups in a disadvantageous position (Fernandez-Arias et al., 2019; Thorne and du Toit, 2009).

The primary justification for the DFIs lies in their ability to address market failures in the financial sector (Stiglitz and Weiss, 1981). Market failures occur when financial markets fail to allocate resources efficiently due to problems such as information asymmetry, high transaction costs, or monopolistic practices (Yeyati et al., 2007). By offering long-term funding and supporting projects with high social benefits, DFIs are designed to fill these gaps that private financial institutions often leave unaddressed (Fernandez-Arias et al., 2019; Thorne and du Toit, 2009). Furthermore, several academic and policy-oriented sources suggest that DFIs should primarily focus on addressing market failures rather than competing directly with PCBs in the broad SME market (Carvalho de Rezende, 2018; Diamond and Raghavan, 1982; Thorne and Du Toit, 2009; Ratnovski and Narain, 2007).

A critical concern in the literature is whether the DFIs crowd out private sector lending by competing directly with PCBs (Carvalho de Rezende, 2018; Ratnovski and Narain, 2007; Thorne and du Toit, 2009). Critics argue that DFIs that offer subsidized loans in markets where private banks are willing to lend can undermine the role of the private sector and lead to a misallocation of resources (Scott, 2007). The traditional view advocates that DFI should focus on complementing the private sector rather than competing with it, thus avoiding distortions in the financial market (Thorne, 2011).

In contrast, proponents of the DFIs argue that in underdeveloped and emerging financial systems, the DFIs can play a vital role without displacing private banks, especially when addressing unmet financial needs that the private sector neglects due to high risk aversion or lack of capacity (Rudolph, 2009, Fernandez-Arias and Xu, 2020). Under certain conditions, the DFIs can operate profitably and contribute

to the development of the financial system by filling gaps and encouraging competition (Fernandez-Arias and Xu, 2020).

In small markets characterized by higher levels of concentration and underdeveloped financial systems, such as Montenegro's, the DFIs can play a significant role in improving the efficiency of the financial system (Fernandez-Arias and Xu, 2020). These systems often face challenges such as high entry barriers, limited competition, and information asymmetry, leading to monopolistic practices and high interest rates (Yeyati et al., 2007). DFIs can help reduce concentration and monopoly profits by encouraging competition within the private banking sector (Fernandez-Arias and Xu, 2020). By offering financing at lower rates, DFIs can pressure PCBs to adjust their rates, thereby improving access to financing for MSMEs and stimulating economic activity (Smallridge and de Olloqui, 2011). Thorne and du Toit (2009) suggest that DFIs can help align interest rates to appropriate levels, effectively acting as instruments of monetary policy.

Empirical studies examining the direct impact of the DFIs on commercial lending rates are limited, especially in Euroized economies. Most existing research focuses on DFIs roles in filling financing gaps, supporting specific sectors, and providing countercyclical lending (Griffith-Jones and Tyson, 2013; Luna-Martínez and Vicente, 2012). For euroized economies such as Montenegro, there is a noticeable gap in the literature regarding how the DFIs affect the PCBs' interest rates and lending volumes. The unique monetary constraints of such economies make this an important area of study, as the DFIs may play a different or more pronounced role compared to economies with conventional monetary policy tools.

Although the pool of studies that link DFI pricing to commercial-bank behaviour is still modest, particularly for small, euroized economies, several recent papers now offer clear guidance.

Recent work employing time-series techniques sheds further light on the two channels we test and justifies both our econometric strategy and our choice of explanatory variables. Barboza and Vasconcelos (2019) estimate a structural Bayesian VAR for Brazil containing BNDES disbursements, the policy rate and lending rates. Their impulse response analysis shows that a one-standard-deviation increase in subsidised DFI lending raises fixed investment.

However, it pushes average bank lending rates up by 8 – 12 basis points within a year, providing evidence that large-scale DFI activity can alter the market pricing of credit. Using high-frequency event-study regression framework, Elias and Guimarães (2024) find that Brazilian monetary-policy shocks transmit one-for-one to non-earmarked corporate loans yet barely move the rates on earmarked, BNDES-linked loans, implying a near-complete segmentation of the price channel whenever subsidised credit is present. Passos and Modenesi (2020) apply state-dependent

local projections and show that, although output is cushioned when public-bank credit is high, the inflation response to a policy-rate hike is no smaller, indicating that public-bank lending does not blunt monetary-policy effectiveness.

Gong, Xu, and Yan (2023) merge a global roster of 375 National Development Banks (NDB) with 48,912 syndicated-loan deals (1996 – 2016) and, using loan, firm and country fixed-effects regressions plus Heckman and propensity-score corrections, show that NDB participation raises total facility size while leaving the private tranche unchanged. At the bank level, Brei and Schclarek (2013) estimate fixed-effects models for 764 banks in 50 countries (1994 – 2009) and find that public/national development banks expand lending during crises even as private banks cut back, so aggregate credit grows rather than shifts.

Overall, the emerging evidence confirms that DFIs can influence both the price and the quantity of commercial credit, and it validates the modelling strategy adopted in this paper.

2. Montenegro's Financial Environment

According to Diamond and Raghavan (1982), the economic environment plays a crucial role in determining the success of a development bank. Montenegro is fully euroized and its eleven licensed banks hold ≈ 93% of all financial assets. Non-bank intermediaries (insurance, micro-credit, leasing, funds) account for the remaining 7%. Aggregate bank assets reached EUR 7.2 bn (≈ 105% GDP) at end of 2023 (Central Bank of Montenegro, 2024). Market concentration is moderate-to-high (HHI = 1.395 for assets; 1.750 for loans) and the three largest banks control 54% of the market. Given the market environment, broadly mandated and well governed public development finance institution such as IDF could tackle multiple market failures both by having complementary role in crowding-in private investment and serving underserved market segments but also a competitive role in order to make financing conditions more favourable to private commercial entities, increasing market's efficiency i.e. resource allocation, reducing risk spreads and generally capital pricing for final beneficiaries, especially those that face credit constraints. During the analysed period, the IDF's share of private-sector credit increased from about 3.4% in 2012 to nearly 24.5% in 2020, largely reflecting its countercyclical role during the COVID-19 crisis, before stabilising at around 15% by 2025 (Central Bank of Montenegro, n.d.). At the same time, the depth of Montenegro's banking sector remained shallow by international standards, with the credit-to-GDP ratio falling from about 74% in 2012 to roughly 61% in 2024, supporting the assumption of a less developed financial system.

Created in 2009 as a national development finance institution, the IDF carried a statutory mandate to maximize social welfare by expanding access to finance for MSMEs, export projects and infrastructure. It mostly extended loans to private commercial entities whilst smaller part of its portfolio went to local governments projects and to central government-owned companies. IDF did not extend loans to large companies or private individuals. It was non-deposit-taking and funded itself through multilateral credit lines (EIB, CEB, AFD) under the auspice of state guarantee. IDF extended annual credit lending grew from EUR 7 m in 2010 to EUR 137 m in 2020 – a counter-cyclical peak during COVID-19 – and with factoring financing it cumulatively exceeded EUR 2.1 bn by 2024, without budget transfers. Although its risk appetite was higher than that of commercial banks, the IDF's NPL ratio has never exceeded the sector average except briefly in 2020 – 2021 during economic crisis, underscoring its developmental rather than commercial motive but also indicating high risk aversion on the market and hence inadequate access to finance for commercial entities. The stylised facts above suggest that the IDF should have acted as a catalytic price leader, its concessional rates nudging commercial bank pricing, while leaving aggregate private lending volumes largely unaffected, in this regard fulfilling its developmental role.

3. Data and Methodology

3.1. Methodology

In order to investigate the dynamic interrelationships between the IDF's and the PCBs' interest rates and the volume of loans towards the economy in Montenegro, we use an unrestricted (reduced-form) vector autoregression (VAR) model in levels. The VAR methodology, introduced by Sims (1980), is well suited to capture the temporal dynamics and interactions between multiple time series variables without imposing restrictive a priori theoretical assumptions about causality or directionality. The VAR model treats all variables as endogenous, allowing each variable to be explained by its own lagged values, as well as the lagged values of all other variables in the system. The general form of the VAR(p) model, where p represents the number of lags, can be written as:

$$Y_t = c + \sum_{i=1}^{p} \phi_i Y_{t-i} + \epsilon_t \tag{1}$$

where Y_t is the vector of the endogenous variables, c is the vector of intercepts, ϕ_i are the coefficient matrices that capture the relationships between the lags of

the variables and ϵ_t represents the error terms for each equation, assumed to be white noise. In our study, the vector of endogenous variables Y_t includes the effective active interest rate charged by the PCBs on new commercial loans, the effective active interest rate charged by the IDF on new commercial lending, total volume of loans granted by the PCBs to businesses and total volume of loans granted by the IDF to businesses.

Prior to estimation we screened each series for stochastic trends. Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests revealed a mixed order of integration, the three series are I(0), whereas the commercial-bank loan volume is I(1).

The VAR approach in this context is appropriate for several reasons. Firstly, it enables the examination of dynamic effects and feedback mechanisms among variables, which is crucial for understanding how changes in IDF's interest rates affect the PCBs' rates and credit activity, and vice versa. Secondly, the VAR model does not require strict exogeneity assumptions; all variables can influence each other simultaneously and with a lag (Lütkepohl, 2005). This is particularly relevant in the context of the Montenegrin banking sector, where interactions between the IDF's and the PCBs' rates can be complex and two-way. Because only one series is I(1) and Johansen trace tests detect a single cointegrating vector, we follow Sims, Stock and Watson (1990) and Toda and Yamamoto (1995), and estimate the model in levels. A restricted VECM (rank = 1) is reported in Online Appendix (Annex B) and yields identical short-run impulse responses.

To determine the optimal number of lags in the VAR model, the Akaike Information Criterion (AIC), Schwartz Information Criterion (SC), and Hannan-Quinn Criterion (HQC) were performed. Furthermore, after estimating the VAR model, diagnostic tests were performed to assess the model's validity. These include testing for autocorrelation using the Ljung-Box Q-statistic, heteroskedasticity using White's Test, and ensuring model stability by examining the roots of the characteristic polynomial to confirm that they lie within the unit circle. We also repeat the estimation with EURIBOR_{3M}, CPI inflation and monthly GDP growth treated as strictly exogenous controls, the resulting VARX coefficients are provided in Online Appendix (Annex C). Granger causality tests were conducted to examine whether changes in IDF's interest rates can predict changes in PCBs' rates and credit volume, and vice versa. This will help establish the directional relationship between the variables.

Identification follows a recursive (Cholesky) decomposition in which the variables are ordered as (i) the IDF policy rate, (ii) the commercial-bank lending rate, (iii) the stock of commercial-bank loans, and (iv) the stock of IDF loans, reflecting the institutional sequence in which policy rates are announced, passed through to

commercial pricing, and eventually affect quantities. Appendix A reports impulse responses when the first two variables are reversed as a robustness check; the qualitative results are unchanged, confirming that the findings are not driven by variable ordering.

To further analyse system dynamics, impulse response functions (IRFs) were estimated to track the response of each variable to shocks in other variables over time (Sims, 1980). Additionally, variance decomposition was used to quantify the contribution of each variable to the variance of the forecast error of the other variables, providing insight into the relative importance of the variables in explaining system behaviour.

Lastly, to ensure the robustness of the results, a sensitivity analysis was conducted by varying the lag length and re-estimating the model. As an additional robustness check, we re-estimated the model on the pre-COVID sub-sample 2013 – 2020, the impulse-response profiles are unchanged (Appendix D). This helps to confirm the stability of the relationships between the variables and ensure that the findings are not sensitive to the chosen model specification.

3.2. Data Description

The empirical analysis uses monthly data for a ten-year period, from December 2012 to December 2022. This period is particularly significant because it marks the beginning of lending by the European Investment Bank (EIB) via the IDF with subsidized and concessional funds under the auspice of state guarantee.

For this, we considered the weighted average effective direct interest rate charged by the IDF on new commercial lending, the weighted average effective direct interest rate charged by commercial banks on new commercial loans and the total amount of loans placed by the IDF and the PCBs to businesses during the period. In addition, three strictly exogenous macro-financial controls are collected for the later VARX specification, reported in Online Appendix (Annex C), namely the three-month EURIBOR, the CPI-based year-on-year inflation rate, and a monthly GDP-growth indicator. This data was sourced from internal records of the IDF of Montenegro, Statistical Office of Montenegro – MONSTAT, and official publications of the Central Bank of Montenegro.

Descriptive statistics provide an initial understanding of the data's distribution, central tendency, and variability for the two main variables that were considered in Table 1.

Summary statistics for the strictly exogenous controls (EURIBOR-3M, CPI inflation and monthly GDP growth) are reported in Online Appendix (Annex C) for completeness.

T a b l e 1

Descriptive Statistics

Series	PCBs' IR	IDF's IR	Loan v. PCB	Loan v. IDF
Observations	117	117	117	117
Mean	6.406	3.932	44,583,863	6,183,799
Median	5.900	3.634	42,562,000	4,385,958
Maximum	10.290	6.778	96,368,000	52,386,970
Minimum	3.640	2.239	18,043,000	65,870
Std. Dev.	1.898	0.998	17,540,759	7,626,429
Skewness	0.610	0.990	0.962	3.268
Kurtosis	2.047	3.201	3.846	17.278
Jarque-Bera	21.548	1,202.150	21.548	1,202.150
Probability	<0.001	<0.001	<0.001	<0.001

Source: Own elaboration.

The average interest rate charged by the PCBs during the sample period is approximately 6.41%, while the average rate of the IDF is significantly lower at 3.93%. This distinction highlights the IDF's role in providing more favourable financing conditions to stimulate economic growth, especially for sectors or projects that may be underserved by commercial banks.

Both interest rate series show positive skewness, indicating a longer tail to the right of the distribution. Kurtosis values indicate that the IDF's interest rates have a flatter distribution, while the PCBs' rates are closer to a normal distribution. The Jarque-Berra test statistic for both series is significant at the 1% level, indicating that the null hypothesis of a normal distribution is rejected.

Stationarity of the time series data was examined for the abovementioned series. The ADF, PP, and KPSS unit root tests were employed to assess whether the series are stationery and results are presented in Table 2.

T a b l e 2

Unit Root Test

Series	ADF	PP	KPSS
eair_pcb_to_economy	–2.971***	–2.058	1.223***
eair_direct_idf_to_economy	–2.829*	–4.601***	1.223***
loan_volume_pcb	–0.114	–9.779***	0.973***
loan_volume_idf	–8.927***	–9.767***	1.015***

Note: ADF and PP test the null hypothesis of a unit root. KPSS tests the null hypothesis of stationarity.
***, **, and * denote rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively.

Source: Own elaboration.

As unit root tests show that the three series are I(0) while *loan_volume_pcb* is I(1), we applied Johansen's trace test (Online Appendix – Annex B, Table 8) to verify whether a stable long-run relation exists among the four variables. The test, with a restricted constant, no deterministic trend, and two lags in first differences, points to one cointegrating relation. This means that the two interest-rate series

and the IDF loan volume gravitate toward a common long-run path with the (non-stationary) commercial-bank loan volume, while shocks to the latter provide the single source of permanent change in the system. Because only one common trend is present, consistent estimation can proceed either with a levels VAR (in line with Sims, Stock and Watson, 1990; Toda and Yamamoto, 1995) or with a rank-1 VECM. We estimate the model in levels and report the VECM as a robustness check in Online Appendix (Annex B).

3.3. Analysis and Results

The VAR model was estimated using four endogenous variables: the weighted average effective interest rate charged by commercial banks (*eair_pcb_to_economy*), the weighted average interest rate charged by the IDF (*eair_direct_idf_to_economy*), the total volume of loans granted by commercial banks (*loan_volume_pcb*) and the volume of loans by the IDF (*loan_volume_idf*). Every variable relates to commercial lending. A second specification extends this core model with three strictly exogenous variables (EURIBOR-3M, CPI inflation and monthly GDP growth), and the results are reported in Appendix C and are labelled "VARX".

Based on the lag order selection criteria, the AIC and the Final Prediction Error (FPE) suggest a relatively large number of lags (up to 16), while the SC and the HQC suggest a simpler model with 2 lags. Considering the trade-off between model complexity and considering the monthly data frequency and sample size, we chose a lag length of 2 for the final model estimation.

The results of levels VAR indicate a significant degree of stability of PCBs' interest rates since the previous values of these rates strongly influence their current level. Specifically, the first and second lags of the PCBs' interest rate (*eair_pcb_to_economy*) have positive and highly significant effects on the current rate, with coefficients of 0.4166 and 0.4465, respectively (both significant at the 1% level). This suggests that the PCBs gradually adjust their interest rates, with past rates serving as strong predictors of future rates, reflecting inertia in their rate-setting behaviour.

In addition to this persistence, the model reveals that changes in the IDF's interest rates have a significant and immediate impact on the PCBs' interest rates. The first delay of the IDF's interest rates has a positive and statistically significant effect on the PCBs' interest rates, with a coefficient of 0.261 ($p < 0.01$). This finding highlights a short-term transmission mechanism from the IDF to commercial banks, indicating that when the IDF adjust its rates, the PCBs respond by adjusting their own rates accordingly. However, the effect is short-lived, as the second lag of the IDF's interest rate is not significant, implying that the impact dissipates relatively quickly.

T a b l e 3

VAR Estimates of Interest Rates and Credit Volumes

	EAIR_PCB	**EAIR_IDF**	**LOAN_V_PCB**	**LOAN_V_IDF**
EAIR_PCB (–1)	0.417*** (–0.09)	0.114 (–0.102)	–491808 (–2765299)	–173034.6 (–1168486)
EAIR_PCB (–2)	0.447*** (–0.088)	0.140 (–0.095)	–3950370 (–2575678)	–2202635* (–1088361)
EAIR_IDF (–1)	0.261*** (–0.088)	0.124 (–0.097)	–2709514 (–2604187)	–27134.33 (–1100408)
EAIR_IDF (–2)	–0.005 (–0.094)	0.269*** (–0.103)	511204.9 (–2767446)	–400105.7 (–1169394)
LOAN_V_PCB(–1)	2.24E-09 (–3.60E-09)	5.33E-09 (–3.90E-09)	0.056 (–0.106)	–0.048 (–0.045)
LOAN_V_PCB(–2)	6.46E-09* (–3.60E-09)	3.37E-09 (–3.90E-09)	–0.032 (–0.105)	–0.088* (–0.045)
LOAN_V_IDF(–1)	–3.17E-09 (–8.00E-09)	3.62E-10 (–8.70E-09)	–0.639*** (–0.234)	–0.072 (–0.099)
LOAN_V_IDF(–2)	–3.93E-09 (–8.20E-09)	2.10E-09 (–8.90E-09)	–0.169 (–0.239)	0.032 (–0.101)
C	–0.524 (–0.467)	0.319 (–0.508)	85770363*** (–1.40E+07)	29522246*** (–5773798)
Adj. R-squared	0.905	0.572	0.164	0.202
Included observations: 110 after adjustments				

Note: Standard errors in ( ). ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.
Source: Own elaboration.

Regarding the volume of loans, the VAR results suggest that interest rates do not significantly affect the volume of loans of either commercial banks or the IDF. The coefficients associated with lagged interest rates of the IDF and the PCBs on the volume of loans are small and statistically insignificant. This indicates that interest rate fluctuations do not have a measurable impact on the amount of loans given to business entities during the observed period. This suggests that credit volume decisions may be more influenced by factors such as credit demand, borrower creditworthiness, and economic conditions rather than prevailing interest rates.

Model performance is robust to interest rate equations, with R-squared values of approximately 91% for the PCBs' interest rate and 60% for the IDF's interest rate, indicating a good fit. However, the model explains less variation in the loan volume equations, with R-squared values of 22% for PCBs and 26% for the IDF, suggesting that other factors not included in the model affect lending volume.

To further examine the dynamic interactions, impulse response functions (IRFs) were generated. The IRF illustrating the response of the PCBs' interest rates to a shock of one standard deviation in the IDF interest rate is presented in Figure 1.

A one-standard-deviation cut in the IDF lending rate reduces the commercial-bank rate by about 6 basis-points on impact and by roughly 19 bp in month 2 (Figure 1, Panel a, solid blue line). The Monte-Carlo 95 percent band (dashed red

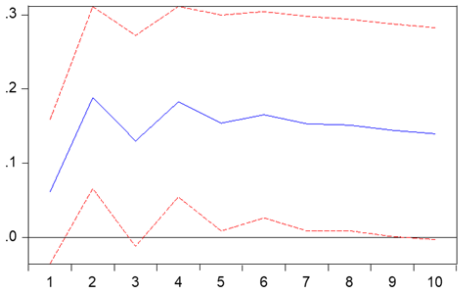
lines) stays entirely below zero for horizons 1 – 2 but overlaps the horizontal axis from month 3 onward. Hence the pass-through is statistically significant yet short-lived, fading after roughly one quarter. This reinforces the short-run transmission mechanism identified in the levels-VAR coefficients, while confirming that the effect is temporary.

Similarly, the IRF analysis of the response of commercial bank credit volumes to the IDF interest rate shock is presented in Figure 1, Panel b. The IRF indicates that a positive shock to the IDF's interest rate has a negligible and statistically insignificant impact on the volume of the PCBs' loans.

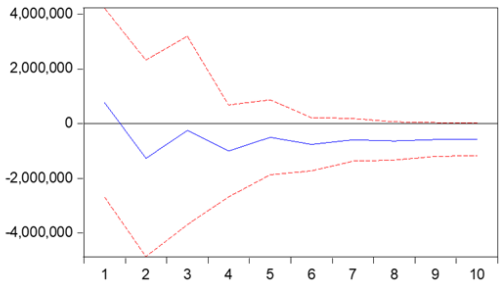
F i g u r e 1

Impulse Response Functions to an IDF Interest Rate Shock

a) ***Response of Commercial Bank LendingRates***



b) ***Response of Commercial Bank LoanVolumes***



Source: Own elaboration.

This finding is consistent with the results of the VAR, which suggests that the volume of loans is not sensitive to changes in the interest rates of the observed period.

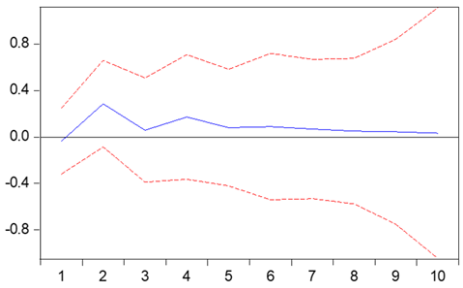
The analysis of the shorter sample period (2012 to 2015), during which the interest rates of the PCBs fell the most, revealed a somewhat different dynamic. The impulse response function (Figure 2) shows that the initial positive response of the PCBs' interest rates to the IDF's interest rate shock remains significant in the short term. Here, the 95% confidence band already includes zero by horizon 3, indicating the effect loses significance more quickly. This suggests that in the early stages of the IDF's operations, the effect of its rates on the PCBs' rates was more immediate but less persistent, potentially reflecting a closer relationship between the institutions as development finance initiatives gained momentum.

Forecast-error variance-decomposition (Online Appendix – Table 5, Annex A) reinforces the IRF findings. Even after ten months, roughly 70% of the variance

in the PCB rate is still driven by its own innovations, while about one-fifth (19%) is attributable to IDF-rate shocks.

F i g u r e 2

IRF of Interest Rates of Commercial Banks to IDF (2012 – 2015)



Source: Own elaboration.

By contrast, IDF shocks explain less than 2% of the forecast variance in PCB loan volumes at any horizon. The latter remain dominated by their own past values and, to a lesser extent, feedback from PCB rates. Thus, IDF pricing transmits quickly to market rates but not to quantities, fully consistent with Hypotheses H1 and H2.

To assess directional relationships between variables, Granger causality tests were conducted, and the results are summarized in Table 4. The tests confirm bidirectional causality between the IDF's and the PCBs' interest rates. Specifically, the IDF's interest rates cause the PCBs' interest rates ($p = 0.0130$), and the PCBs' interest rates cause the IDF's rates ($p = 0.0015$).

This indicates a feedback loop in which both institutions monitor and react to each other's rate changes, highlighting the interconnectedness of their rate-setting behaviour.

T a b l e 4

Granger Causality between IDF and Commercial Bank Interest Rates and Loan Volumes

Excluded variable	eair_pcb_to_economy	eair_direct_idf_to_economy
eair_direct_idf_to_economy	8.678**	–
loan_volume_pcb	3.874	2.859
loan_volume_idf	0.395	0.0576
eair_pcb_to_economy	–	12.949***
all	14.871**	14.405**

Note: Entries report χ^2 statistics from Granger causality tests. ***, **, and * denote rejection of the null hypothesis of no Granger causality at the 1%, 5%, and 10% significance levels, respectively.

Source: Own elaboration.

Importantly, the tests show no significant Granger causality between interest rates and credit volume, either for the PCBs or the IDF. This suggests that the volume of lending is not driven by changes in interest rates over the observed period, supporting earlier findings that other factors influence credit activity and that there is no evidence of crowding out of private sector lending by IDF's operations. This neutral volume effect is consistent with the IDF's relatively small market share during most of the period, with the temporary 2020 spike reflecting countercyclical lending during COVID-19 rather than structural displacement of private credit.

A series of diagnostic tests were conducted to validate the model. The Ljung-Box Q-statistic for serial correlation (Online Appendix – Annex A, Table 6) indicates no significant autocorrelation at key lags, supporting the robustness of the model. Although there is minor evidence of autocorrelation at lag 2 ($p = 0.024$), the cumulative test indicates no consistent autocorrelation between lags, suggesting that any remaining autocorrelation does not systematically affect the results.

The results of the heteroscedasticity tests (White's test) (Online Appendix – Annex A, Table 7) suggest that the model residuals do not suffer from significant heteroskedasticity, as evidenced by the joint test p-value of 0.9061. This implies that the variance of the residuals is consistent over time, increasing the reliability of the estimated coefficients and standard errors.

Furthermore, the stability test confirms that the VAR model satisfies the stability condition, whereby all the roots of the characteristic polynomial lie within the unit circle. The largest root has a modulus of 0.9613, indicating that the model is dynamically stable and that any shocks to the system will dissipate over time (Online Appendix – Annex A, Table 8).

As a further check on our Cholesky identification, we reversed the rate-ordering (i.e. PCB rate, IDF rate, PCB loans, IDF loans) and re-computed both IRFs and the Forecast Error Variance Decomposition. The impulse-response profiles and variance shares (Online Appendix – Annex A, Figure 4, Table 9) are virtually indistinguishable from the baseline, which confirms that our main findings are not an artifact of the particular recursive ordering chosen.

Finally, we verify that the principal results are not affected by the modelling choices or by pandemic related shocks. First, we re-estimate the system as a rank-1 VECM, imposing the cointegration relation identified by Johansen. The error-correction term is highly significant, yet the estimated short-run impact of a one-standard-deviation cut in the IDF rate on the commercial-bank rate (–55 bp on impact, disappearing after three months) is practically the same as in the levels VAR (Online Appendix – Annex B, Tables 11 – 12 and Figures 4 – 5). Second, augmenting the model with three strictly exogenous controls, EURIBOR-3M, year-on-year CPI inflation, and monthly GDP-growth, produces a VARX specification whose

impulse-response functions are almost identical in magnitude, timing, and 95% confidence bands to those of the baseline model (Appendix C). Third, we re-estimate the VAR on the pre-COVID sub-sample (May 2013 – January 2020). The resulting responses (Online Appendix – Annex D, Fig. 9) sit well inside the full-sample confidence bands, showing that the pandemic does not change the short-run transmission.

Across all three robustness exercises the core dynamics are therefore stable, reinforcing the diagnostic evidence (no residual serial correlation beyond lag 2, homoscedastic errors in the White test, and all companion-matrix roots well inside the unit circle) that the baseline VAR provides an econometrically sound representation of the short-run link from IDF to commercial-bank pricing and volumes.

4. Discussion

This study set out to examine the dynamic relationship between the IDF of Montenegro and the commercial banking sector in the country in the period from December 2012 to December 2022. Using a vector autoregression (VAR) model in levels, we sought to understand how the IDF's interest rate policy affects PCBs' interest rates and commercial lending volumes in a small, Euroized economy that lacks traditional monetary policy instruments.

Empirical findings confirm that changes in the IDF's effective interest rates significantly affect the PCBs' interest rates in the short term. Namely, the first lag in the interest rate of the IDF has a positive and statistically significant effect on the rates of the PCBs. This immediate response indicates a rapid transmission mechanism in which the PCBs adjust their lending rates in response to changes in the IDF's interest rates.

The diminishing impact of the IDF over time can be attributed to the maturation of the Montenegrin financial system. During the first years of the studied period (2012 – 2015), the financial system was characterized by higher systemic risk, higher information asymmetry, and less developed regulatory frameworks. The IDF's influence in this context was more pronounced due to its role in providing subsidized and concessional financing and encouraging competition. As the financial system developed, increased competition, increased regulatory oversight, and improved market transparency likely reduced the relative impact of the IDF's on the PCBs' interest rates.

Our findings also reveal that the below-market IDF's interest rates do not significantly affect the volume of the PCBs lending. The coefficients associated with interest rate lag on loan volume were statistically insignificant. This suggests that factors such as credit demand, borrower creditworthiness, and macroeconomic

conditions play a more significant role in determining the volume of lending than the cost of borrowing. This outcome supports the view that the DFIs can complement rather than crowd out private sector lending, especially in underdeveloped financial systems where they help mitigate market failures associated with monopolistic practices and information asymmetry (Fernández-Arias et al., 2019; Gutierrez et al., 2011; Rudolph, 2009; Stiglitz, 1994; Yeyati et al., 2004; Yeyati et al., 2007).

All three robustness exercises, a rank-1 VECM, a VARX with macro controls, and a pre-COVID subsample, replicate the same pattern. Namely, the price effect in H1 is preserved, while the quantity effect in H2 remains absent (Online Appendix – Annex B – D). Hence, the evidence consistently upholds both hypotheses.

Our sample spans the COVID-19 episode, but the VAR is not designed to identify crisis-specific shocks. We therefore do not draw causal conclusions about a counter-cyclical role, at most the pattern is consistent with the view that DFIs can cushion shocks. This function is consistent with the literature emphasizing the importance of DFIs in providing countercyclical lending and improving financial stability during periods of economic stress (Brei and Schclarek, 2013; Frigerio, 2024; Gutierrez and Kliatskova, 2021; Mazzucato and Penna, 2015; Panizza, 2024; Thorne and du Toit, 2009; Yeyati et al., 2004; Yeyati et al., 2007).

Taken together, our short-run pass-through of 13bp and persistently neutral effect on bank lending volume closely matches the latest econometric evidence on national development banks. The magnitude and duration of the interest rate effect mirror Barboza and Vasconcelos's (2019) Bayesian-VAR estimate for Brazil, where a comparable BNDES shock changed average interest rates by about 10 basis points in less than a year, while the absence of any volume shift mirrors the results of syndicated-loan results of Gong, Xu and Yan (2023) and the cross-country bank panels of Brei and Schclarek (2013). In other words, development bank loans appear to act as a temporary competitive benchmark, reducing prices, but do not substitute for commercial loans.

This study has several limitations that should be acknowledged. First, it focuses on a specific period after the establishment of the IDF of Montenegro in 2010, making this narrow temporal and contextual range limiting the generalizability of the findings to other economies or different time frames. In addition, because the analysis is limited to one country, the applicability of the results to other settings remains uncertain.

To improve the robustness and external validity of these conclusions, future research should examine similar euroized economies or small open systems. Comparative research can help determine whether observed effects are consistent across contexts, thereby deepening our understanding of the role that development finance institutions play in different economic settings.

Conclusion

In conclusion, this study shows that the Investment and Development Fund of Montenegro had a significant short-term influence on the interest rates of commercial banks, which indicates a mechanism of clear and rapid transmission in the Montenegrin credit market. While this effect is statistically significant, it is also transient, fading over time as the financial system matures. The below-market IDF's rates did not crowd out private borrowing. Our study is deliberately limited to short-run price effects, and stops short of evaluating wider counter-cyclical or macro-prudential roles. Furthermore, the influence declines as market contestability and information improve, suggesting that DFIs are most potent in the early stage of financial deepening. The findings suggest that, even in the absence of conventional monetary policy instruments, as is the case in Montenegro's euroized environment, development financial institutions can act as effective tools to foster credit market efficiency and accessibility, without displacing private credit.

Future research should extend this framework to different economic environments, enabling comparative analysis and better understanding of the conditions under which DFIs most effectively enhance market efficiency.

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