

Treasury-Bill Yields and Private-Sector Credit

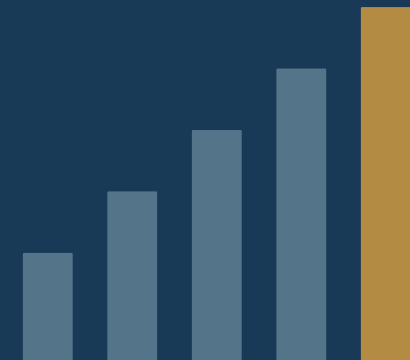
How Are They Connected?

Government finance. Loan pricing. Bank portfolios.

Evidence on comovement, allocation and the limits of causal inference

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RESEARCH BRIEFING | PUBLICATION EDITION | SEPTEMBER 2026



EVIDENCE CUT-OFF
19 SEPTEMBER 2026

Rates / banking: to February 2026
Government financing: FY 2025

Three evidence streams answer three different questions

A linked reading route from government financing to loan pricing and balance-sheet allocation.

01 GOVERNMENT YIELDS

What does government borrowing cost?

Auction yields, issuance, maturities and the holders of marketable government debt.

[Markets and financing | pp. 9–15](#)

02 BUSINESS CREDIT

What changes for businesses?

Aggregate lending rates, enterprise credit stocks, borrower costs and access conditions.

[Pricing and credit | pp. 16–30](#)

03 BANK PORTFOLIOS

Where do banks place funds?

Cash, loans and investments; issuer separation; causal identification and research delivery.

[Portfolios and identification | pp. 31–50](#)

Publication note 3 | Executive evidence 4–8 | Technical and validation appendices 51–71 | References 72–75 | Synthesis 76

Publication note and abstract

Dated evidence, exploratory estimates and a reproducible record of uncertainty.

Abstract

Using 30 monthly observations (September 2023–February 2026), the report estimates a contemporaneous lending-rate association of 0.140 percentage points per 1-point change in the 91-day bill rate (approximate 95% interval: -0.003 to 0.284). Levels correlate at 0.939; monthly changes at 0.405. Results depend on controls, timing and influential observations.

Separate official snapshots show 16.6% nominal enterprise-credit growth and a 9.6-point rise in banks' investment share in the year to February 2026; net domestic issuance fell 34.3% in provisional 2025. These are not causal displacement estimates. A 16-date forecasting exercise provides no validated real-time investment signal. The proposed causal study requires linked bank–firm and auction records and a defensible assignment design.

Publication and access

Authored by Dr. Felix Larry Essilfie
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Evidence cut-off: 19 September 2026
Rates: September 2023–February 2026
Financing: 2024 / provisional 2025

Companion package: data, code, source records and author's notes.

Independent IDER research; no external peer review or institutional certification is claimed.

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Pricing, credit and portfolio changes do not tell the same story

Each result retains its own unit, denominator and observation period.

**CORRELATION: LEVELS /
CHANGES**

0.94 / 0.41

Pearson r; n = 30 / 29 months

ENTERPRISE CREDIT STOCK

+16.6%

Nominal; year to February 2026

BANK INVESTMENTS / ASSETS

+9.6 pp

February 2025 to February 2026

NET DOMESTIC ISSUANCE

−34.3%

Provisional 2025 versus 2024

The empirical connection is multidimensional

Lower yields can accompany lower loan rates, larger credit stocks and more investment holdings at the same time. Those movements must be reconciled before testing which changes were caused by government borrowing.

These observations do not measure a causal crowding-out coefficient or risk-adjusted lending relief for individual firms.

What the completed analysis establishes

Association, accounting and causal identification are separate analytical claims.

Table 1. Evidence delivered and limits

Evidence layer	Completed output	Interpretation boundary
Pricing	30 rate levels; 29 changes; extended model and sensitivity checks	Not a structural or causal pass-through elasticity
Government borrowing	Gross / net issuance, auctions, debt cost and holders	Reported financing categories are not all fresh cash receipts
Credit and portfolios	Official enterprise / household stocks and asset shares	Snapshots; no interpolated bank-level panel
Causal research	Expanded estimand, assignment, selection and inference protocol	Proposed; no identified Ghana coefficient supplied

Sources: BoG (2026); MoF (2026); BoG monthly tables; IDER calculations. S01, S02, S03, S04, S05.

Define the quantities before comparing the movements

A yield, a loan price, a stock of credit and a portfolio share are not interchangeable.

Table 2. Core measurement objects

Quantity	Correct measure	Common error
Government borrowing cost	Same tenor, date and yield convention	Using one auction yield as the cost of the entire debt stock
Business loan price	Same loan: benchmark, spread, fees and repayment basis	Treating aggregate ALR as an SME quotation
Business lending	Enterprise stocks, originations, repayments and approvals	Calling a stock change “new loans granted”
Bank allocation	Issuer-specific holdings / bank assets	Calling all investments Government of Ghana T-bills
Government holder share	Holder’s securities / government securities outstanding	Reading that share as securities / bank assets

Sources: BoG (2026); MoF (2026); MoF; IDER calculations. S01, S02, S07.

Several mechanisms can produce the same observed correlation

Mechanisms below are hypotheses to distinguish, not effects already identified for Ghana.

Relative return

Loan coupons compete with security yields only after credit losses, operating costs, capital, liquidity and maturity are made comparable.

Common conditions

Policy rates, inflation, funding, exchange rates and credit demand can move yields and loans together without a direct causal link.

Balance-sheet channels

Securities can absorb funds, provide collateral or create valuation gains and losses. Deposit growth can allow loans and securities to rise together.

The evidence has deliberately different time windows

No stock series is interpolated, and no later benchmark is paired with an older loan rate.

Table 3. Dataset windows and verification

Dataset	Coverage	Verification status
Monthly rate panel	Sep 2023–Feb 2026; 30 months	65 cells rechecked; earlier 17 months retained
Credit stocks	Feb 2024, Feb 2025, Dec 2025, Feb 2026	Prior official Table A.9 text; image check incomplete
Bank portfolio shares	Same four snapshots	Prior official Figure 6.1 image check retained
Government financing / holders	2024 and provisional 2025	Official tables and images rechecked in the report
Business loan access	Survey interviews Feb 2023–Feb 2024	World Bank Figure 14 checked; not a 2026 survey

Sources: BoG (2026); MoF (2026); BoG monthly tables; World Bank Enterprise Surveys (2024); IDER calculations. S01, S02, S03, S04, S05, S06.

Separate Government of Ghana bills from Bank of Ghana securities

The issuer determines the financing channel; instrument labels alone are insufficient.

Table 4. Issuer and instrument separation

Instrument / record	What it measures	Treatment in this report
Government T-bill	Short-term government financing, typically 91 / 182 / 364 days	Yield series is 91-day; quantities retain source coverage
Bank of Ghana security	Central-bank instrument; separate issuer	Do not add to government financing without consolidation rules
Government bond	Longer contractual maturity; residual tenor may be short	Separate duration, coupon and restructuring treatment
Bank “investments”	Bills, securities and equity across reported categories	Broader than government T-bills
Auction dealer bid	Bid placed through a dealer	Not proof of the dealer’s beneficial ownership

Sources: BoG (2026); MoF (2026); MoF; MoF (2022); IDER calculations. S01, S02, S07, S08.

Discount rates and investment yields have different denominators

A declared mathematical illustration—not a quotation or a statutory Ghana pricing formula.

FACE VALUE

100.00

Repaid at maturity

PURCHASE PRICE

97.51

10% annual simple discount

INVESTMENT YIELD

10.26%

Return relative to purchase price

Discount rate = (Face – Price) / Face × 365 / days

Investment yield = (Face – Price) / Price × 365 / days

Illustration assumes a 365-day year and simple annualisation. Actual source conventions must be recorded.

Lower average debt cost coexisted with shorter domestic maturity

Existing domestic debt portfolio; end-2024 versus provisional end-2025—not monthly auction yields.

Table 5. Domestic borrowing cost and refinancing profile

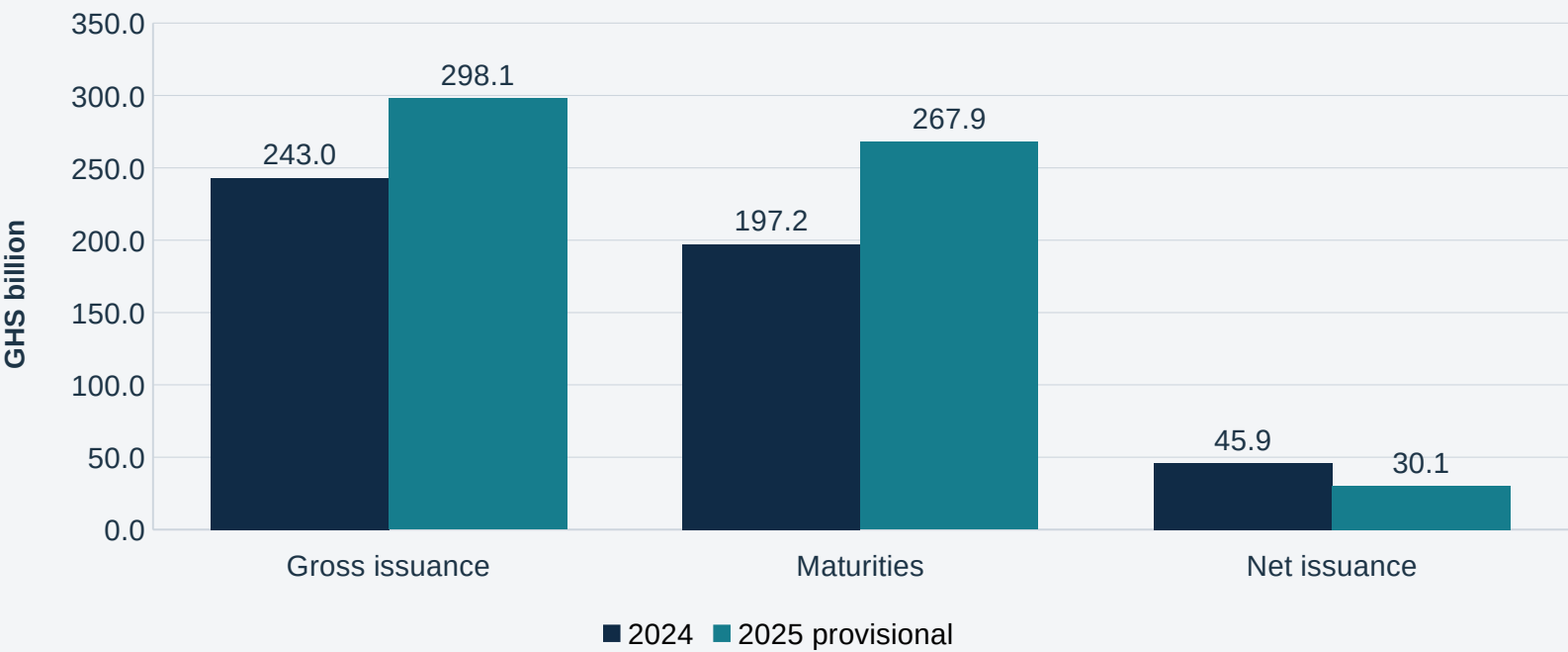
Domestic debt indicator	2024	2025 provisional	Change
Weighted average interest rate	16.2%	12.8%	–3.4 percentage points
Average time to maturity	4.8 years	4.1 years	–0.7 years
Maturing within one year	38.0%	39.6%	+1.6 percentage points
Measurement meaning	Existing portfolio	Existing portfolio	Not a marginal 91-day auction cost

Sources: MoF (2026); IDER calculations. S02.

Gross issuance increased while net issuance declined

MoF Table 6.1, 2024 versus provisional 2025; GHS billion.

Figure 1. Domestic marketable financing and rollover



Two quantities

Gross issuance: +22.6%

Net issuance: -34.3%

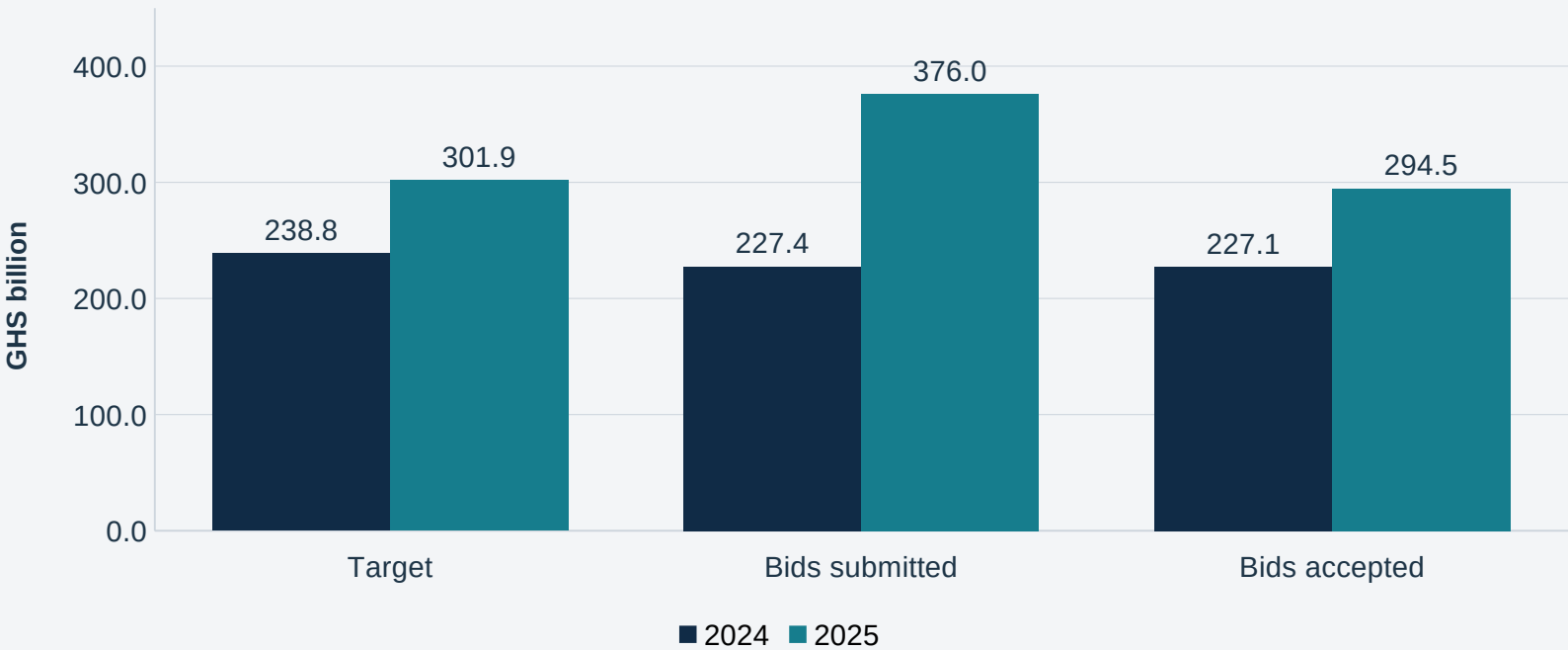
A larger auction or issuance total need not imply more net budget financing.

Published financing-table categories, including non-cash issuance components; not a gross bank-credit displacement measure.

Bids covered the target; accepted bids were a different quantity

Calendar-year Treasury-bill auction totals, 2024 and 2025.

Figure 2. Auction demand, targets and acceptance



2025 ratios

Bids / target: 1.25×
Accepted / target: 97.5%
Accepted / bids: 78.3%

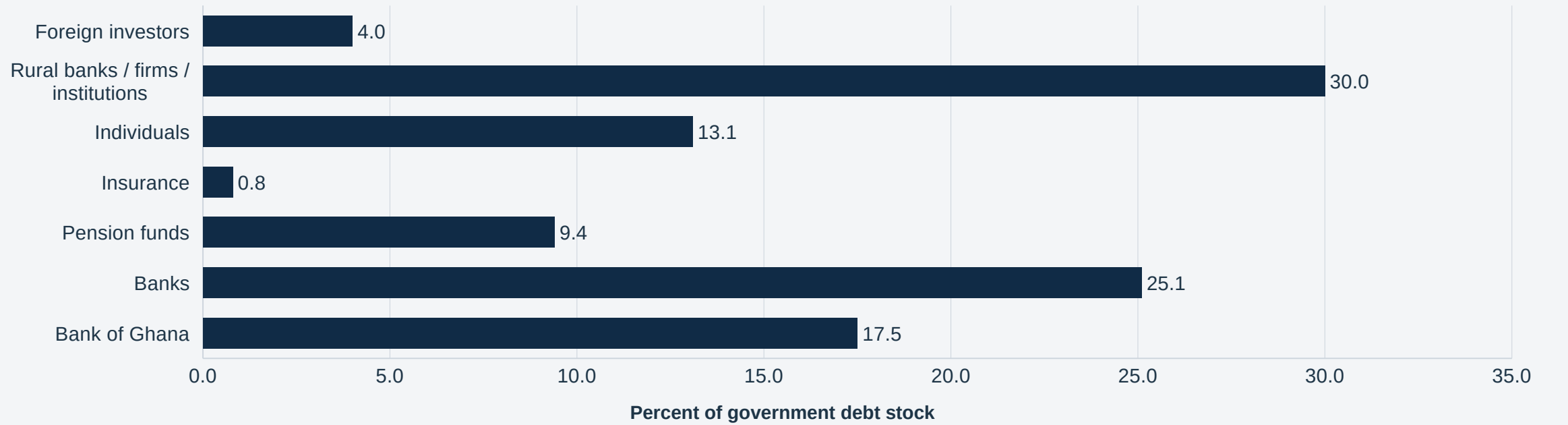
Each denominator answers a different question.

Annual ratios are ratios of annual sums. Dealer bids do not identify the final investor or a causal supply shock.

Banks were one part of a broader government investor base

Marketable domestic government debt; provisional end-2025 shares of the government debt stock.

Figure 3. Holder composition of marketable government debt



Sources: MoF (2026); IDER calculations. S02.

Government holdings and total bank investments are different universes

No single percentage can substitute for issuer, holder, valuation and balance-sheet coverage.

Table 6. Non-equivalent holdings measures

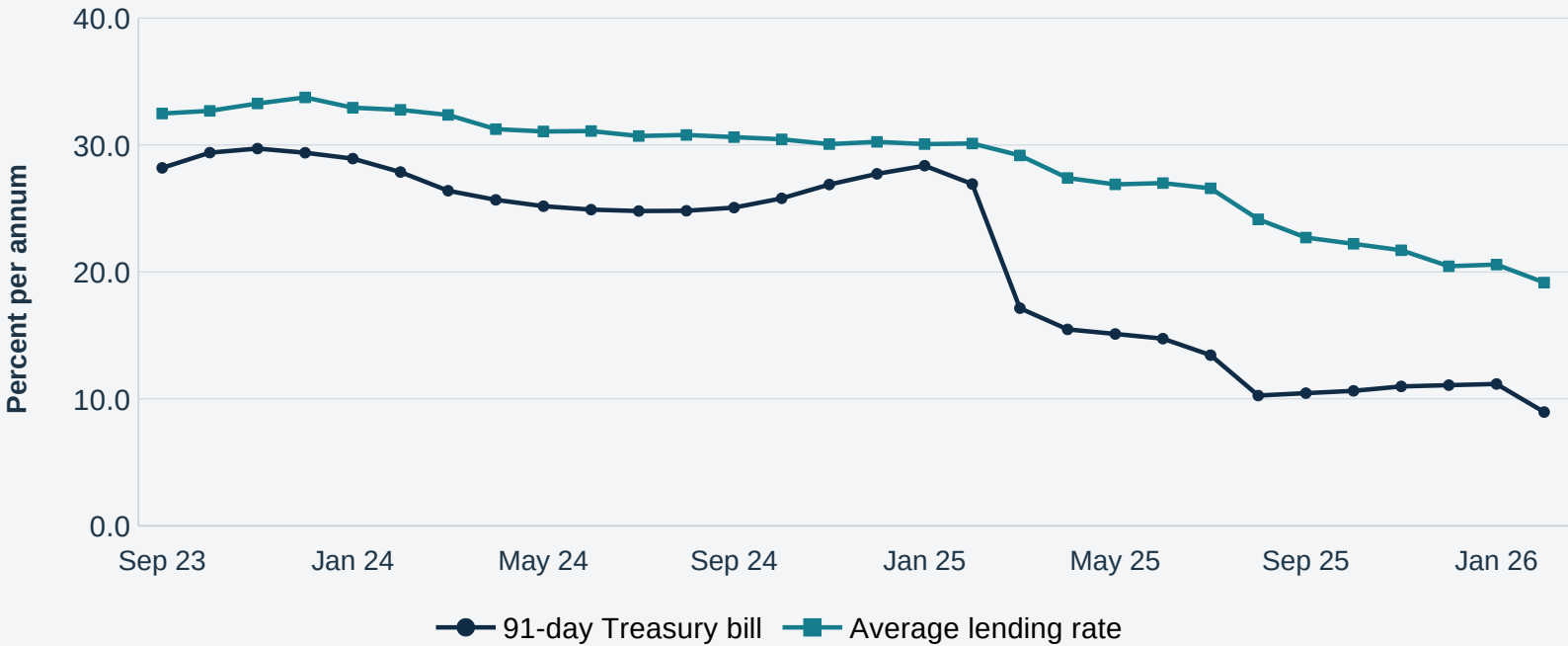
Published measure	Value	Why it cannot be substituted
Banks’ marketable government debt holdings, Dec 2025	GHS 83.83bn	Issuer-specific government debt; not all investments
Banks’ share of marketable government debt, Dec 2025	25.1%	Denominator: government securities outstanding
Banks’ total investments, Feb 2026	GHS 192.8bn	Broader instruments and different observation date
Investment share of bank assets, Feb 2026	41.4%	Denominator: total bank assets

Sources: BoG (2026); MoF (2026); IDER calculations. S01, S02.

Treasury-bill yields and average lending rates moved together in levels

September 2023–February 2026; annual percentages; 30 matched monthly observations.

Figure 4. Treasury-bill and average lending rate levels



Level correlation

Pearson $r = 0.94$
 $n = 30$ months

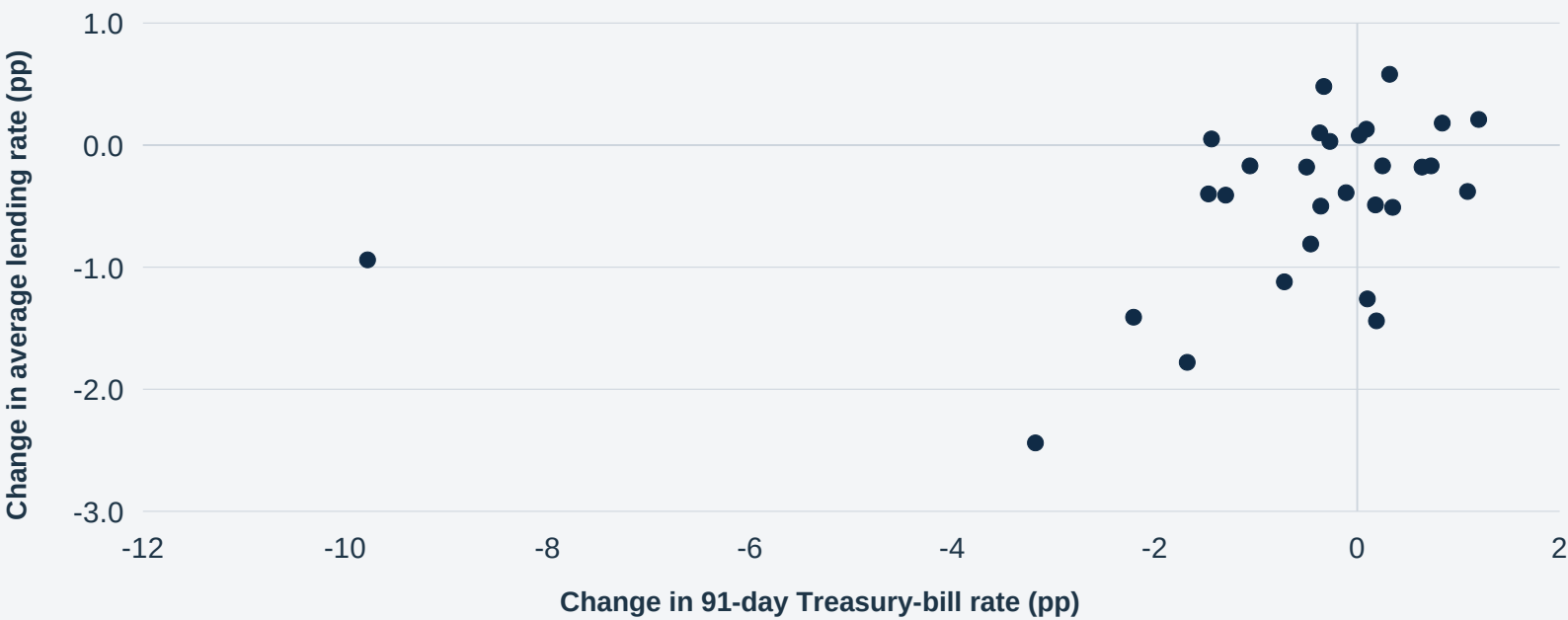
Comovement in levels is not a structural relationship or a same-borrower loan response.

Rate inputs for February 2025–February 2026 are directly rechecked; earlier months remain retained transcriptions.

Monthly changes show a weaker and more dispersed association

Change in lending rate against change in 91-day bill rate; percentage points, n = 29.

Figure 5. Same-month changes in published rates



Changes correlation

Pearson $r = 0.41$
Spearman $\rho = 0.45$

March 2025: bill -9.78 pp;
lending -0.94 pp.

One point is one monthly change. No regression line is labelled as a causal transmission function.

Levels, changes and lead–lag correlations answer different questions

Pearson and rank correlations; no IID significance tests attached to serially dependent observations.

Table 7. Correlation diagnostics

Comparison	n	Pearson r	Spearman ρ
Levels: same month	30	0.939	0.869
Changes: same month	29	0.405	0.447
Yield change leads lending change by 1 month	28	0.567	0.553
Yield change leads lending change by 3 months	26	-0.234	-0.091

Exploratory regressions quantify association, not displacement

Coefficient: lending-rate change in pp per 1 pp Treasury-bill change; approximate 95% intervals.

Table 8. First-difference association models

Model	n	β on bill change	95% interval	R ²
A. Same-month changes	29	0.140	[-0.003, 0.284]	0.164
B. Changes, conditional on MPR	29	0.157	[0.007, 0.307]	0.193
C. One-month-ahead lending change	28	0.195	[0.094, 0.297]	0.321

HAC(3), Bartlett weights; small-sample correction; t-based intervals. Causal attribution is not established; expanded diagnostics and selection requirements appear on pp. 58–71.

The result depends on sample and uncertainty conventions

Main findings retain the full sample; alternative specifications are disclosed rather than selected by significance.

Table 9. Sensitivity of the pricing association

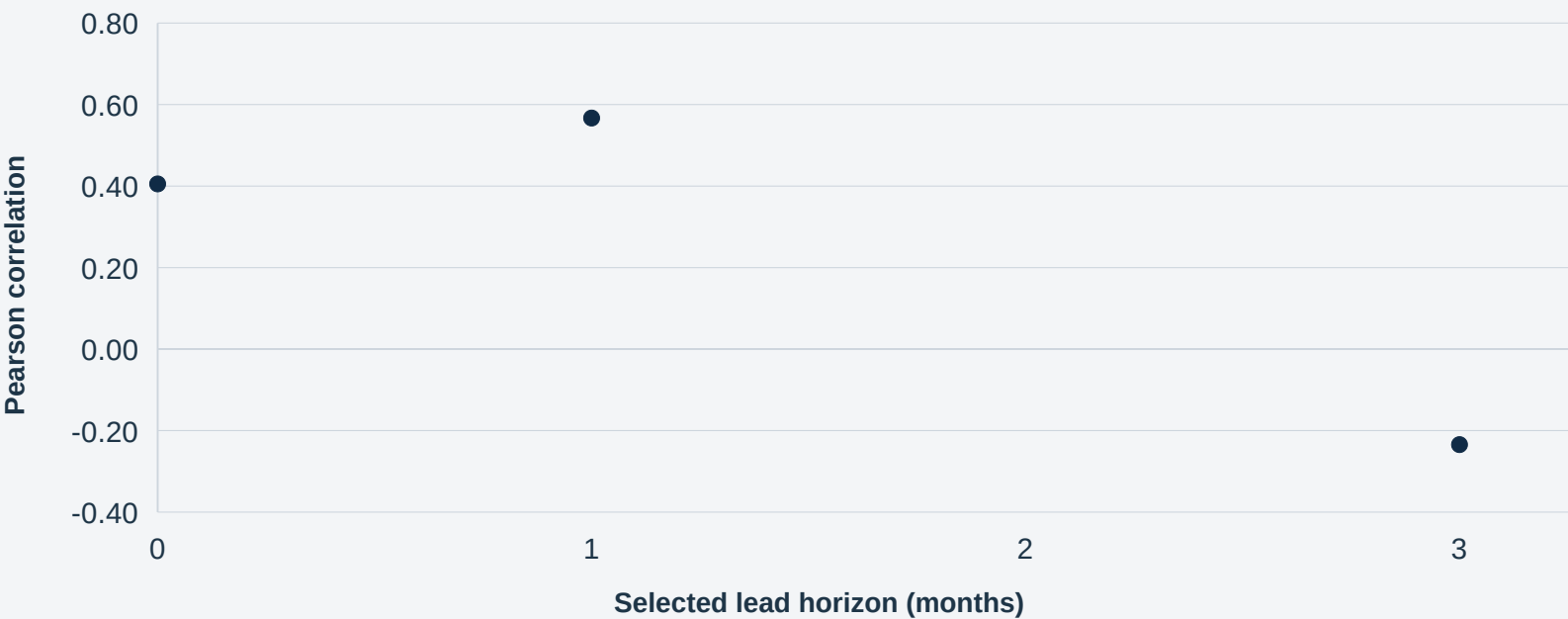
Specification	n	β	Approx. 95% interval
D. Same-month changes, HAC(1)	29	0.140	[-0.014, 0.295]
E. Same-month changes, HAC(6)	29	0.140	[0.020, 0.260]
F. Exclude March 2025; HC3	28	0.412	[0.100, 0.724]
G. Through February 2025	17	0.143	[-0.087, 0.374]
H. March 2025 onward	12	0.075	[-0.076, 0.226]

HC3 does not correct serial dependence; see the calendar-aware omission extension. Subperiods remain small (n=17 and 12).

A lead–lag correlation is not an estimated response path

Treasury change at t versus the single-month lending change at $t + h$.

Figure 6. Monthly change correlations across stated lags



Signed associations

- Same month: +0.41
- Next month: +0.57
- Three months later: -0.23

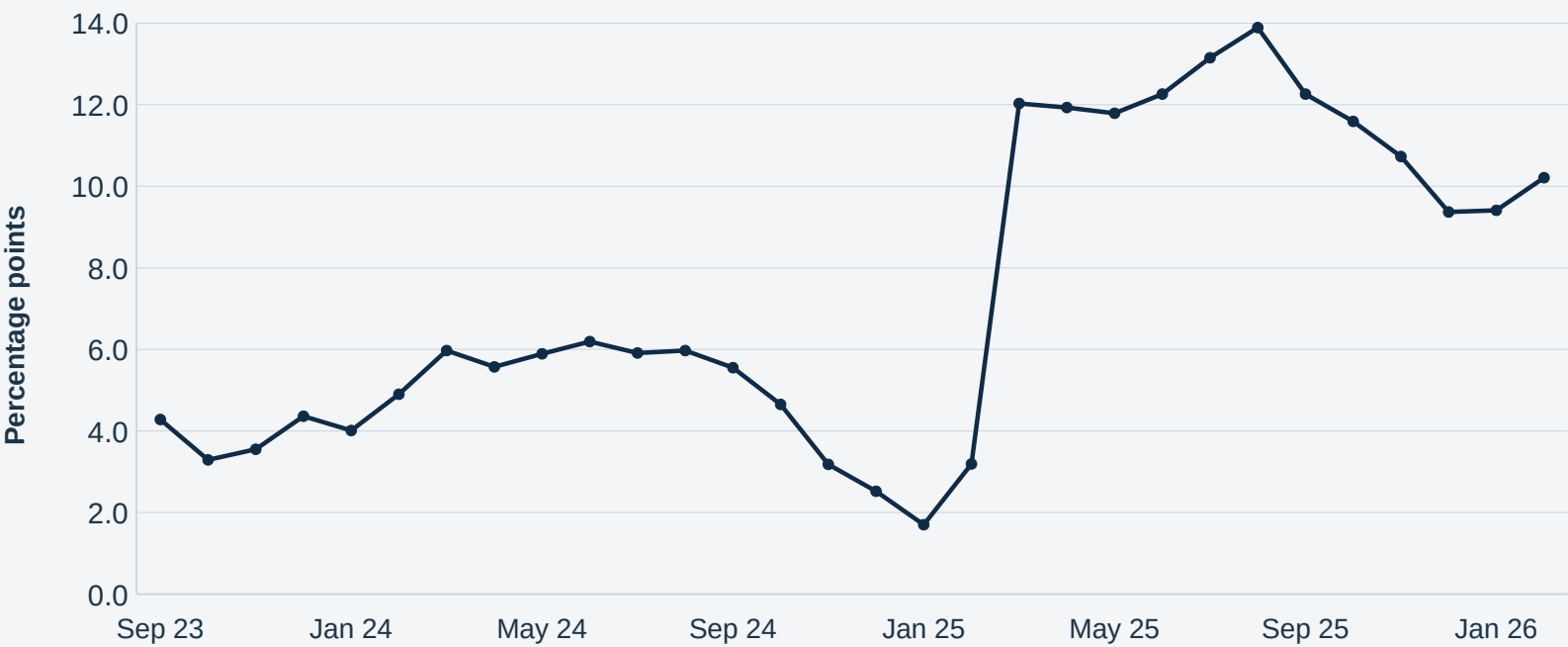
These are not estimated causal response coefficients.

Non-cumulative correlations; $n = 29, 28$ and 26 . Lag selection is descriptive, not an identified impulse response.

Lending rates fell less than bill yields over the February interval

Average lending rate minus the same-month 91-day Treasury-bill rate; percentage points.

Figure 7. Aggregate loan–bill rate differential



Dated comparison

3.19 pp in Feb 2025

10.21 pp in Feb 2026

Change: +7.02 pp

Both underlying rates fell.

This gap is not net interest margin, profit, a contractual loan spread or an identified risk premium.

Endpoint ratios change when the baseline changes

Signed changes relative to explicit starting dates; a ratio is not an elasticity.

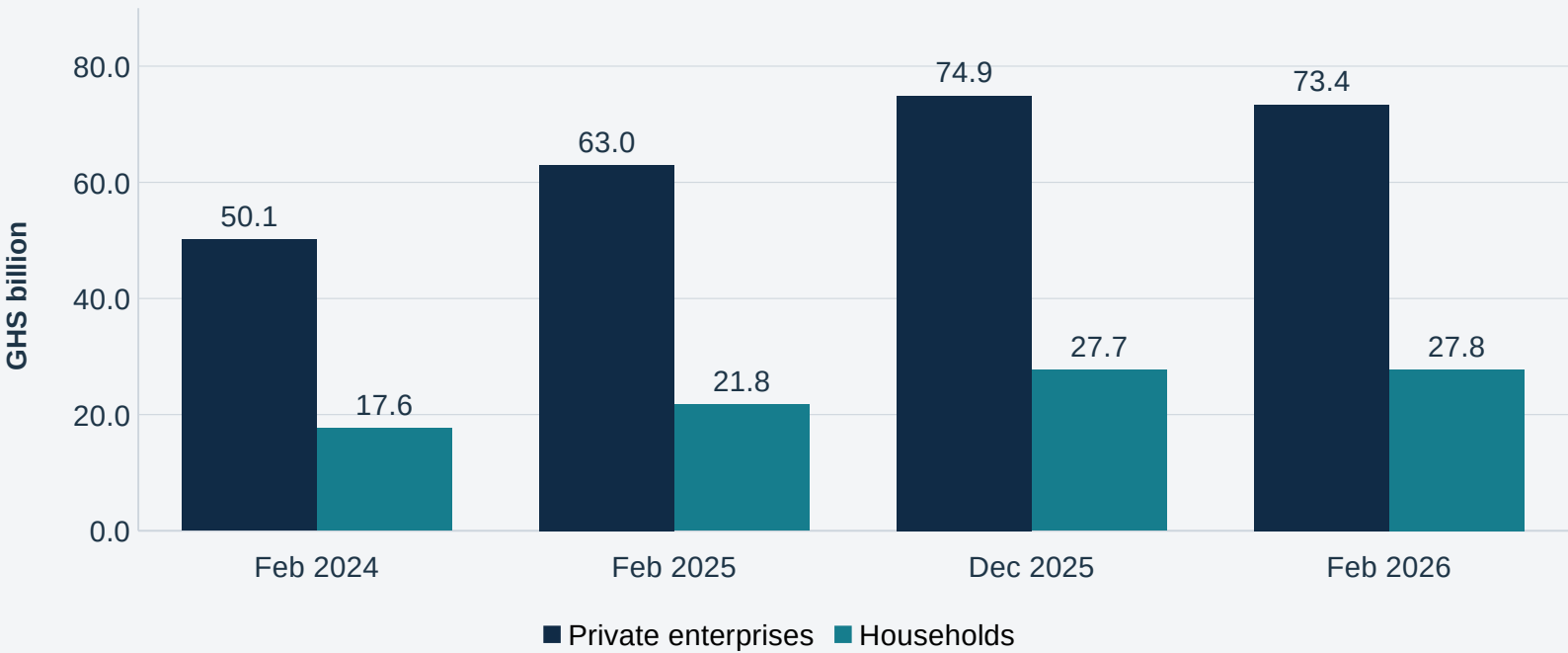
Table 10. Endpoint repricing comparisons

Window	Bill change (bp)	Lending change (bp)	Lending / bill change
Sep 2023 → Feb 2026	-1924	-1331	69.2%
Feb 2025 → Feb 2026	-1797	-1095	60.9%
Jun 2025 → Feb 2026	-578	-783	135.5%
Feb 2025 → Jun 2025	-1219	-312	25.6%

Private credit includes enterprises, households and other borrowers

Official bank-credit snapshots; GHS billion; no interpolation between observation dates.

Figure 8. Enterprise and household credit stocks



Scope matters

Businesses are separately identified in the enterprise series.

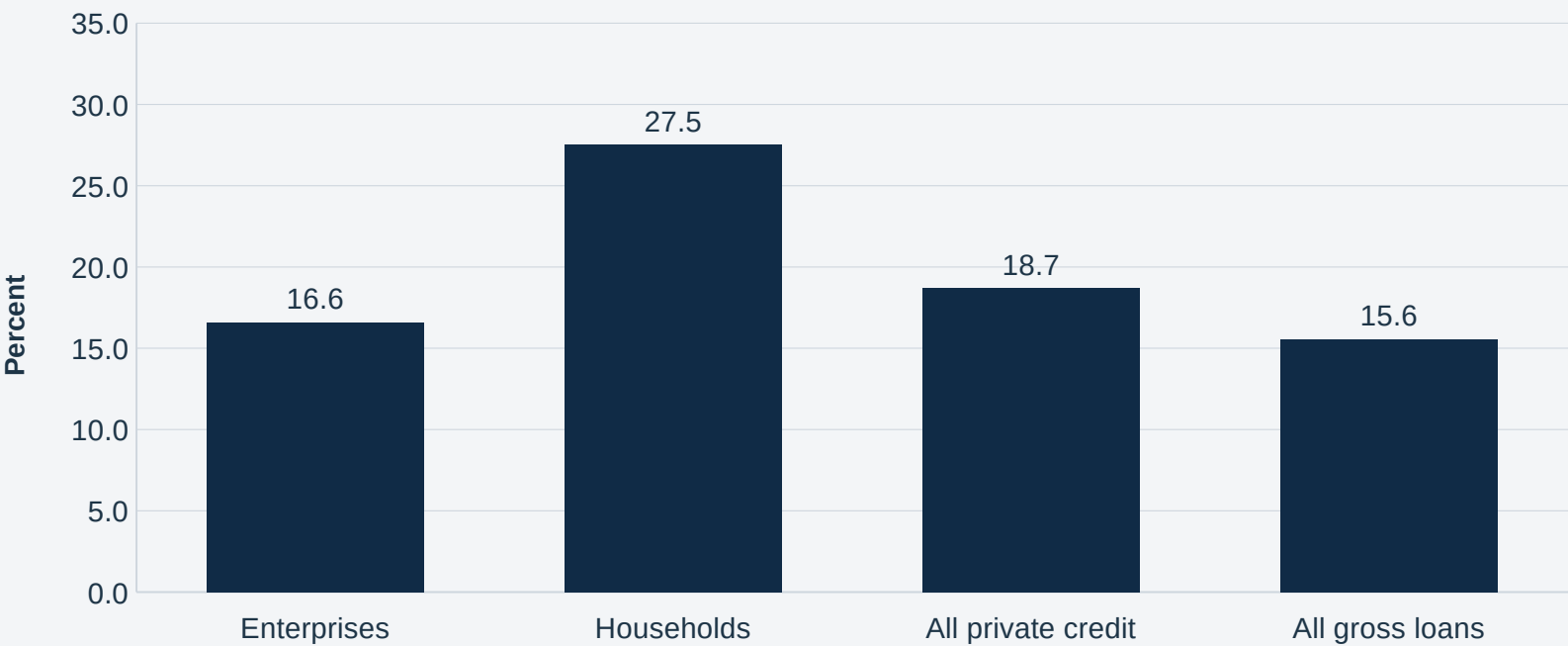
Aggregate ALR still combines household and firm pricing.

Private-sector credit is broader than business lending. These are outstanding balances, not new loan approvals.

Enterprise and household credit grew at different rates

Year-on-year growth to February 2026, calculated from the official stock series.

Figure 9. Credit growth by borrower universe



Business lending

GHS 62.95bn
→ GHS 73.41bn

+GHS 10.46bn
+16.6% year on year

Growth in nominal stocks does not identify the number of businesses financed, loan terms or causal credit-supply effects.

A year-on-year increase can coexist with a recent decline

Enterprise and private-credit stocks, December 2025 to February 2026.

Table 11. Recent credit-stock changes

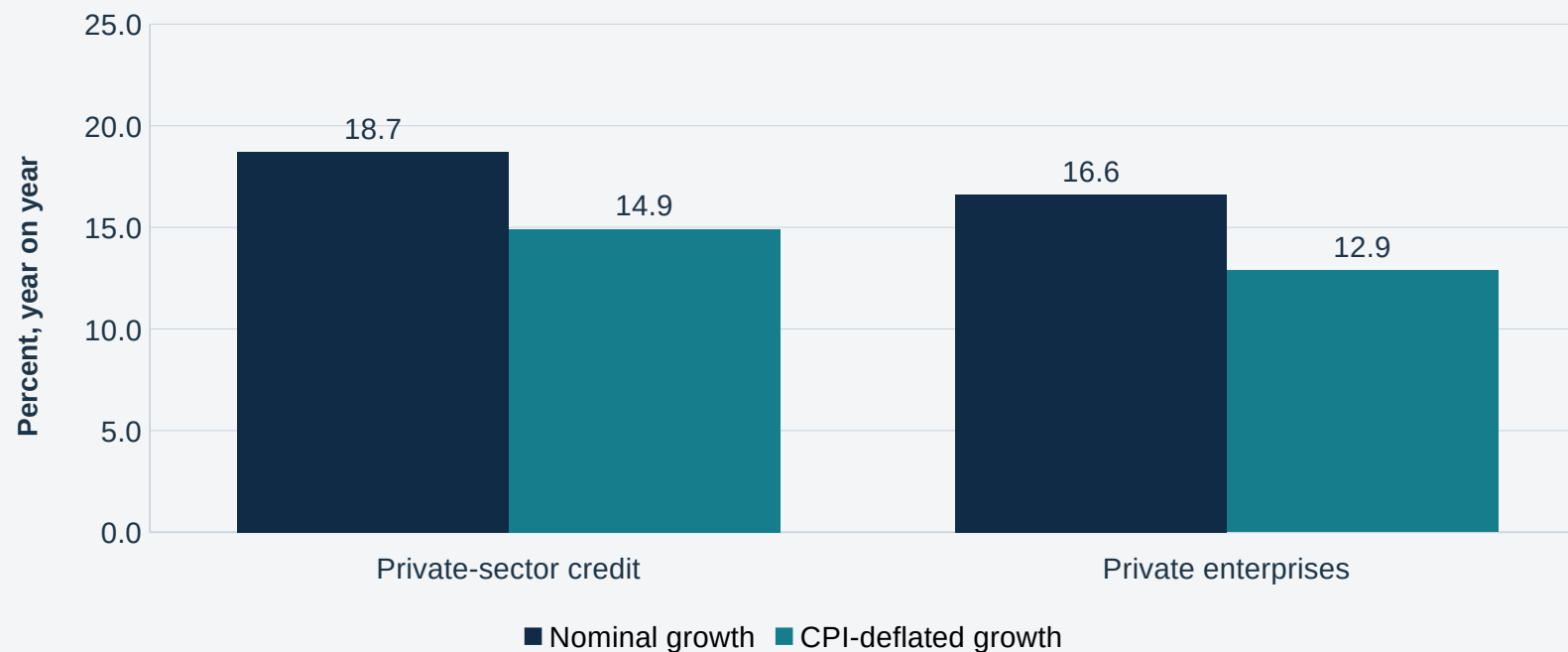
Credit stock	Dec 2025	Feb 2026	Change, GHS bn	Two-month change
Enterprises	74.92	73.41	-1.51	-2.02%
Households	27.71	27.76	+0.05	+0.18%
Total private credit	106.19	103.67	-2.52	-2.37%

Sources: BoG (2026); IDER calculations. S01.

Disinflation changes the real-credit interpretation

Year to February 2026; credit deflated using February year-on-year CPI inflation of 3.3%.

Figure 10. Nominal and CPI-deflated credit growth



Exact deflation

$$\text{Real growth} = \frac{(1 + \text{nominal growth})}{(1 + \text{inflation})} - 1$$

Do not merely subtract inflation.

CPI-based real growth is not exchange-rate-adjusted lending or an identified increase in productive investment.

Reconcile stock changes before calling them new lending

The bridge separates transactions from valuation, impairment and reporting changes.

Closing credit – opening credit $\neq$ gross new loans granted

Transactions

New disbursements
– repayments
+ capitalised amounts

Non-cash changes

Write-offs / impairment
FX revaluation
Portfolio transfers

Comparable records

Same currency and basis
Same borrower universe
Gross versus net balances

Credit risk and liquidity remain relevant when yields decline

Year-on-year banking indicators at February 2026; each measure has distinct coverage.

Table 12. Concurrent banking conditions

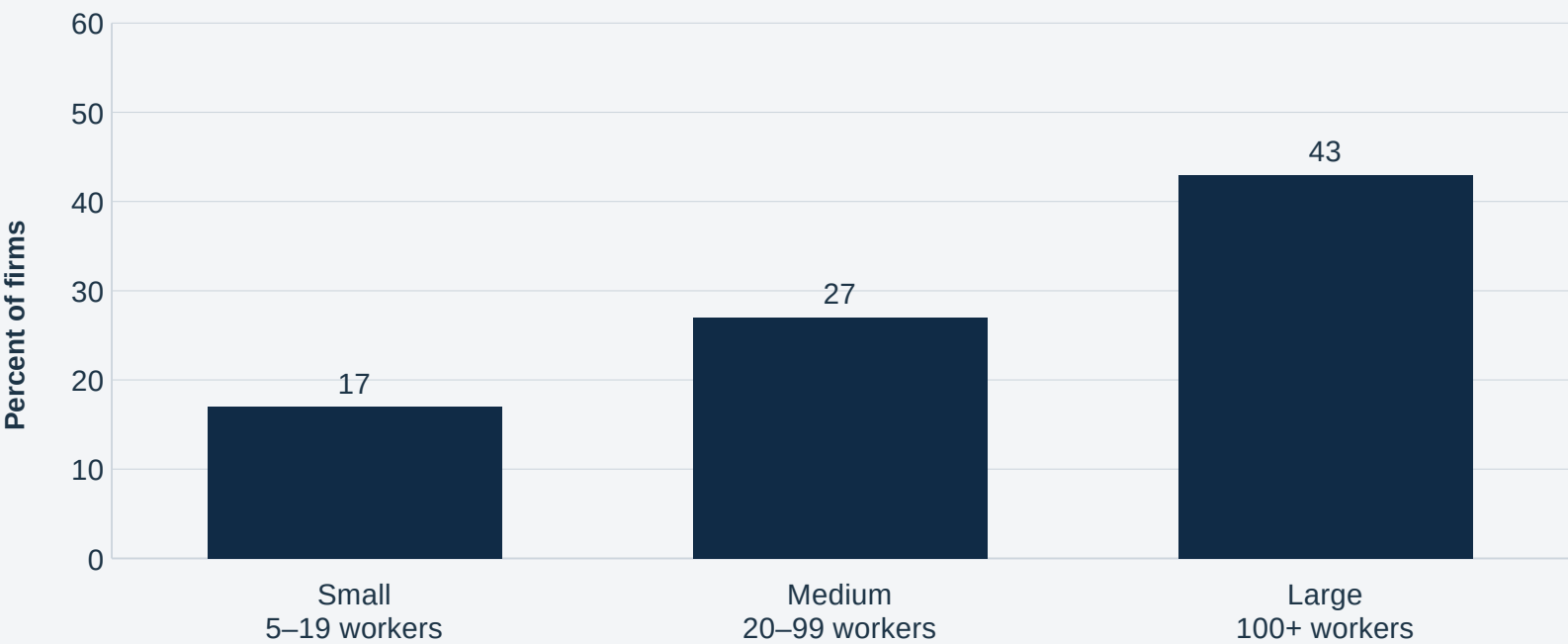
Indicator	Published movement	Interpretive safeguard
Nonperforming-loan ratio	22.6% → 18.4%	Banking chapter; overview says 18.7%. Not an expected-loss estimate
Gross loan stock	+15.6% year on year	Not approval growth or risk-standardised supply
Deposit stock	+18.0% year on year	Funding is not a fixed pool across the two dates
Contingent liabilities	−13.0% year on year	Trade-finance / guarantee exposures are not on-balance-sheet loans

Sources: BoG (2026); IDER calculations. S01.

Business access cannot be inferred from the average lending rate

Firms with a bank loan; Ghana 2023 survey, interviews February 2023–February 2024.

Figure 11. Loan access by firm size



Separate outcome

Loan access is not the same as loan price.

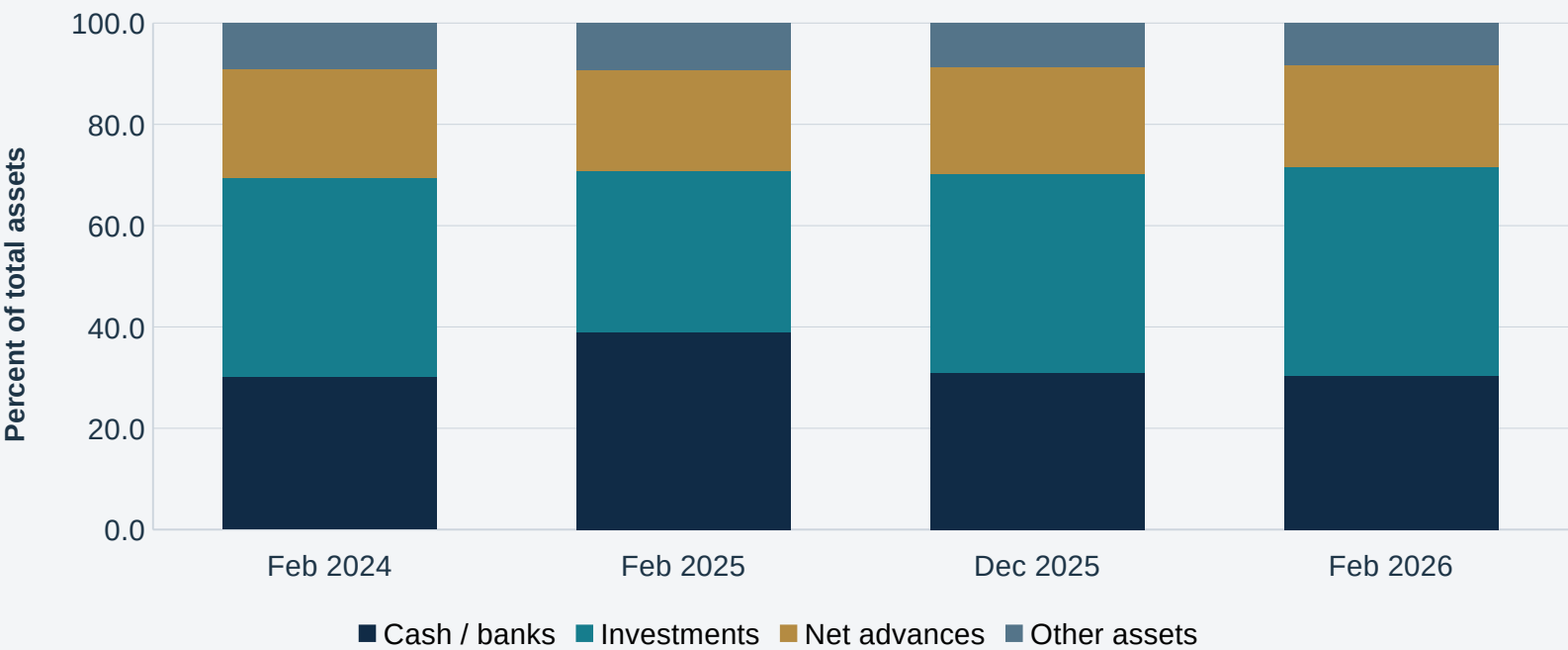
The relevant denominator includes firms that never become borrowers.

Dated survey estimates; no design-based confidence intervals reproduced. Firms with fewer than five workers are excluded.

Banks’ investment share rose while the cash share fell

Shares of total bank assets; selected dates from BoG Figure 6.1.

Figure 12. Bank asset composition



Feb 2025 → Feb 2026

Investments: +9.6 pp
Cash / banks: –8.6 pp
Net advances: about 20%

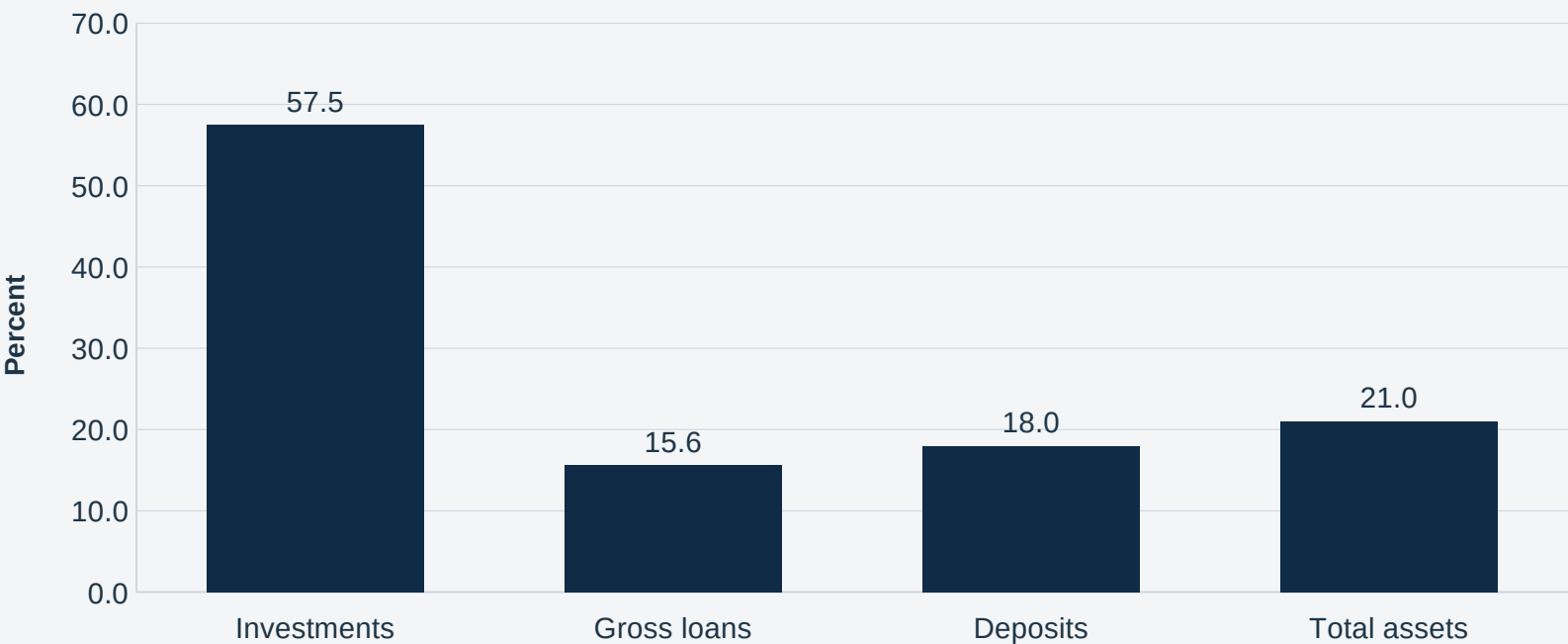
Allocation is not a fixed-asset experiment.

Figure values retained. Feb 2025 net advances are 20.1% in Figure 6.1 but 20.0% in Table 6.1; treat the share as about 20%.

Investment and loan stocks can grow together

Published year-on-year growth at February 2026.

Figure 13. Bank balance-sheet growth



Growth rates have different bases. Investments are broader than Government of Ghana T-bills.

Avoid a zero-sum claim

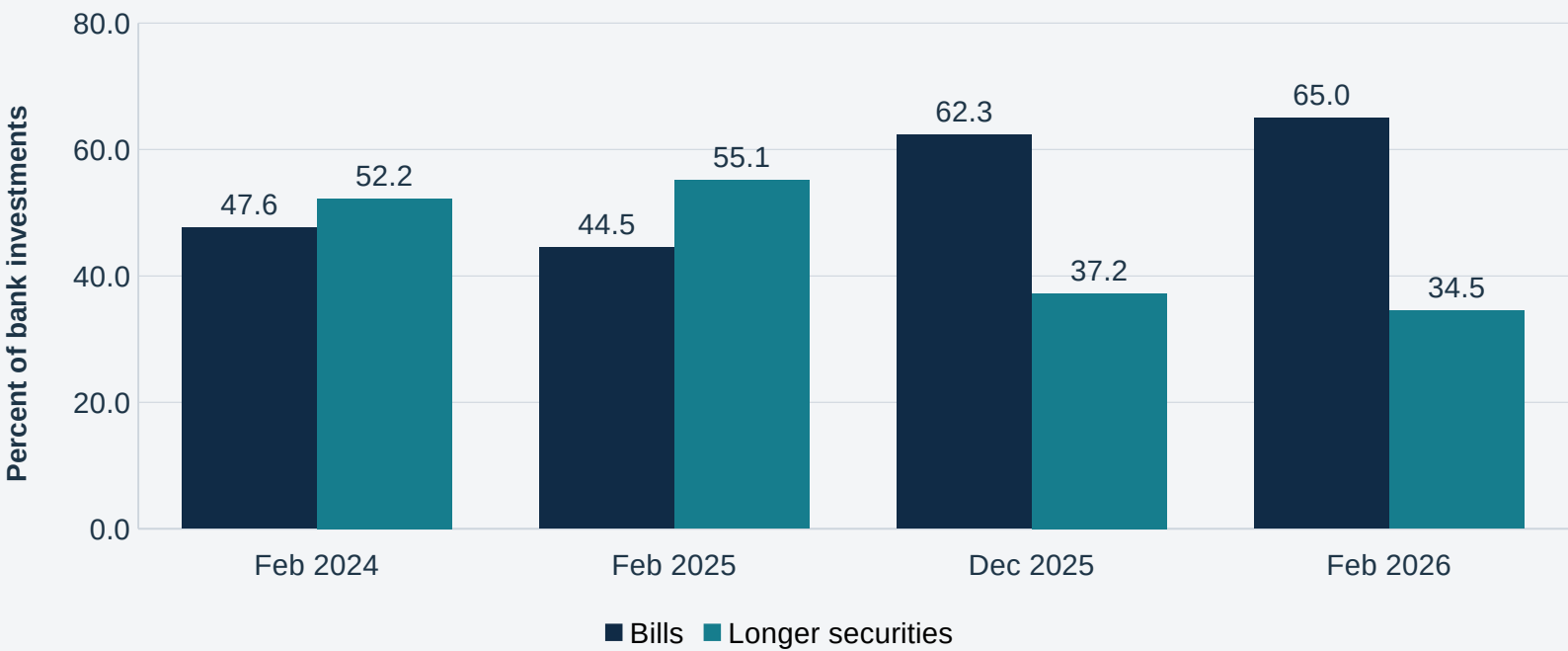
A larger investment allocation can coexist with more lending.

The counterfactual loan stock remains unobserved.

The investment mix shifted toward bills

Shares within banks' investment portfolio—not shares of government debt or total assets.

Figure 14. Reported bank investment mix



Different denominator

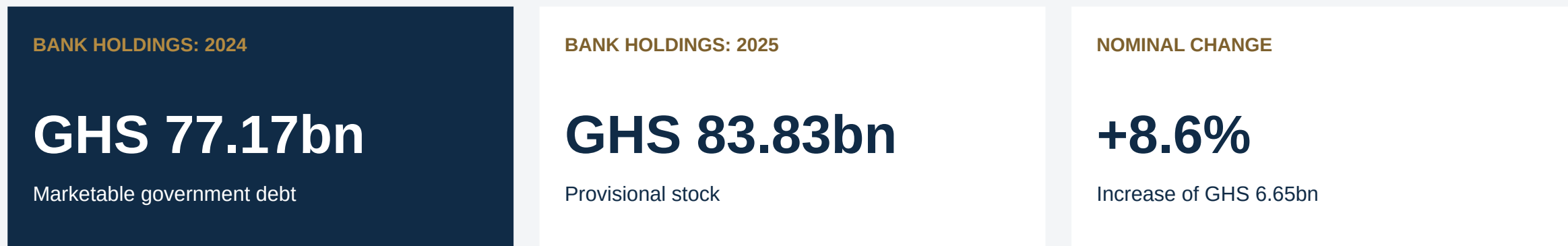
Bills: 65.0% of investments in Feb 2026.

Not 65.0% of bank assets and not 65.0% of government debt.

The “bills” series is not an issuer-specific Government of Ghana T-bill series; small equity shares are omitted.

Government exposure rose, but its share denominator also changed

Commercial-bank holdings of marketable domestic government debt, 2024 versus provisional 2025.



Share of government marketable debt: 25.0% → 25.1%

A small change in a share can coexist with substantial growth in the nominal amount. Neither statistic identifies how much business credit was displaced.

The accounting identity is not a causal model of crowding out

Funding, valuation and credit creation must be represented rather than held fixed by assumption.

$$\text{Loans} + \text{securities} + \text{cash} + \text{other assets} = \text{funding} + \text{equity}$$

What the identity does

Reconciles sources and uses of funds at consistent dates and valuation bases.

What it does not do

Prove that an extra cedi of government securities reduced business loans by one cedi.

What the test needs

Observed bank constraints, an identified shock and a credible untreated comparison.

A bank compares risk-adjusted uses of funds, not headline yields alone

A conceptual comparison; no Ghana risk premia or optimal allocation are estimated.

Table 13. Risk-adjusted asset comparison

Dimension	Government security	Business loan
Cash return	Yield, coupon, price and redemption	Coupon, compulsory fees and repayments
Risk	Sovereign, duration, inflation, reinvestment	Borrower default, recovery and concentration
Liquidity service	Tradability, repo eligibility and haircut	Usually less liquid; contract-specific transferability
Operating / capital cost	Trading, custody and applicable prudential treatment	Origination, monitoring, collections and capital
Comparison	Same currency, maturity and valuation basis	Same borrower, security and contractual reset basis

Sources: IMF (2025); Beyer et al. (2024); IDER calculations. S11, S12.

A lower Treasury yield does not specify the borrower’s all-in saving

Match the actual loan contract before attributing changes to the government benchmark.

Table 14. Same-loan borrowing-cost record

Borrower record	What must be captured	Question answered
Rate formula	Benchmark, effective date, spread, reset, floor / cap	Was the change contractually due?
Cash-flow cost	Net amount received and every required payment	Did effective borrowing cost fall?
Security	Collateral type, haircut, cash pledge and release date	Did usable finance or eligibility change?
Borrower / product	Risk grade, currency, tenor, sector and purpose	Are the two prices genuinely comparable?
Access	Applications, approvals, withdrawals and drawdowns	Who was excluded from the observed loan-price sample?

Source: IDER analytical framework and calculations; definitions and limitations in author's notes.

For the Ministry of Finance: read price, quantity and rollover together

These diagnostics inform financing analysis; they do not prescribe a policy setting.

Financing requirement

Separate gross rollover from net budget financing. Reconcile auction receipts, other issuance and non-cash instruments.

Market conditions

Read bids, acceptance, yield dispersion, investor composition and maturity together—not a coverage ratio alone.

Bank-credit connection

Match issuer-specific allocations to bank funding and enterprise credit. Aggregate yield declines do not establish crowding-in.

For fund managers: separate income, valuation and reinvestment risk

The same yield decline can affect new purchases and existing holdings differently.

New investments

Lower purchase yields change prospective income and the reinvestment rate on maturing securities.

Existing holdings

Fixed-rate securities may gain market value when yields decline; duration and accounting classification matter.

Illustration only

Modified duration: 2.5 years
Yield change: –2 percentage points
Approximate price change: +5%
Not a portfolio return forecast.

Four evidentiary statements must not be collapsed into one

The current report completes the first two layers and estimates exploratory conditional associations.

Table 15. Evidence hierarchy

Statement	Evidence needed	Status here
Yields and lending rates moved together	Dated, consistently defined observations	Computed
Asset and funding changes reconcile	Comparable stocks, valuation and accounting coverage	Selected aggregate identities checked
A conditional pricing association exists	Specified sample, covariates and uncertainty	Exploratory estimates reported
Government borrowing caused lower business lending	Credible counterfactual and identified variation	Not established by this dataset

Sources: Önder et al. (2024); Khwaja and Mian (2008); Beyer et al. (2024); IDER calculations. S09, S10, S12.

Published causal designs guide the tests—not Ghana’s coefficients

External estimates are not imported as a calibrated crowding-out effect.

Table 16. Literature and Ghana research requirements

Primary source	Relevant design / insight	Transferability boundary
Önder et al. (2024)	Multiple bank relationships; local dealer / auction comparisons	Requires Ghana’s actual allocation rules and bid-level data
Khwaja & Mian (2008)	Same firm borrowing from differently affected banks	Demand control does not ensure coverage of single-bank SMEs
Beyer et al. (2024)	Product and funding heterogeneity in transmission	European evidence is not a Ghana pricing coefficient
IMF (2025), SSA outlook	Sovereign–bank risk and domestic-financing links	Regional discussion is not identified Ghana displacement

Sources: Önder et al. (2024); Khwaja and Mian (2008); IMF (2025); Beyer et al. (2024); IDER calculations. S09, S10, S11, S12.

A same-borrower design can help separate loan supply from demand

Research specification only; not estimated with the aggregate data in this report.

$$\Delta \log L(f,b,t) = \alpha(f,b) + \delta(f,t) + \beta [\text{Shock}(t) \times \text{Exposure}(b,0)] + u(f,b,t)$$

Borrower demand

Compare the same firm across banks using firm-by-time effects.

Bank exposure

Use holdings or auction exposure fixed before the identified financing shock.

Effect identified

A differential lending response among covered relationships—not the unconditional national effect.

Predetermined exposure is not sufficient for exogeneity. The shock, exclusion assumptions and common-support tests must be defended.

Auction allocation can be informative only under testable conditions

Near-winner versus near-loser comparisons require the original bids, rules and cut-off.

Assignment record

Recover the auction cut-off, partial allocation rule, bid timing and final beneficial owner.

Validity tests

Test manipulation, sorting, baseline balance and sensitivity to bandwidth and excluded near-cut-off bids.

Linked outcomes

Follow the bank's securities, deposits and loans to the same firms before and after settlement.

Identification safeguards address distinct threats

A robust standard error cannot repair an invalid instrument or a missing comparison group.

Table 17. Threats and safeguards

Threat	Required diagnostic	Do not assume
Endogenous yields / issuance	Identified surprise or defensible assignment rule	A raw Treasury-rate change is exogenous
Exposure selection	Predetermined holdings; balance and pre-trend checks	Pre-existing holdings are randomly assigned
Common shocks / mediation	Explicit causal diagram and estimand	Current GRR, risk or deposits are always neutral controls
Few banks / auctions	Dependence-aware, finite-cluster and weak-IV inference	Many loan rows create many independent events
Borrower selection	Applications, exits, defaults and refinancing	Observed borrowers represent all firms

Sources: Önder et al. (2024); Khwaja and Mian (2008); statsmodels; IDER calculations. S09, S10, S13.

Pricing, quantities and access require separate outcome models

Specify the estimand before deciding which controls to include.

Price outcome

Same-loan coupon and effective cash-flow cost; separate benchmark changes, spread changes and compulsory fees.

Quantity outcome

New disbursements, approved limits, repayments and constant-currency credit stocks.

Access outcome

Approval, withdrawal and disbursement probability; retain rejected and discouraged applicants where observable.

Heterogeneity must be prespecified and population-aware

A multi-bank corporate sample does not automatically represent SMEs or informal businesses.

Table 18. Prespecified heterogeneity dimensions

Dimension	Minimum split	Interpretation control
Business size and formality	Micro / small / medium / large; formal status	Document firms outside the administrative frame
Contract	Currency, tenor, secured status, fixed / floating	Do not compare different risk and duration mechanically
Bank	Funding, capital, liquidity and prior government exposure	Use pre-shock attributes for treatment heterogeneity
Borrower risk	Consistent grades and default horizon	Distinguish pre-treatment risk from a policy mediator
Outcome coverage	Borrowers, rejected / withdrawn applicants, exits	Keep the eligible population denominator visible

Sources: World Bank Enterprise Surveys (2024); Khwaja and Mian (2008); Beyer et al. (2024); IDER calculations. S06, S10, S12.

A SMART dashboard links every indicator to a denominator

Proposed reporting controls—not achieved outcomes or regulatory targets.

Table 19. Proposed auditable indicators

Indicator	Definition	Frequency / proposed control
Government financing	Accepted cash proceeds minus same-period cash maturities	Weekly; reconcile non-cash issuance separately
Bank government exposure	GoG securities / bank assets, by tenor and valuation	Monthly; distinguish BoG instruments
Enterprise loan pricing	Same-loan coupon, spread and effective-cost change	Monthly; ≥98% mandatory-field completeness
Benchmark / issuer match	Correct dated links / eligible records	Monthly; proposed ≥95%, exceptions disclosed
Credit quantity and access	Originations, limits, approvals, drawdowns and declines	Monthly; firm size / sector / risk / currency

Source: IDER analytical framework and calculations; definitions and limitations in author's notes.

Link four data blocks before attempting causal estimation

The evidence package includes an empty collection template; no loan-level records are invented.

Table 20. Minimum linked data architecture

Block	Core records	Linkage key / governance
Government market	Auction, bid, settlement, issue, maturity and issuer	Auction ID / ISIN / beneficial holder
Bank balance sheet	Holdings, deposits, liquidity, capital and valuation	Bank / month / instrument / currency
Borrower and loan	Applications, decisions, risk, terms and reset dates	Pseudonymous borrower / loan / bank IDs
Cash flows	Disbursements, fees, repayments, write-offs and FX changes	Dated loan-level ledger
Quality and access	Versions, authorisation, exceptions and coverage	Controlled linkage and disclosure review

Source: IDER analytical framework and calculations; definitions and limitations in author's notes.

A 90-day programme can establish repeatable measurement

The clock starts after institutional approvals and data-access agreements—not before.

Table 21. Research delivery schedule

Period	Deliverable	Acceptance condition
Days 0–15	Protocol, data dictionary and access / confidentiality agreements	Institutional approval; definitions frozen
Days 16–30	Historical data intake and stock–flow / issuer reconciliation	Source checks, exceptions and coverage documented
Days 31–60	Linked panel, identification and inference feasibility review	Design assumptions and effective sample assessed
Days 61–90	Supported estimates, independent review and stakeholder briefing	No unsupported causal claim; reproducibility passed

Source: IDER analytical framework and calculations; definitions and limitations in author's notes.

The same evidence supports different institutional questions

Research uses below do not imply that an institution has adopted or commissioned the framework.

Table 22. Use by principal audience

Audience	Analytical use	Decision boundary
Ministry of Finance	Reconcile yields, gross / net financing and rollover	No yield-only inference about crowding-in
Bank of Ghana	Separate monetary operations, GoG exposures and credit supply	No bank-conduct finding from aggregate gaps
Banks / fund managers	Assess repricing, duration, funding and liquidity	No optimal portfolio allocation estimated
Businesses / SME associations	Compare same-loan cash flows and access conditions	Published ALR is not a binding offer
Investors / research partners	Track exposures, definitions and verified changes	No forecast return or causal coefficient fabricated

Source: IDER analytical framework and calculations; definitions and limitations in author's notes.

The principal limitations change what can be concluded

They are part of the research result, not qualifications to remove in publication.

Source and scope

Earlier 17 rate months remain retained transcriptions. The prior reporting documented 65 later rate-cell comparisons. Banking and debt data still differ in dates and coverage.

Model and inference

Thirty rate months do not identify business-credit displacement. Results are sensitive to sample, timing and covariance choices.

Missing counterfactual

No linked bank–firm panel, issuer-level auction allocations or untreated comparison identifies the national causal effect.

Calculation definitions used throughout the report

Units and denominators are explicit in the data and reproduction script.

Table 23. Calculation conventions

Measure	Formula / convention	Unit
Rate change	$100 \times (\text{end rate} - \text{start rate}), \text{ input in } \%$	Basis points
Nominal credit growth	$100 \times (\text{end stock} / \text{start stock} - 1)$	Percent
CPI-deflated growth	$100 \times [(\text{end} / \text{start}) / (1 + \text{inflation} / 100) - 1]$	Percent
Portfolio-share change	End share – start share	Percentage points
Issuer holding share	$100 \times \text{issuer-specific holdings} / \text{relevant asset stock}$	Percent; denominator named
Bid-cover ratio	Sum of bids / sum of targets	Ratio; not average weekly ratio

Source: IDER analytical framework and calculations; definitions and limitations in author's notes.

The regression specification and covariance are reproducible

Small-sample approximate inference is reported transparently, without significance stars.

$$\Delta \text{ALR}(t) = \alpha + \beta \Delta \text{T-bill}(t) + u(t)$$

Estimation

OLS with an intercept. Model B adds ΔMPR ; Model C uses next-month ΔALR .

Uncertainty

Newey–West / Bartlett HAC(3), $n/(n-k)$ correction and $t(n-k)$ intervals.

Cross-check

Independent least-squares and sandwich calculations reproduce coefficients, standard errors and interval endpoints.

Precision and robustness are not the same as causal validity

A confidence interval covers a model parameter under assumptions—not every uncertainty in the evidence.

Table 24. Uncertainty and reporting safeguards

Uncertainty	Treatment	What is not claimed
Published rounding	Retain source precision; round displays last	Extra decimals add genuine measurement accuracy
Sampling / serial dependence	HAC intervals and covariance sensitivities	Exact small-sample coverage
Influential month / window	Full sample plus disclosed omission and subperiods	One selected specification is definitive
Source reportings / reconciliation	Versioned inputs and exception log	All inputs are independently audited
Causal attribution	Explicitly withheld without identified variation	Statistical significance proves causation

Source: IDER analytical framework and calculations; definitions and limitations in author's notes.

Source discrepancies are retained and reconciled—not silently repaired

The table or figure used is identified; unresolved alternatives remain visible.

Table 25. Material source exceptions

Source issue	Treatment in this report
MoF banking-sector share: prose 41.6%; table 42.6%	Use Table 8.8; its stocks imply 42.6%. Banks alone are 25.1%.
Auction target “met” versus accepted / target 97.5%	Report bids / target and accepted / target separately.
MoF maturity totals differ across Tables 6.1 and 8.11	Use Table 6.1 consistently; do not splice financing identities.
BoG Feb 2025 net-advance share: 20.0% / 20.1%	Cite Figure 6.1 for chart; describe loan share as about 20%.
BoG investment narrative mentions rising market rates	Do not adopt the attribution; dated rate tables show declines.

Inputs, calculations and the report's data can be checked separately

The package supplies datasets, code, sources, author’s notes and recorded validation results.

Table 26. Reproducibility controls

Validation block	Available evidence	Boundary
Input provenance	Source IDs, locators, hashes; 65 documented comparisons	Earlier 17 rate months remain retained transcriptions
Calculation replay	Correlations, regression, financing and credit outputs	Conditional on observed / retained inputs
Independent numerical checks	Matrix OLS and HAC; stock and financing identities	Not an audit of primary bank submissions
Publication checks	Editable chart register, page map, notes and render review	No external institutional clearance implied
Further research	Blank bank–loan data template and proposed protocol	No synthetic borrowers or causal coefficients

Source: IDER analytical framework and calculations; definitions and limitations in author's notes.

Abbreviations and statistical conventions

The same definitions apply in the report, data files and author’s notes.

Table 27. Abbreviations and units

Term	Meaning	Convention
ALR / MPR / GRR	Average lending / monetary policy / Ghana Reference Rate	Annual percentages; not interchangeable benchmarks
GoG / BoG / MoF	Government / Bank of Ghana / Ministry of Finance	Issuer and institutional role distinguished
pp / bp	Percentage points / basis points	1 pp = 100 bp
OLS / HAC	Ordinary least squares / robust covariance	Exploratory association; not causal identification
NPL / PIK	Nonperforming loan / payment in kind	Credit quality / non-cash issuance distinguished
GHS bn / GHS mn	Ghana cedi billion / million	1 billion = 1,000 million

Source: IDER analytical framework and calculations; definitions and limitations in author's notes.

What this Report verifies, tests and leaves open

Data authenticity, numerical correctness and causal identification are separate requirements.

Table 28. Report actions and interpretation boundaries

Requirement	Action completed	Remaining boundary
Primary rate inputs	65 prior comparisons retained; February 2025–February 2026	17 earlier months not newly authenticated
Numerical accuracy	Independent least squares, covariance and identities rerun	Conditional on input definitions and source precision
Endogeneity	Confounding sensitivity; lagged controls; estimands separated	No valid excluded shock or random assignment observed
Sample selection	Population, missingness, weighting and bounds protocol specified	No applicant-level data to estimate selection probabilities
Business intelligence	16-date expanding-window forecasting comparison completed	Not a validated live trading or loan-pricing forecast

Sources: BoG monthly tables; Cinelli and Hazlett (2020); Andrews et al. (2019); IDER calculations. S05, S14, S16.

Control and sample changes alter the pricing coefficient

Coefficient in pp of lending-rate change per 1 pp bill-rate change; approximate 95% intervals.

Table 29. Expanded calendar-aware association estimates

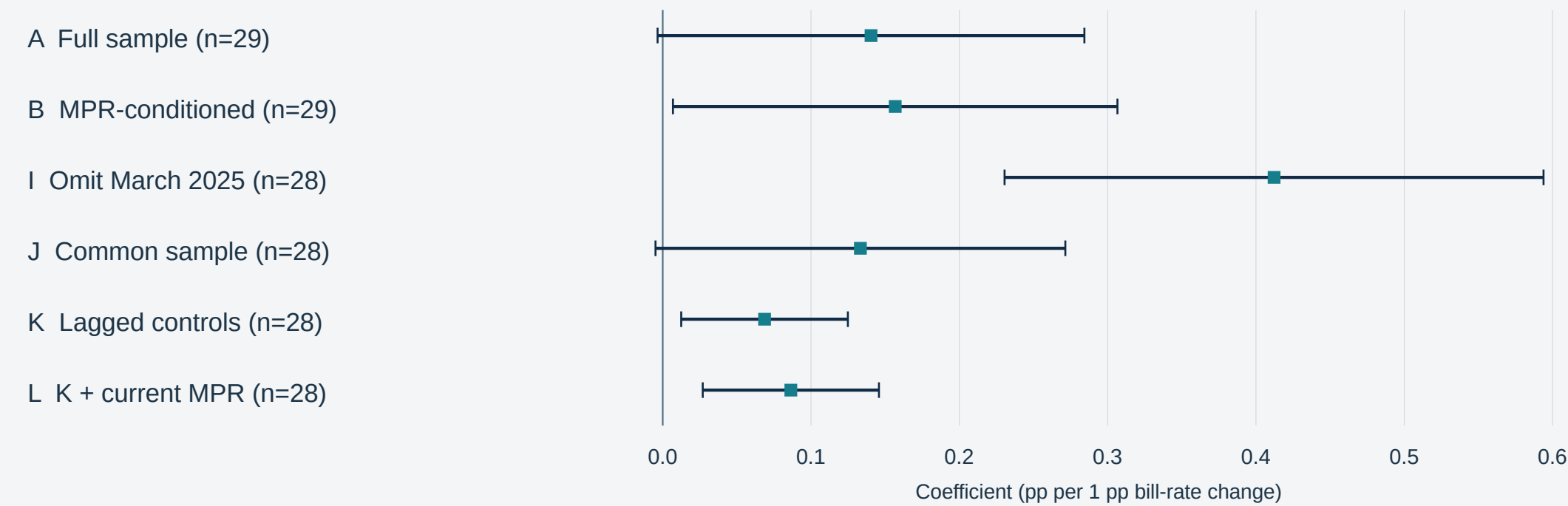
Specification	n	β	95% interval	k
A. Full sample	29	0.140	[-0.003, 0.284]	2
B. MPR-conditioned	29	0.157	[0.007, 0.307]	3
I. March 2025 omitted	28	0.412	[0.231, 0.594]	2
J. Common 28-month sample	28	0.133	[-0.005, 0.271]	2
K. Lagged controls	28	0.069	[0.012, 0.125]	5
L. Lagged controls + MPR	28	0.086	[0.027, 0.146]	6

K: lagged Δ ALR, Δ bill and Δ MPR; L adds current Δ MPR. These controls do not establish exogeneity.

Uncertainty belongs beside every model coefficient

Points are OLS coefficients; segments are pointwise 95% calendar-HAC(3) intervals, not causal effects.

Figure 15. Pricing association and specification uncertainty

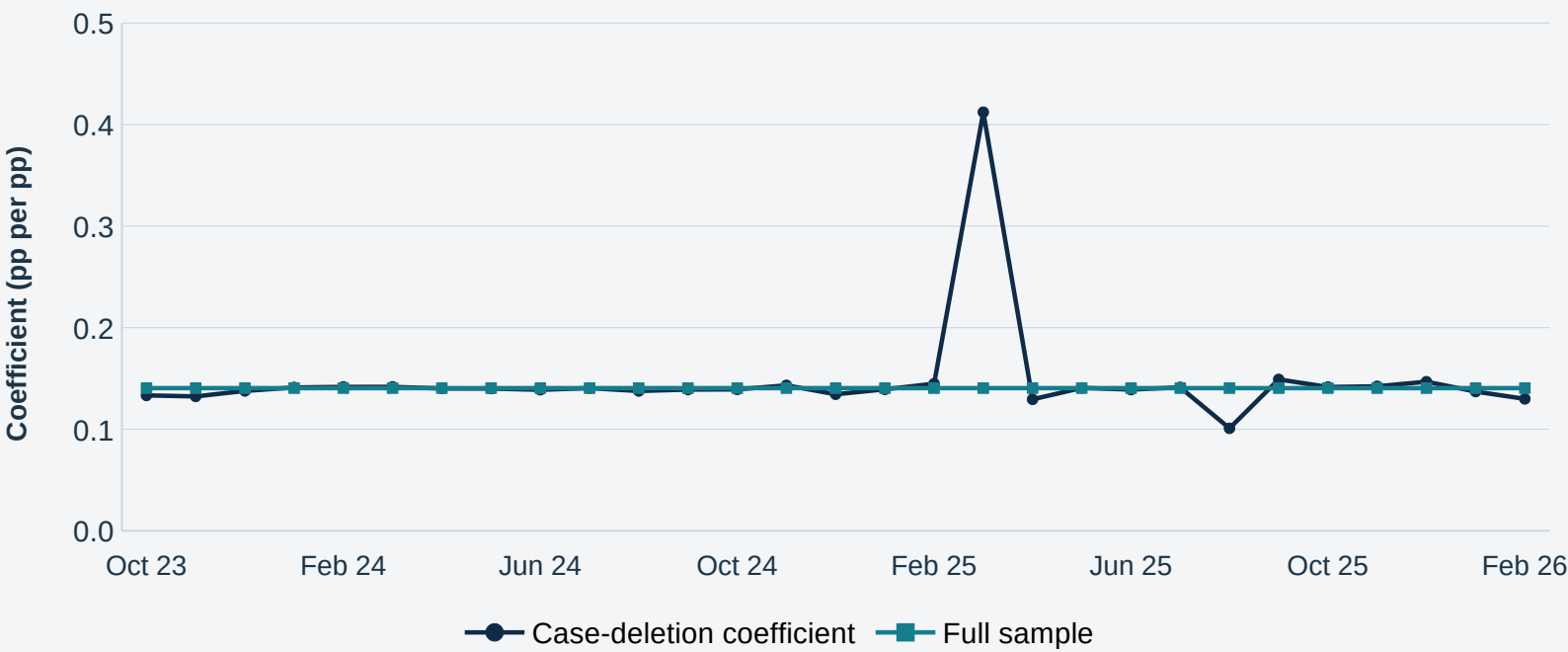


Intervals are approximate and not adjusted for multiple model comparisons; specifications were chosen retrospectively.

March 2025 materially influences the aggregate association

Every month is omitted once; the full-sample estimate still retains all 29 changes.

Figure 16. Association after excluding each stated month



Full sample retained

All changes: 0.140
Omit Mar 2025: 0.412

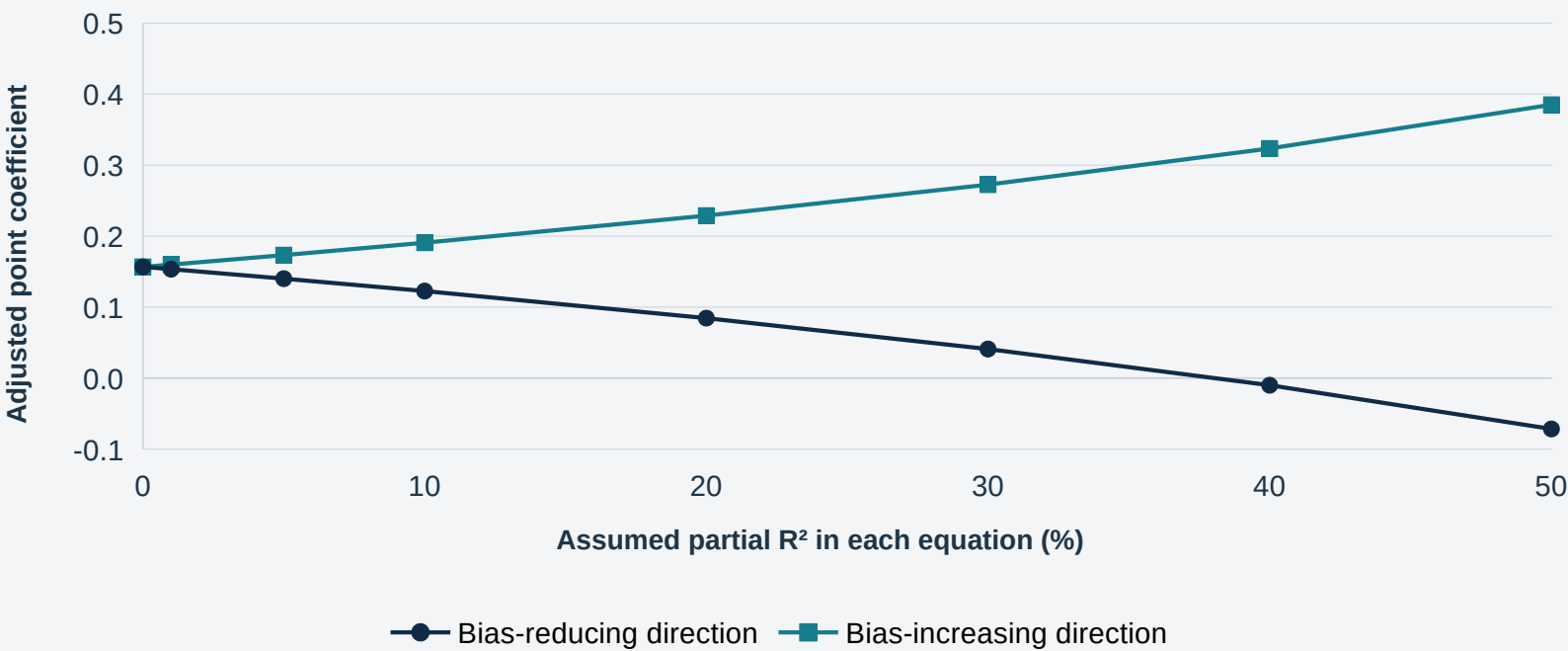
Calendar-HAC interval for omission: [0.231, 0.594].

An influential observation is not an erroneous observation; deletion is a sensitivity check, not a correction to the main sample.

Quantify sensitivity to an omitted common driver

Assumed partial R² values change the point coefficient; they are not measured Ghana confounders.

Figure 17. Point-coefficient sensitivity to equal residual explanatory strength



Explicit assumption

At 38.2% for each partial R², the point estimate can reach zero.

Not a test that endogeneity has been removed.

Sensitivity ranges are not confidence intervals. The direction and strength of omitted confounding remain assumptions.

In-sample comovement did not ensure forecasting gains

Expanding-window, one-month-ahead forecasts; 16 common evaluation dates, November 2024–February 2026.

Table 30. Common-date pseudo-out-of-sample forecast errors

Forecast model	Evaluation months	MAE (pp)	RMSE (pp)
Historical mean	16	0.601	0.838
ALR-only lag	16	0.631	0.834
Bill-only lag	16	0.630	0.908
Both lagged rates	16	0.655	0.934

Retrospective, frozen-vintage evaluation; release lags and trading costs are not reproduced. Not a live investment signal.

A causal question requires a defined intervention and population

Government borrowing volume, auction allocation and market yields are different potential treatments.

Table 31. Estimands and their distinct counterfactuals

Target effect	Unit and comparison	Identification requirement
Financing effect	Credit under an exogenous net-cash issuance innovation	Defensible shock; fiscal-spending and monetary responses distinguished
Allocation effect	Near-cutoff eligible bids / dealers within the same auction	Actual award rule; no precise sorting; local continuity or randomization
Bank supply effect	Same firm, differently exposed banks, same period	Exogenous exposure variation; firm-time demand controls
Business total-credit effect	All lenders and access outcomes for the same firm	Observe switching, denial, non-bank borrowing and spillovers

No national credit-displacement coefficient is estimated from the present aggregate pricing panel.

Separate confounders, mediators and selection mechanisms

A conceptual time-ordered map; no arrow is an effect already estimated for Ghana.

Before the intervention

Macroeconomic conditions, bank funding and borrower risk may influence both exposure and later loan outcomes.

Record these before the shock.

Along the mechanism

Yields, bank funding, reference rates and collateral conditions may transmit the intervention.

Controlling for them can change the estimand.

At observation

Approval, withdrawal, exit and repayment determine which prices are observed.

Keep selection outcomes visible, not just successful loans.

An auction design starts with the actual assignment rule

Treat near-cutoff allocation as a research design to validate—not an automatically valid instrument.

Assignment integrity

Freeze the rule and running score. Separate customer bids from bank-owned awards. Check discretionary and partial allocations.

Local validity

Examine bid sorting, repeated scores, pre-event outcomes and baseline balance. Disclose bandwidth and donut sensitivities.

Linked consequences

Measure holdings, funding and lending after settlement. Report award ITT first; add IV only when its extra assumptions are credible.

Borrowing-cost effects and auction-award effects are not interchangeable; this protocol has not produced a Ghana causal estimate.

Within-firm comparisons target differential bank loan supply

A firm-by-time effect absorbs common firm demand, not all bank selection or economy-wide spillovers.

$$\Delta \log L(f,b,t) = \alpha(f,b) + \delta(f,t) + \beta Z(b,t) + u(f,b,t)$$

Comparison group	Outcomes	Population
Same firm; different banks; common time. Treatment varies across banks, not only across dates.	Positive-loan intensive margin separately from approval, entry, exit and total firm credit.	Publish the covered multi-bank population; do not silently extrapolate to every Ghanaian SME.

Existing holdings and pre-trends alone do not prove exogeneity; zero loans and missing observations must be treated separately.

Selection is addressed at the population and outcome level

A completed-loan sample cannot reveal rejected applicants or firms that did not apply.

Table 32. Selection records and outcome definitions

Selection point	Required record	Treatment
Entry to finance market	Eligible firm frame; application / discouragement	State coverage outside formal or administrative samples
Approval and take-up	All applications, decisions and withdrawals	Keep denominator; estimate access separately from prices
Missing price	No loan versus absent / corrupt record	Never code a denied-loan rate as zero
Exit and refinancing	Prepayment, default, closure and movement across banks	Separate economic exit from loss of observation
Loan composition	Pre-shock risk, product, currency, tenor and weights	Same-loan / fixed-composition comparisons where supported

Sources: World Bank Enterprise Surveys (2024); Lee (2009); Cole and Hernán (2008); IDER calculations. S06, S15, S19.

Weights and bounds have explicit identification conditions

These procedures are specified for the future microdata study, not imposed on 30 aggregate months.

Table 33. Conditional remedies for different selection problems

Procedure	Conditions / diagnostics	Boundary
Observation weighting	Pre-treatment covariates; overlap; weight tails; effective n	Does not remove unmeasured treatment confounding
Lee-style bounds	Credible assignment and monotonic selection; trim observed tails	Local always-observed population, not all firms
Selection-model estimation	Substantive exclusion and distributional assumptions	Not justified by software availability or significance
Unmeasured selection sensitivity	Declare departures from missing-at-random; report ranges	No applicant microdata here; no empirical bound fabricated

Sources: Lee (2009); Cole and Hernán (2008); IDER calculations. S15, S19.

Instrument validity and uncertainty need separate evidence

Robust standard errors address dependence—not the exclusion restriction or representativeness.

Table 34. Identification and inference release requirements

Requirement	Evidence before causal release	Failure treatment
Instrument admissibility	Mechanism, timing, relevance and explicit exclusion argument	Withhold IV causal interpretation
Weak identification	First stage; dependence-appropriate robust confidence set	Allow wide / unbounded sets; do not suppress
Dependence	Bank, auction and repeated-borrower structure	Effective clusters and small-cluster limits disclosed
Multiplicity / design choice	Outcomes, windows and primary specification locked before new data	Report all prespecified tests and material deviations
Spillovers	Firm total credit, lender switching and market feedback	Keep local effects separate from national effects

No 2SLS coefficient is generated from an instrument whose relevance and exclusion have not been supported.

Stronger intelligence follows a transparent release decision

A documented path from present descriptive evidence to an independently reviewed causal study.

Table 35. Proposed release gates and decision uses

Gate	Deliverable / decision	Business-intelligence use
Source and accounting	Versioned inputs; issuer, unit and date reconciliation	Reliable financing and exposure monitoring
Design and population	Written estimand, assignment audit and coverage ledger	Clarifies whose financing conditions can be inferred
Estimation and selection	Locked specification; assumption and overlap checks	Separates supported effects from sensitivity scenarios
Forecast and decision use	Holdout tests; real-time release-lag validation	No investment forecast from in-sample fit alone
Independent review	Replicated outputs; subject-matter review; disclosure sign-off	Publish only the level of claim the evidence supports

Sources: Cinelli and Hazlett (2020); Andrews et al. (2019); Cole and Hernán (2008); IDER calculations. S14, S16, S19.

References and source links 1 / 4

Clickable source titles; exact locators, access status and use are recorded in the source register.

S01	Bank of Ghana 2026 Monetary Policy Report, March 2026 Sections 5–7; Figure 6.1; Tables 6.1 and A.9. Banking and credit snapshot evidence.
S02	Ministry of Finance, Ghana 2026 Annual Public Debt Report for the 2025 Financial Year Tables 5.1, 6.1, 7.1 and 8.8. Financial year 2025; provisional figures identified.
S03	Bank of Ghana 2024 Summary of Economic and Financial Data, March 2024 Interest rates, printed p. 3 / PDF p. 5. Used for September 2023–February 2024.
S04	Bank of Ghana 2025 Summary of Economic and Financial Data, March 2025 Interest rates, printed p. 3 / PDF p. 5. Used for March 2024–January 2025.
S05	Bank of Ghana 2026 Summary of Economic and Financial Data, March 2026 Interest rates, printed p. 3 / PDF p. 5. Used for February 2025–February 2026.

References and source links 2 / 4

Clickable source titles; exact locators, access status and use are recorded in the source register.

S06	World Bank Enterprise Surveys 2024 Ghana 2023 Country Profile Survey methodology and Figure 14, PDF p. 7. Interviews February 2023–February 2024.
S07	Ministry of Finance, Ghana Accessed 2026 Public Debt Management: Domestic Debt Market Official domestic-debt market webpage. Institutional context; not a current legal assessment.
S08	Ministry of Finance, Ghana 2022 Domestic Debt Exchange: Frequently Asked Questions Question 2, PDF p. 2. Original December 2022 announcement; subsequent changes not inferred.
S09	Önder, Restrepo-Tamayo, Ruiz-Sanchez and Villamizar-Villegas 2024 Government Borrowing and Crowding Out American Economic Journal: Macroeconomics 16(1): 286–321. doi:10.1257/mac.20200273.
S10	Khwaja, Asim Ijaz, and Atif Mian 2008 Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market American Economic Review 98(4): 1413–1442. doi:10.1257/aer.98.4.1413.

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Clickable source titles; exact locators, access status and use are recorded in the source register.

S11	International Monetary Fund 2025 Regional Economic Outlook: Sub-Saharan Africa — Holding Steady Regional Economic Outlook, October 2025. Bank–sovereign nexus discussion, pp. 4 and 7.
S12	Beyer, Chen, Li, Misch, Ozturk and Ratnovski 2024 Monetary Policy Pass-Through to Interest Rates: Stylized Facts from 30 European Countries IMF Working Paper 24/9. European-country evidence; no Ghana parameter transferred.
S13	statsmodels developers Accessed 2026 HAC / Newey–West covariance documentation Official cov_hac documentation. Software versions used are recorded in requirements-lock.txt.
S14	Cinelli, Carlos, and Chad Hazlett 2020 Making Sense of Sensitivity: Extending Omitted Variable Bias Journal of the Royal Statistical Society, Series B 82(1): 39–67. doi:10.1111/rssb.12348.
S15	Lee, David S. 2009 Training, Wages, and Sample Selection: Estimating Sharp Bounds on Treatment Effects Review of Economic Studies 76(3): 1071–1102. doi:10.1111/j.1467-937X.2009.00536.x.

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S16	Andrews, Isaiah; James H. Stock; Liyang Sun 2019 Weak Instruments in Instrumental Variables Regression: Theory and Practice Annual Review of Economics 11: 727–753. doi:10.1146/annurev-economics-080218-025643.
S17	Cattaneo, Matias D.; Nicolás Idrobo; Rocío Titiunik 2024 A Practical Introduction to Regression Discontinuity Designs: Extensions Cambridge Elements. Fuzzy RD, discrete scores, local randomisation and validity diagnostics.
S18	Hyndman, Rob J., and George Athanasopoulos 2021; online edition accessed 2026 Forecasting: Principles and Practice, 3rd ed. — Time Series Cross-Validation OTexts, 3rd edition, section 5.10. Expanding-window and rolling-origin evaluation.
S19	Cole, Stephen R., and Miguel A. Hernán 2008 Constructing Inverse Probability Weights for Marginal Structural Models American Journal of Epidemiology 168(6): 656–664. doi:10.1093/aje/kwn164.
S20	World Bank DIME Analytics and LSMS Team Accessed 2026 replit: Reproducibility Best-Practice Toolkit Official project documentation. Versioned dependencies, portable paths and reproducibility checks.

Read the connection through prices, financing and portfolios

The report finds associations and reconciles quantities; it does not identify national credit displacement.

What is observed

Rates co-moved; enterprise credit increased year on year; bank investments grew faster than loans; gross and net government financing diverged.

What is not identified

How many cedris of business credit were lost or gained because of a change in government borrowing costs.

What closes the gap

Issuer-specific holdings, net cash issuance, bank funding and matched business-loan outcomes linked to a credible shock.



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