

Beyond Gross Reserves

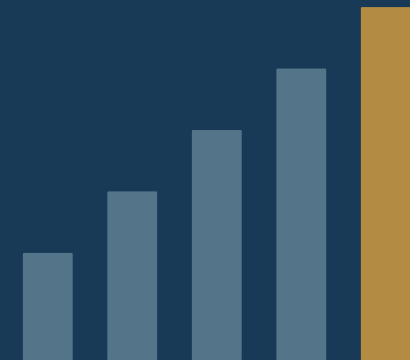
Assessing Ghana's External Liquidity

Reserve definitions. Gold valuation. Payment capacity.

Commissioning institution: Institute of Development and Economic Research (IDER)

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About this publication

Independent research • transparent evidence • reproducible calculations

TITLE AND SERIES

Beyond Gross Reserves: Assessing Ghana's External Liquidity

IDER's Ghana Macroeconomic Policy and Business Intelligence Briefings

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RESPONSIBILITY AND INTERPRETATION

The analysis and interpretations are those of the author and IDER. This is not a World Bank or IMF publication; source citation does not imply endorsement. Accounting checks are not a custodian audit or a causal policy evaluation.

DATA, CODE AND ENQUIRIES

The companion evidence package contains source-labelled inputs, calculation code, figure data, model documentation and verification records. For research, corrections or reuse enquiries: info@iderafrica.com.

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Page numbers match the printed folios and the PDF page count; all entries are clickable.

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NAVIGATION Click a running header to return here. Source IDs link to the references; equation IDs link to the model index.

Read the reserve stock, asset usability and payment calendar together

Three connected analytical pillars; a reported reserve balance is not a dated cash budget.

01 WHAT IS COUNTED?

Headline and programme gross reserves; programme net reserves; monetary gold; valuation, exclusions and source differences.

[Decision brief | p. 6](#)

[External obligations | p. 43](#)

[Empirical extension | p. 79](#)

02 WHAT CAN BE USED?

Custody, encumbrance, currency, settlement and monetisation. Gold is a reserve asset, but its cash availability is horizon-specific.

[Reserve definitions | p. 15](#)

[Liquidity scenarios | p. 51](#)

[Causal design | p. 87](#)

03 WHAT MUST BE PAID?

Import-pressure benchmarks; external debt; contractual and contingent drains; 30-day, 90-day and 12-month stress tests.

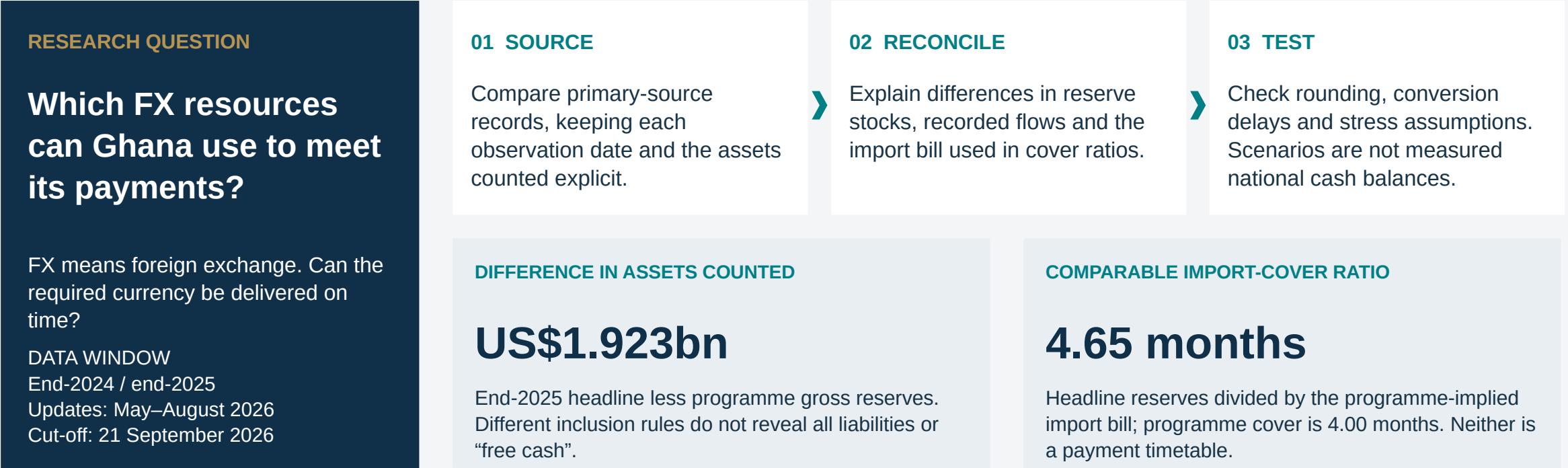
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Measure the stock. Test usability. Match the payment date.

A reserve balance shows recorded assets; payment capacity also depends on currency, restrictions and timing.



WHAT THIS MEANS The calculations can be repeated. Net international reserves (NIR), daily usable cash and causal policy effects remain unmeasured without matched assets, liabilities and a credible research design.

Stronger recorded reserves do not certify immediate payment capacity

Read the assets counted, the import-cover denominator and the foreign-exchange (FX) payment calendar together.

01 RECORDED STOCK

REPORTED • END-2025

US\$13.829bn

Headline gross reserves

US\$11.906bn

Programme gross reserves

The reporting “perimeter” means the assets included. A larger gross stock is not the same as cash after liabilities and restrictions.

02 ADEQUACY MEASURE

DERIVED • COMPARABLE BASIS

5.70 months

Published headline cover

4.65 / 4.00

Headline / programme on common imports

Import cover divides reserves by an average monthly import bill. Matching the denominator makes the ratios comparable—not a promise of FX delivery.

03 CASH READINESS

NOT IDENTIFIED

No verified

national 30/90-day cash-buffer estimate

Assets + due dates

Currency, restrictions and liabilities required

A cash ledger matches usable resources to each payment date. Missing records mean uncertainty; they do not mean zero liabilities or zero liquidity.

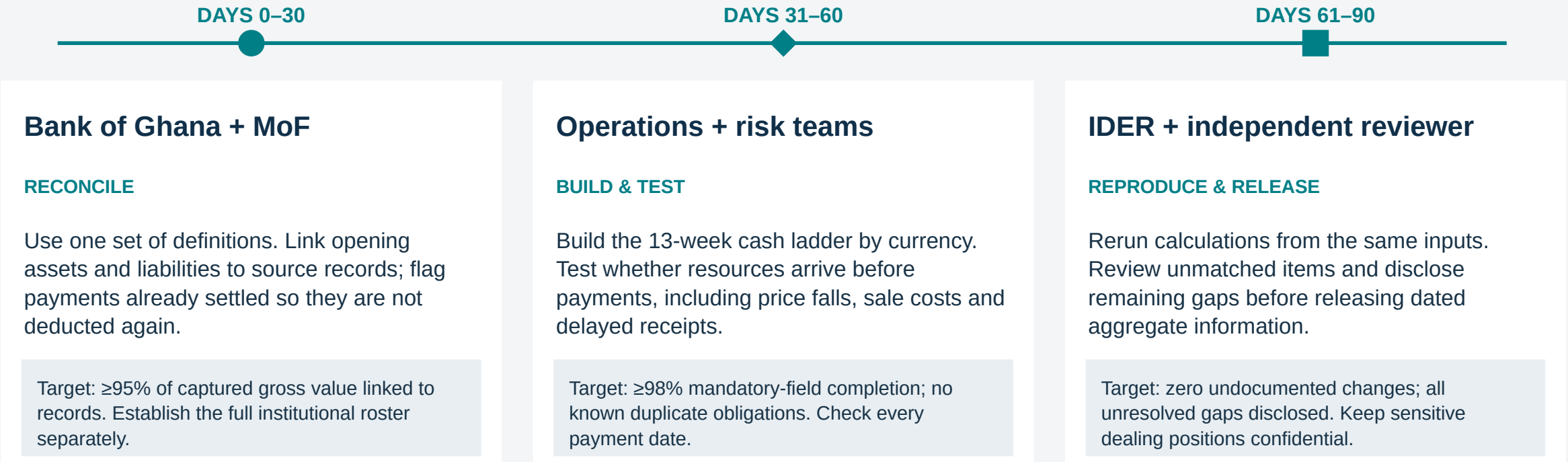
US\$0.532bn

UNALLOCATED STOCK–FLOW DIFFERENCE

The stock increase exceeds the recorded reserve acquisition by this amount. It is not an identified gold gain or new cash receipt.

A 90-day route from scattered records to a controlled liquidity release

Proposed after access approval. A “cash ladder” is a dated schedule of receipts and payments for each currency.



HOW TO READ THE TARGETS Captured records are the dataset obtained—not all national exposure. MoF = Ministry of Finance. GoldBod/custodians reconcile gold and FX; banks/firms match their own invoices and funding dates.

Abbreviations and reading terms

Definitions support the existing analysis; source-specific measurement rules remain controlling.

ARA	Assessing Reserve Adequacy; a reserve-risk framework.
BoG	Bank of Ghana.
BOP	Balance of payments.
ECF	Extended Credit Facility; the IMF programme referenced in the source records.
FX	Foreign exchange; the currency needed to settle a transaction.
GIR	Gross international reserves; specify the headline or programme perimeter.
GoldBod	Ghana Gold Board.
IDER	Institute of Development and Economic Research.
IMF	International Monetary Fund.

IRFCL	International Reserves and Foreign Currency Liquidity.
ITT / IV	Intention-to-treat / instrumental variable; prospective designs only here.
LP / LP-IV	Local projections / instrumental-variable local projections.
MoF	Ministry of Finance, Ghana.
NFA / NIR	Net foreign assets / net international reserves; not interchangeable.
PCI / PPG	Policy Coordination Instrument / public and publicly guaranteed.
SDR / TMU	Special drawing rights / Technical Memorandum of Understanding.
US\$; m; bn	US dollars; million; billion. One billion equals 1,000 million.
Perimeter	The institutions, instruments and claims included in a measure.

How to interpret the evidence

Read the evidence status, measurement boundary and assumptions before interpreting a number.

SOURCE-REPORTED / PRELIMINARY

Transcribed source observations retain their date, institutional scope and revision status. A reported balance is not an audited daily cash position.

DERIVED ACCOUNTING

Ratios, growth rates and decompositions are calculated from stated inputs. An accounting contribution is not an identified causal effect.

ILLUSTRATIVE / CONDITIONAL

Portfolio, price, haircut, timing and exposure assumptions define a scenario. These results are not measurements of Ghana's actual shortfall.

PROSPECTIVE / NOT ESTIMATED

P01–P07 document possible research specifications. No fitted coefficient, empirical standard error or completed experiment is reported.

UNITS AND ROUNDING

Retain source precision in the input files; calculate before rounding. Small differences between totals and displayed components may reflect rounding.

SIGNS AND HORIZONS

Positive reserve acquisition means accumulation in the report's bridge. Horizon totals are cumulative; 30-, 90- and 365-day amounts must not be added.

RANGES AND MISSINGNESS

Rounding envelopes and exposure bounds are not confidence intervals. "Not estimated" is not zero. No shock or breach probability is assigned.

SOURCES AND EQUATIONS

S01–S18 identify source records, not independent replications. E01–E24 cover definitions, accounting, scenarios and controls; P01–P07 are prospective.

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Model and equation index

Family IDs are stable; each displayed equation now also carries a unique, searchable line identifier.

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E02 is a definition, not a reconstructed NIR stock; E24 contains proposed quality controls. None of P01–P07 has been estimated.

Three conclusions have different levels of empirical support

Observed public aggregates, reproduced calculations and unobserved operational detail are distinguished.

Table 1. Three conclusions have different levels of empirical support

Dimension	Assessment	Decision implication
Recorded reserve buffer	Materially stronger in 2025 under both gross definitions	Recognise the improvement without equating it to cash availability.
Reserve adequacy	Programme cover: 4.0 months; staff benchmark about 6	Compare matching definitions and conditional risk assumptions.
Immediate external liquidity	Current matched cash/obligation ledger not obtained	No verified national 30/90-day surplus or shortfall is asserted.

Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#); IMF adequacy (2026) [\[S04\]](#); IMF IRFCL [\[S07\]](#).

Gross, net and readily available are different concepts

Definitions must identify the institutional boundary, valuation basis and deductions.

Table 2. Gross, net and readily available are different concepts

Measure	What it records	What it does not establish
Headline GIR	Source-reported gross international reserve aggregate	Exact programme eligibility or payment-date cash availability.
Programme gross reserves	Assets within the IMF programme reporting perimeter	Net reserve assets after programme liability deductions.
Programme NIR	Eligible reserve assets less defined reserve liabilities	A universal “free cash” concept or a cash-flow ladder.
Horizon-specific FX capacity	Unencumbered assets monetisable by date, plus collectible flows	A published reserve statistic or an actuarial/solvency rating.

Sources: IMF (2026) [\[S02\]](#); IMF TMU (2026) [\[S03\]](#); IMF IRFCL [\[S07\]](#).

Net foreign assets are not automatically net usable reserves

Balance-sheet stocks, programme monitoring and payment execution use different perimeters.

Balance-sheet NFA

Foreign assets less foreign liabilities can include items outside the reserve-asset perimeter. Cedi translation creates valuation movements.

Programme NIR

Fixed programme valuation and defined IMF/short-term liability deductions support programme monitoring—not a simple cash budget.

Operational cash

Which assets settle in the required currency by the payment date? Contractual restrictions and market capacity matter.

The observation date is separate from the research cut-off

Information cut-off: 21 September 2026. No incomplete current year is labelled a full-year outturn.

Table 3. The observation date is separate from the research cut-off

Evidence	Window / status	Use and restriction
Matched gross measures	End-2024 and end-2025; reported / preliminary	Exact paired comparisons; source perimeters remain separate.
Programme NIR performance	2025 and 2026Q1 cumulative changes	Changes only; no matched current stock reconstructed.
Programme reserve monitoring	End-May 2026, rounded US\$12.2bn	Separate dated update; not September cash.
GoldBod market/reserve allocation	August 2026 institutional statement	Reported flow split; no verified GIR settlement bridge.
External obligations	2026–2030 IMF projections	Calendar-year source line, not next rolling 12-month due dates.

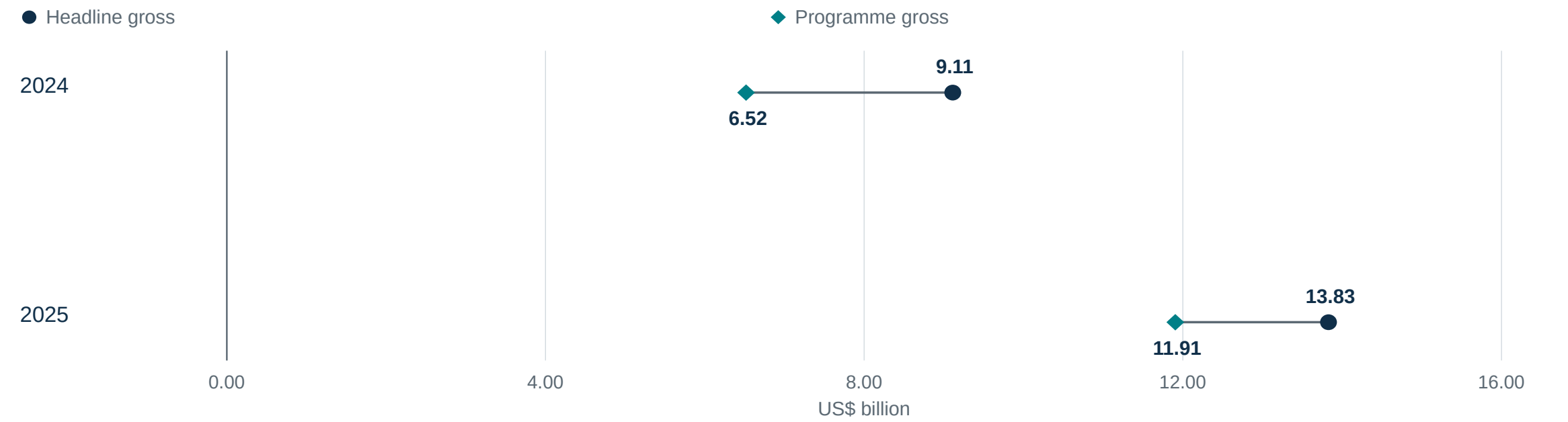
Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#); IMF TMU (2026) [\[S03\]](#); GoldBod (Aug 2026) [\[S06\]](#).

Note: Primary financial table images were verified on 22 September 2026; the underlying reporting submissions were not audited.

Both reserve measures increased, but they did not become identical

End-December stocks; US\$ billion. Headline and programme perimeters retained.

Figure 1. End-December reserve stocks, by reporting perimeter



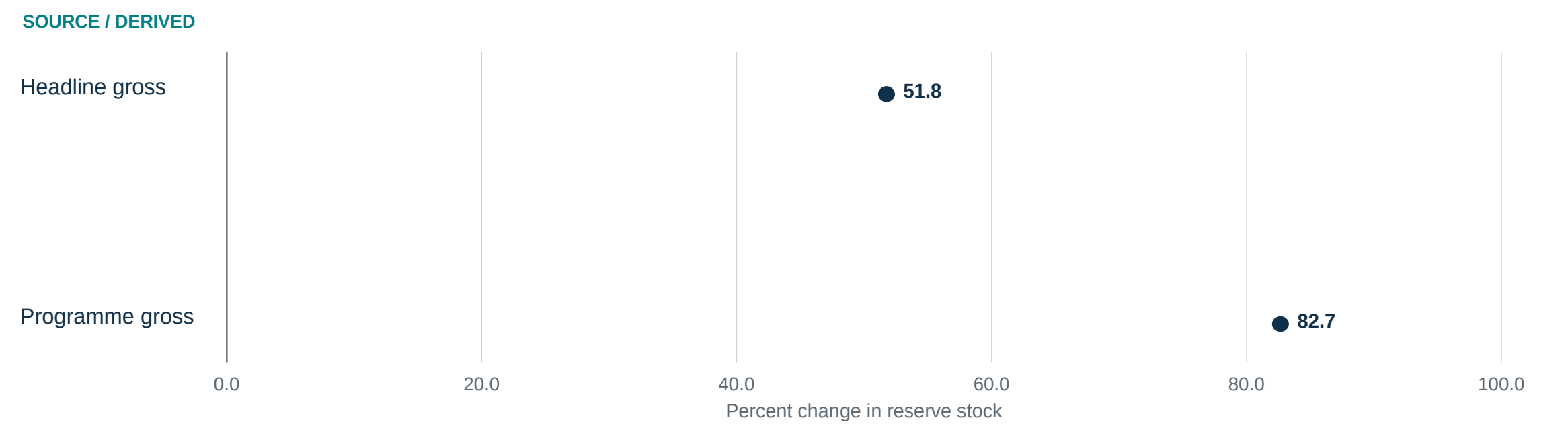
Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#). Calculations: IDER.

Note: Stock changes include transactions and valuation/other changes. They are not investment returns or net intervention.

Growth rates depend on the reserve definition

Matched end-2024 to end-2025; exact growth from the source stocks.

Figure 2. Percentage change between matched end-year reserve stocks

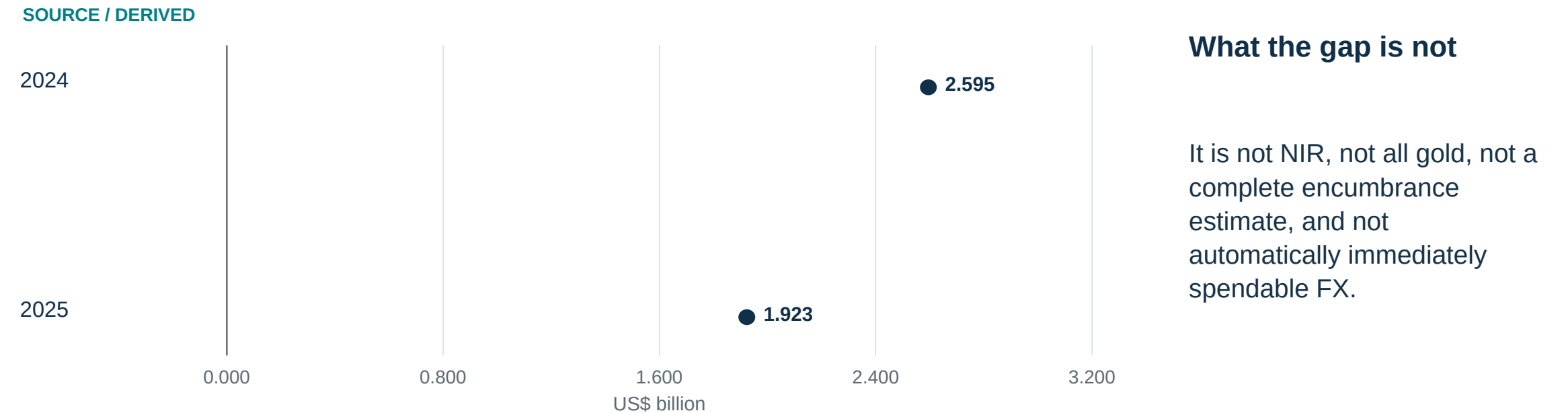


Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#). Calculations: IDER.

The headline–programme gap narrowed in dollar terms

Headline minus programme gross reserve stock; US\$ billion; not reserve liabilities.

Figure 3. Difference between the two gross-reserve measures



Sources: MoF (2026) [S01]; IMF (2026) [S02]; IMF TMU (2026) [S03]. Calculations: IDER.

The programme excludes specified holdings and constrained assets

The TMU controls definitions; actual values for each exclusion are not available in the common record.

Table 4. The programme excludes specified holdings and constrained assets

Adjustment / constraint	Definition to preserve	Required evidence
Specified public funds and deposits	Petroleum funds and BoG claims, including deposits, on Ghana International Bank London excluded by TMU	Account-level matched balances and ownership.
Encumbrance	Pledged, collateralised, swapped or otherwise restricted assets	Asset and corresponding liability IDs; release dates.
Currency / liquidity / residency	Nonconvertible, illiquid or ineligible resident claims excluded	Currency, counterparty residency and market access.
Gold eligibility	Monetary gold may qualify; production or doré is not automatically a reserve asset	Title, refining, custody and availability evidence.

Sources: IMF TMU (2026) [\[S03\]](#); IMF IRFCL [\[S07\]](#).

Note: No numerical breakdown of the gross-measure gap is invented.

Programme NIR deducts a defined liability set

The current TMU definition is not interchangeable with headline net-reserve reporting.

Programme NIR: eligible assets after the full defined liability deductions

Use the TMU’s fixed exchange rates and gold price. Apply its full short-term liability rule, including derivatives and FX deliverable within 12 months, then deduct outstanding IMF credit across maturities. Exclude SDR allocations from that IMF-credit deduction; remove any duplicate liability IDs.

Asset eligibility

Exclude pledged or unavailable holdings before measuring programme assets.

No duplicate deduction

Use unique liability IDs where short-term and Fund records overlap.

Not free cash

Programme NIR is a stock; payment timing requires a separate ledger.

A cumulative NIR increase is not the NIR stock

Programme performance entries; US\$ million. Each calendar year has its own cumulative starting point.

Table 5. A cumulative NIR increase is not the NIR stock

Test date	Cumulative change outturn	Published floor / comparator	Interpretation
December 2025	+3,232	1,450; adjusted 1,445	Annual ECF accumulation measure, not NIR level.
March 2026	-132	+50	First-quarter change, not a negative US\$132m reserve stock.
Current matched NIR stock	Not estimated	Asset/liability bridge not obtained	Do not infer zero or subtract guessed liabilities.

Source: IMF TMU (2026) [\[S03\]](#).

Gold-price gains can move market reserves without the same programme gain

The PCI TMU fixes the gold price at US\$4,608.35 per fine troy ounce on its 31 March 2026 base.

Market-value stock

At unchanged eligible ounces, a higher market gold price raises the reported dollar value of monetary gold. It does not create additional ounces.

Programme monitoring

At a fixed programme gold price, price-only market revaluation does not raise the programme-valued gold component.

Cash execution

A sale, swap or maturity produces a separately dated cash consequence. Costs, settlement and subsequent liabilities must be recorded.

Gold is a reserve asset—not necessarily same-day currency cash

Eligibility and speed of monetisation are separate tests; do not assume all gold is unavailable.

Table 6. Gold is a reserve asset—not necessarily same-day currency cash

Gold record	Analytical treatment	Operational check
Allocated monetary gold	May be eligible and highly marketable under appropriate custody	Title, location, delivery standard, dealing and settlement.
Doré / unrefined purchases	Production or inventory before reserve qualification	Refining, shipment, assay, settlement and ownership.
Pledged / swapped bullion	Availability may be restricted or offset by a liability	Do not count free gold and the same secured cash twice.
Valuation gains	Price remeasurement, not current cash receipts	Separate price, ounces, realised gains and conversion costs.

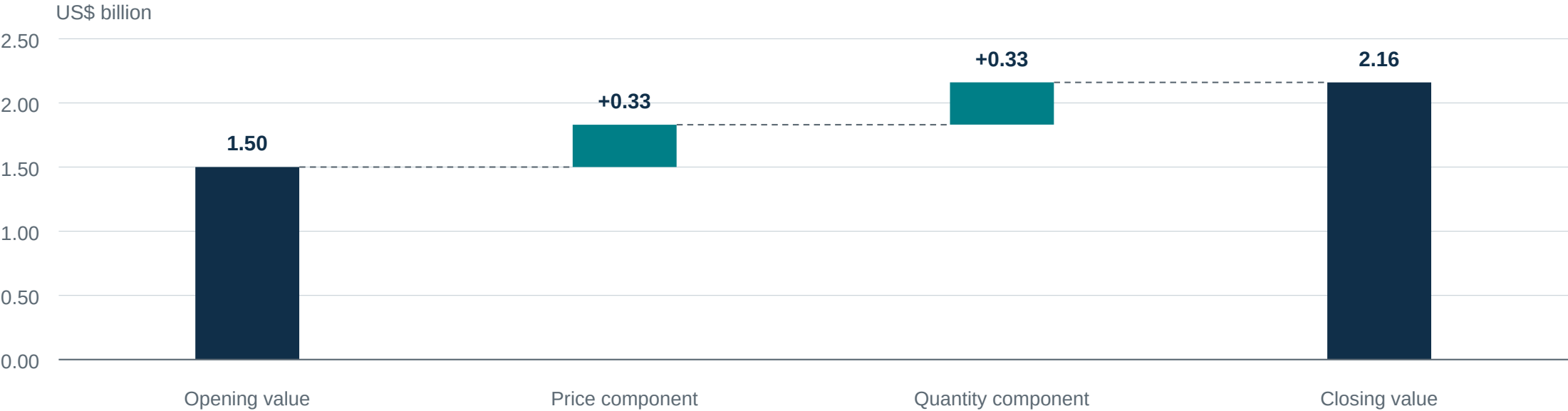
Sources: IMF TMU (2026) [\[S03\]](#); IMF adequacy (2026) [\[S04\]](#); Nolin / IMF (2026) [\[S05\]](#); IMF IRFCL [\[S07\]](#).

Note: IMF reports the Q4 2025 gold share falling from about one-third to under one-fifth; no exact holding or valuation gain is inferred.

Price and quantity changes require separate attribution

Illustration: 0.5m → 0.6m fine ounces; US\$3,000 → US\$3,600 per ounce. Not Ghana observations.

Figure 4. Exact symmetric price–quantity accounting; hypothetical gold



Source: IDER methods [\[S12\]](#).

Note: Symmetric two-factor accounting allocates the interaction equally. Quantity accumulation is not a valuation gain.

The same price shock has a larger effect at higher gold concentration

Illustrative portfolio composition and price declines; other assets and gold quantity fixed.

Figure 5. Portfolio loss under assumed gold concentration and price shocks



Source: IDER methods [\[S12\]](#).

Note: Horizontal axis: assumed gold-price decline (%). No shock probability, sale price or current Ghana gold share is estimated.

Trace gold earnings, reserve assets and market sales only once

Different stages of the same resource chain must not become three independent foreign-exchange inflows.

Origin

Gold production/export receipts, domestic purchases and refining are recorded with quantities, ownership and actual cash dates.

Reserve treatment

Record cash-to-gold or gold-to-cash conversion, eligible custody and any market revaluation separately.

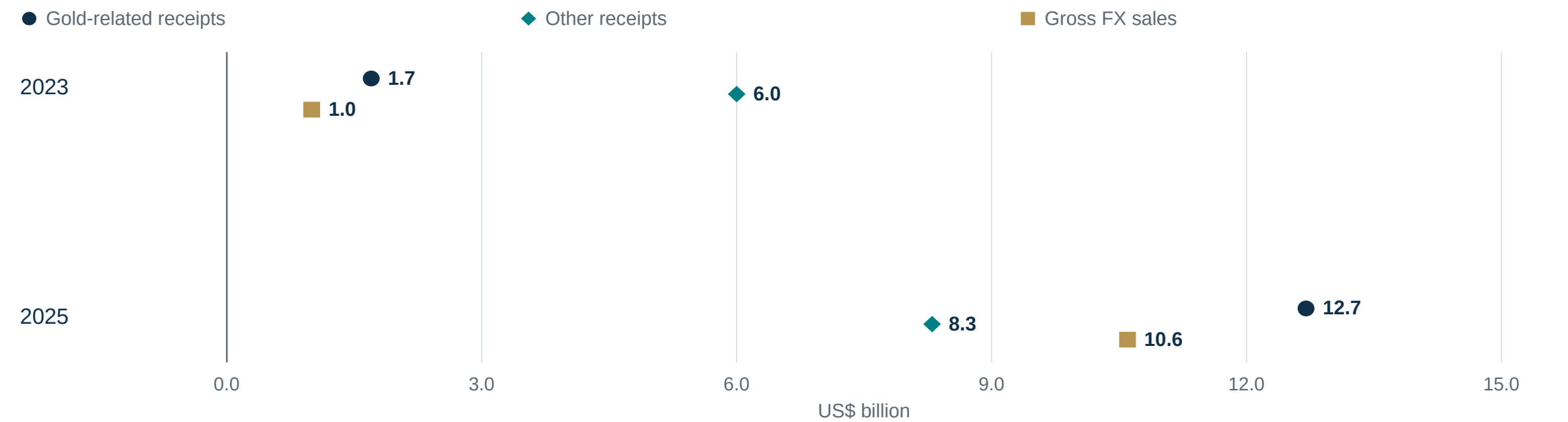
Final use

Official FX sales, debt service and retained reserves are uses or holdings of the resource—not new export earnings.

Larger receipts and larger sales can occur together

BoG cash-flow comparisons from Nolin; rounded US\$ billion. These are not reserve stocks.

Figure 6. Institutional FX receipts and sales; Nolin source perimeter



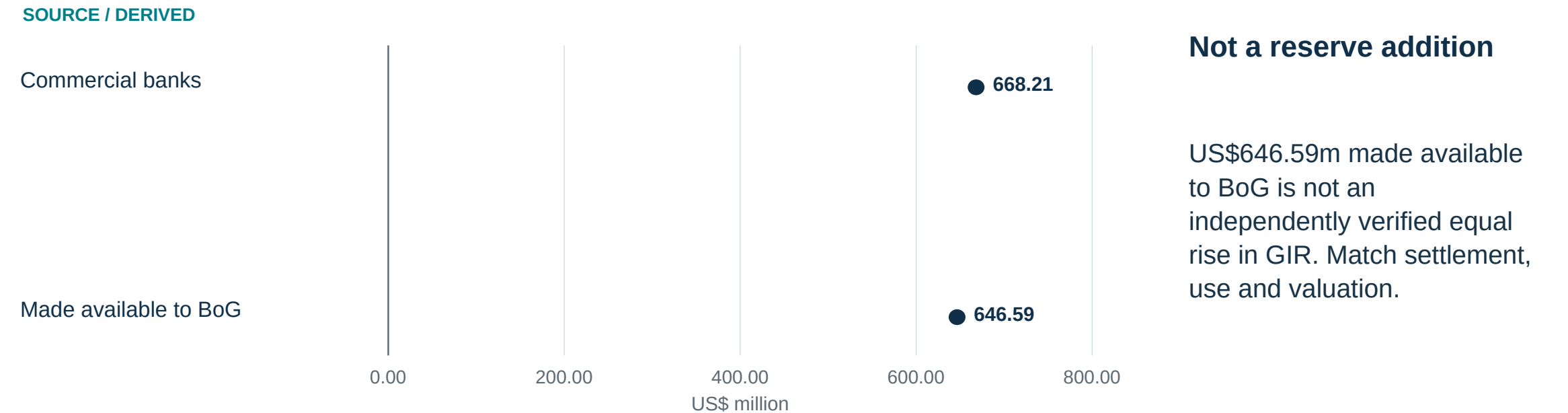
Source: Nolin / IMF (2026) [\[S05\]](#). Calculations: IDER.

Note: Gross sales are not net intervention. The 2025 gold receipt figure includes source-reported net bullion-sale gains.

GoldBod reports different August allocations to banks and BoG

Institution statement dated 31 August 2026; spot and funded forwards are not the same settlement instrument.

Figure 7. Institution-reported August 2026 FX allocations



Source: GoldBod (Aug 2026) [S06]. Calculations: IDER.

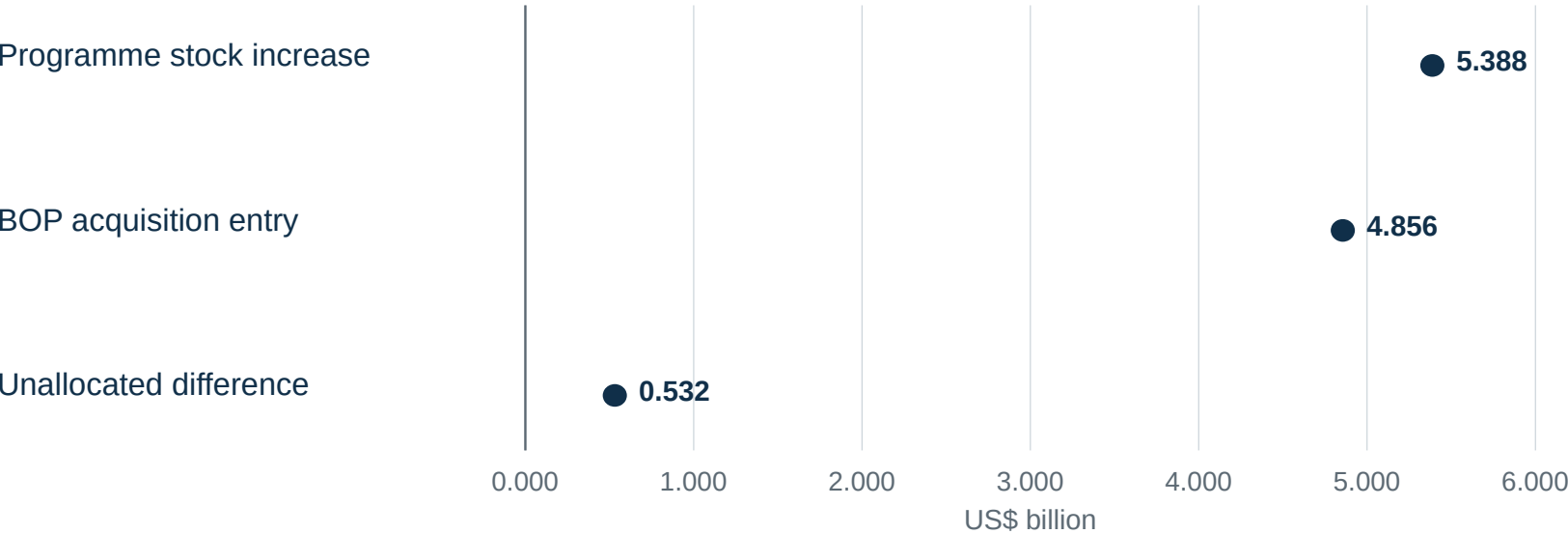
Note: Components sum to US\$1,314.80m; the US\$1,315m headline is rounded. September targets are not observed inflows.

The 2025 reserve-stock increase exceeds the BOP acquisition entry

Programme gross reserves; US\$ billion. The residual is displayed without attributing its cause.

Figure 8. Stock increase, BOP acquisition and unallocated difference

SOURCE / DERIVED



Unallocated ≠ gold gain

US\$0.532bn remains unallocated across domestic gold treatment, valuation, scope and other adjustments.

Source: IMF (2026) [S02]. Calculations: IDER.

Two reserve-flow entries cannot be silently substituted

Same IMF report; US\$ million. Differences are retained instead of forcing a complete bridge.

Table 7. Two reserve-flow entries cannot be silently substituted

Source record	2025 value	Treatment
Programme GIR stock increase	5,388	End-2025 stock minus end-2024 stock.
Table 5: reserve acquisition from BOP	4,856	Accumulation is shown positive here; source financing sign is negative.
Table 6: gross reserve accumulation	3,979	Different reported entry; not substituted for Table 5.
Table 5 versus Table 6 difference	877	Unresolved cross-table discrepancy, not assigned to a driver.

Source: IMF (2026) [\[S02\]](#).

Note: Domestic gold treatment is a documented issue, but its amount is not identified by the residual alone.

The reported month counts use different reserve and import bases

End-December comparisons; headline source versus IMF prospective goods-and-services convention.

Table 8. The reported month counts use different reserve and import bases

Measure	2024 reserves / cover	2025 reserves / cover	Comparison rule
Headline	US\$9.1128bn / 4.1 months	US\$13.8292bn / 5.7 months	Retain MoF/BoG source convention.
Programme	US\$6.518bn / 2.4 months	US\$11.906bn / 4.0 months	Prospective imports of goods and services.
Operational cash coverage	Not measured	Not measured	Requires actual dated payments and available assets.

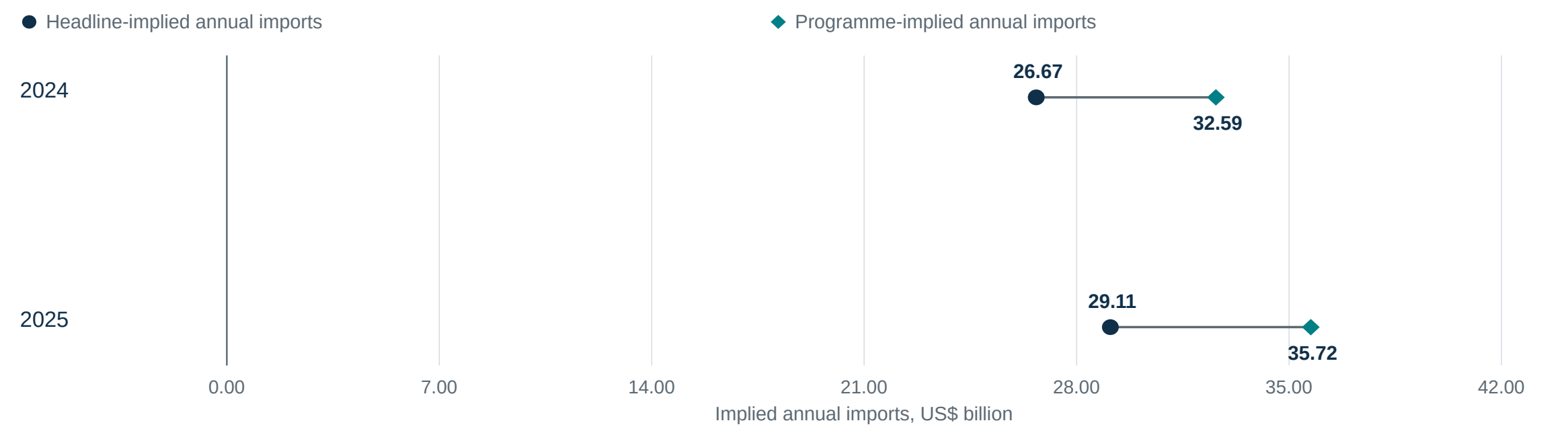
Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#).

Note: Neither headline import cover nor programme prospective cover is a 30-day cash-flow coverage ratio.

The implied import bills differ materially across published measures

Multiply reserves by 12 and divide by reported cover; the implied annual bill inherits source rounding.

Figure 9. Import denominators implied by the published cover ratios



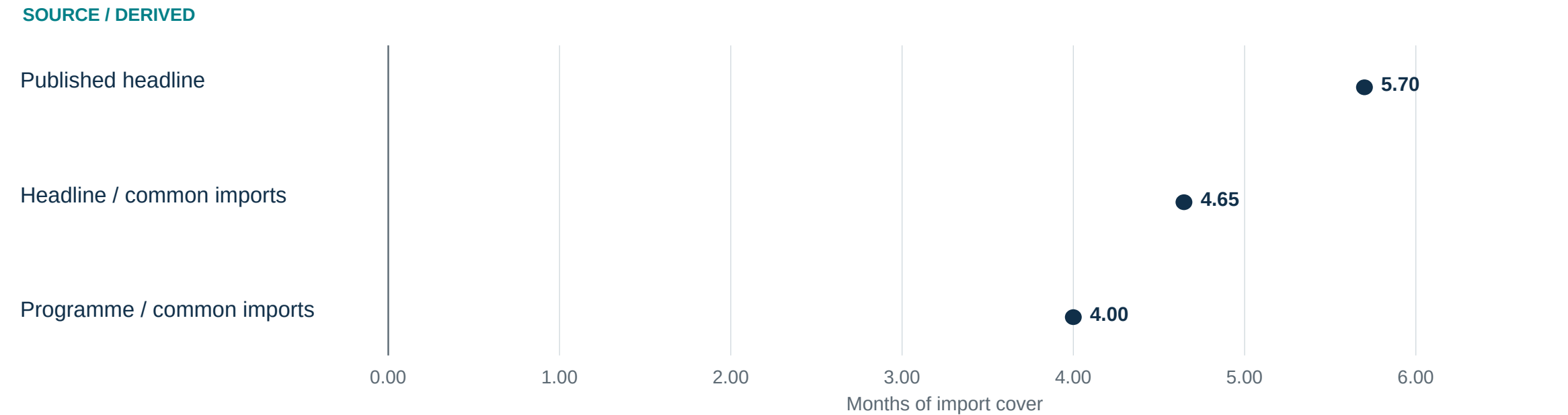
Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#). Calculations: IDER.

Note: Implied amounts are algebraic diagnostics, not independently observed import bills. Source horizons and vintages differ.

A common denominator changes the headline cover interpretation

2025 stocks; hold the programme-implied annual import bill at US\$35.718bn.

Figure 10. Published and common-denominator import cover



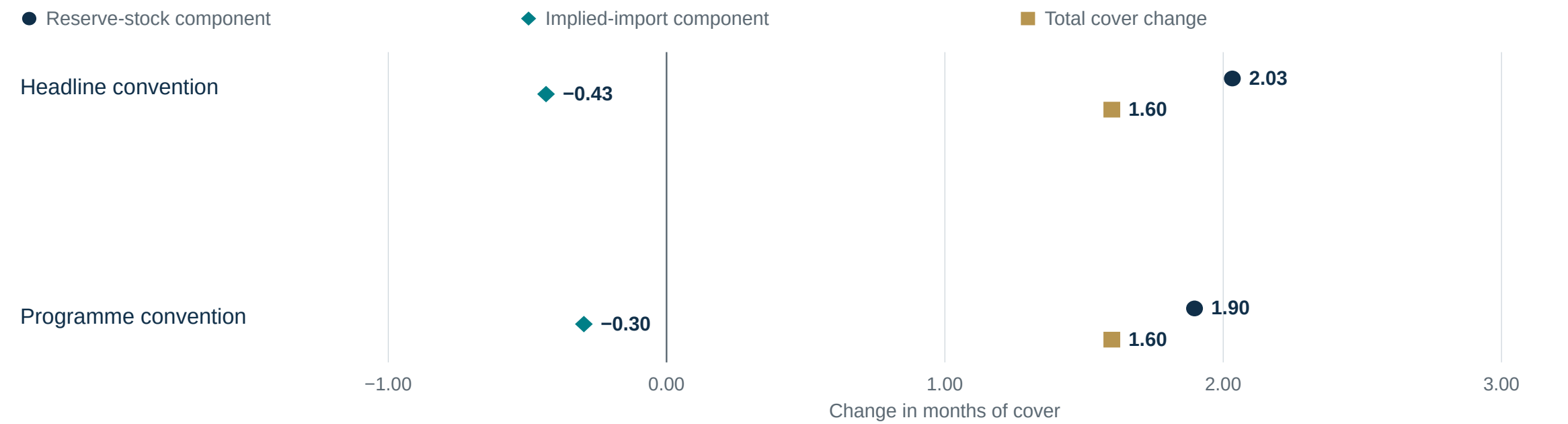
Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#). Calculations: IDER.

Note: The move from 5.70 to 4.65 reflects the denominator; from 4.65 to 4.00 reflects the numerator. Order-invariant attribution appears on p.82.

Reserve accumulation and import-denominator changes offset each other

2024–2025 symmetric accounting using each source’s implied denominator; not causal effects.

Figure 11. Symmetric contributions to the increase in import cover



Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#). Calculations: IDER.

Note: Both reported cover measures rose 1.6 months. Independently rounded components need not add visually at every precision.

A goods-only cover ratio is not a goods-and-services ratio

Constant end-2025 programme reserve numerator of US\$11.906bn; the denominator is deliberately varied.

Table 9. A goods-only cover ratio is not a goods-and-services ratio

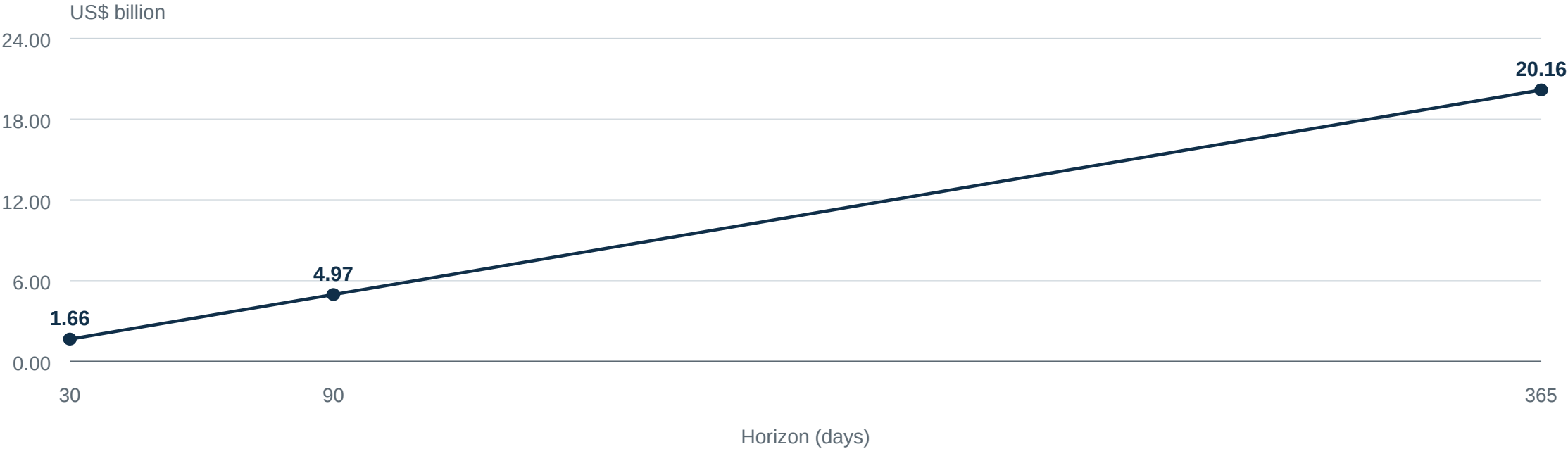
Import denominator	Annual amount (US\$bn)	Derived cover		Qualification
2025 goods imports (backward-looking)	17.452	8.19 months		Different horizon / scope; not a cash-payment schedule.
2026 projected goods imports	20.163	7.09 months		Different horizon / scope; not a cash-payment schedule.
2026 programme-implied goods + services	35.718	4.00 months		Different horizon / scope; not a cash-payment schedule.

Source: IMF (2026) [\[S02\]](#).

An annual import forecast does not reveal the next payment date

Uniform timing illustration based on 2026 projected goods imports of US\$20.163bn; 365-day year.

Figure 12. Uniform accrual benchmark; not a dated payment schedule



Sources: IMF (2026) [\[S02\]](#); IDER methods [\[S12\]](#).

Note: This is a pressure benchmark, not an observed settlement calendar. Private imports are not all official reserve obligations.

Do not treat one benchmark as a universal optimal reserve stock

Adequacy depends on external risks, financing access, adjustment and the cost of holding reserves.

Table 10. Do not treat one benchmark as a universal optimal reserve stock

Lens	What it tests	Boundary
Import cover	Capacity relative to a named import denominator	A single trade ratio omits financing drains and contingent claims.
Short-term external debt coverage	Remaining-maturity debt falling due within one year	Original maturity alone misses upcoming long-term maturities.
Broad reserve-adequacy framework	Export shock, debt rollover, other liabilities and resident capital flight	No new Ghana ARA score is calculated without the full inputs.
Ghana staff adequacy benchmark	About six months; source assumes 4% reserve-holding cost	Conditional staff assessment, not a legal minimum.
GANRAP ambition	15 months by 2028, as reported in the programme documents	Policy ambition; not interchangeable with the staff risk benchmark.

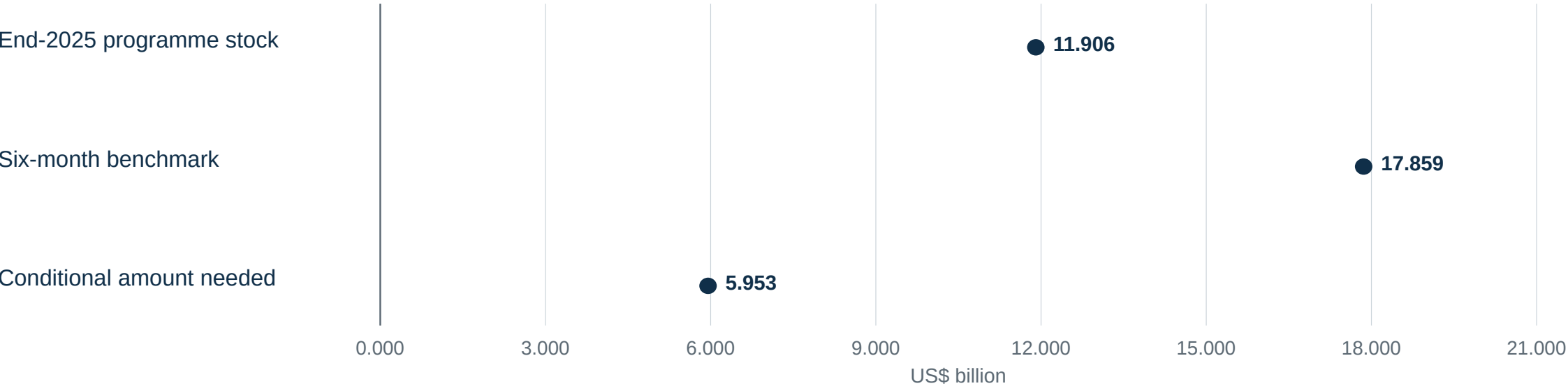
Sources: IMF adequacy (2026) [\[S04\]](#); Nolin / IMF (2026) [\[S05\]](#); IMF ARA framework [\[S10\]](#).

Six months at the same import base would require a larger stock

Hold the programme-implied denominator fixed; no projection of reserve accumulation.

Figure 13. Programme reserve stock and conditional six-month requirement

SOURCE / DERIVED



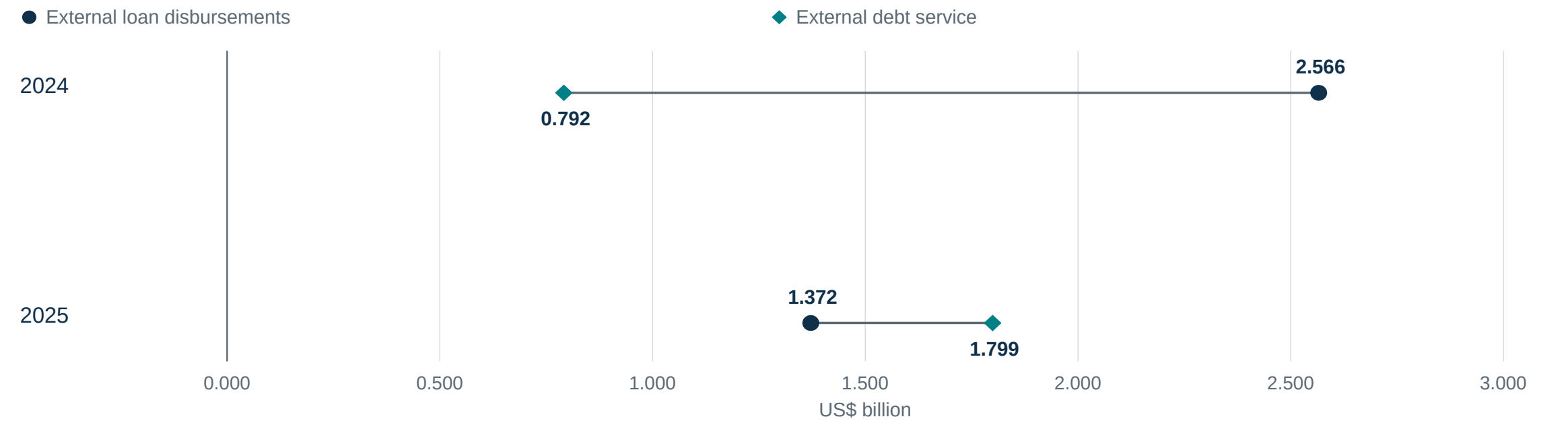
Sources: IMF (2026) [\[S02\]](#); IMF adequacy (2026) [\[S04\]](#). Calculations: IDER.

Note: The US\$5.953bn gap is a fixed-denominator illustration; the future import bill, reserve composition and policy costs will change.

External debt payments and loan receipts must be separated

MoF cash records; US\$ billion; 2024 revised and 2025 provisional public-debt perimeter.

Figure 14. Public external loan receipts and debt-service payments



Source: MoF (2026) [S01]. Calculations: IDER.

Note: A loan receipt may remain in official accounts or fund a direct payment. Gross disbursements are not dealer-market supply.

An early payment must not be deducted again when its due date arrives

MoF identifies a US\$709m payment made in December 2025 for an obligation due on 3 January 2026.

Table 11. An early payment must not be deducted again when its due date arrives

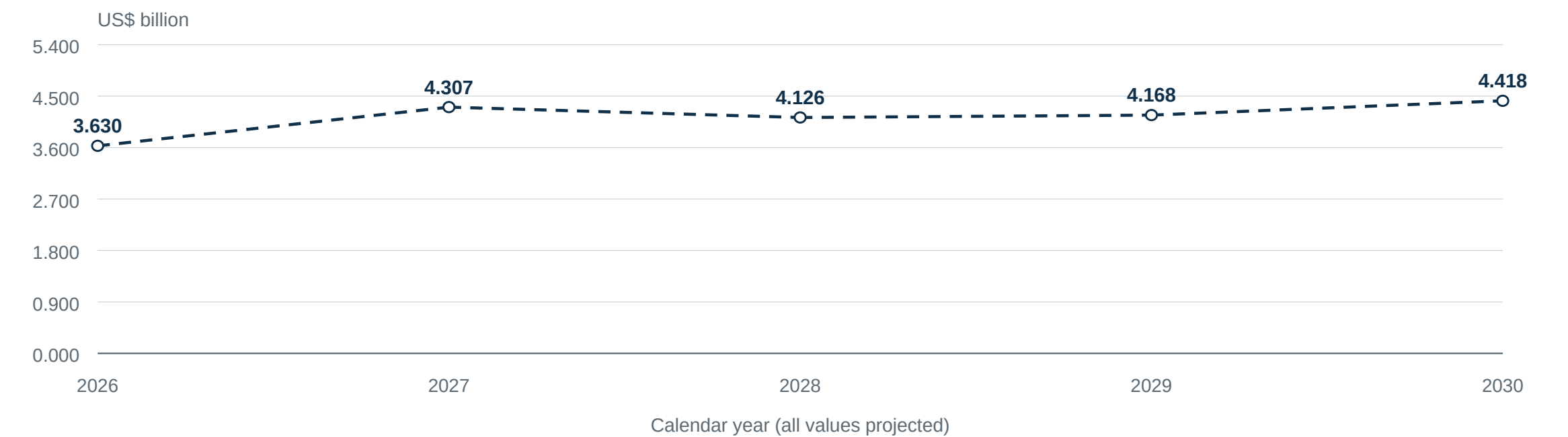
Record	US\$ million	Use in liquidity analysis
2024 actual external debt service	791.6	Annual historical cash comparator.
2025 actual external debt service	1,799.4	Includes the identified early Eurobond payment.
2025 excluding this early payment: illustration	1,090.4	Timing sensitivity only; not a corrected official cash record.
Share of annual increase due to early payment	70.4%	Accounting contribution, not causal reserve or currency attribution.

Source: MoF (2026) [\[S01\]](#).

Annual external-debt service remains a material planning input

IMF Table 8 projected calendar-year amounts; not verified payments due over the next rolling 12 months.

Figure 15. Source-projected external debt service; calendar years



Source: IMF (2026) [S02]. Calculations: IDER.

Note: Projection coverage and payment timing require reconciliation. Table 6 amortisation is not silently merged into this line.

A reserve-to-debt-service ratio is not a complete liquidity test

End-2025 reserve stocks versus the IMF Table 8 2026 debt-service projection of US\$3.630bn.

Table 12. A reserve-to-debt-service ratio is not a complete liquidity test

Reserve numerator	Stock (US\$bn)	Stock / annual debt service	Excluded from the ratio
Headline end-2025	13.8292	3.81×	Other drains, asset constraints and timing.
Programme end-2025	11.9060	3.28×	Other drains, asset constraints and timing.

Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#).

Note: This ratio does not add IMF payments again, certify rolling short-term debt cover or imply that all reserves may be spent.

The payment schedule must be reconciled before operational use

Source forecasts contain different concepts and material cross-table differences.

Table 13. The payment schedule must be reconciled before operational use

Comparison	Source values	Required resolution
2026 IMF Table 6 versus Table 8	PPG amortisation 3,784m; external debt service 3,630m	Establish coverage, restructuring and cash timing; not automatically comparable.
IMF obligations within external service	Table 8 2026: 366m / 3,630m	Do not add the IMF subset again to the source total.
2026 reserve projection	Table 5: 14,037m; Table 6: 14,070m	Retain 33m difference; this report uses Table 5 for projections.
Upcoming as of 21 September	Calendar-year total is not October-to-September total	Use contract-level dates and already-settled flags.

Source: IMF (2026) [\[S02\]](#).

Near-term drains include long-term debt that is about to mature

Cash timing and the full TMU liability test are different; original maturity alone is not sufficient.

Table 14. Near-term drains include long-term debt that is about to mature

Example	NIR / stock concept	Cash ladder treatment
Long-term BoG FX debt due next month (illustration)	Check the TMU’s additional FX-delivery-within 12 months clause; original maturity alone is insufficient	Include principal and interest in the next-month drain.
One-year FX swap with a later settlement	May enter the programme reserve-liability definition	Place both contractual legs on their actual dates.
All outstanding IMF credit	Deducted in programme NIR under the TMU	Only amounts actually due belong in each payment bucket.
Arrears and accelerated obligations	Stock and legal status require separate disclosure	Recognise callable, scheduled clearance and contingent cases.

Sources: IMF TMU (2026) [\[S03\]](#); IMF IRFCL [\[S07\]](#); IMF (2013) [\[S08\]](#).

An off-balance-sheet claim can become a near-term cash drain

Gross legs, currency, maturity and enforceable netting must be recorded.

Table 15. An off-balance-sheet claim can become a near-term cash drain

Instrument / record	Liquidity mechanism	Avoid
FX forward	Contracted currency delivery at settlement	Treating its gross receipt as unencumbered new resources.
Swap / repo	Cash now can be paired with a later repayment or collateral return	Counting both collateral and borrowed cash as freely available.
Margin and guarantee call	A contingent obligation can become payable under stress	Treating every off-balance-sheet item as zero until paid.
Committed credit line	Availability depends on enforceable terms and lender capacity	Adding undrawn conditional support to cash without qualification.

Sources: IMF IRFCL [\[S07\]](#); IMF (2013) [\[S08\]](#); IMF reserve guidelines [\[S09\]](#).

The IRFCL framework links assets to predetermined and contingent drains

International Reserves and Foreign Currency Liquidity (IRFCL): keep a consistent public-authority perimeter and remaining-maturity basis.

Table 16. The IRFCL framework links assets to predetermined and contingent drains

Template section	Content	Recommended research record
I. Assets	Official reserves and other qualifying FX assets	Separate currency, custodian, instrument, valuation and encumbrance.
II. Predetermined drains	Known contractual FX outflows and inflows	Up to 1 month; 1–3 months; 3–12 months, plus exact dates.
III. Contingent drains	Possible guarantees, option exercises and other calls	State trigger, gross exposure and scenario assumptions.
IV. Memoranda	Pledged assets, repo/lending, derivatives and currency composition	Explain off-balance-sheet exposures and linked positions.

Sources: IMF IRFCL [\[S07\]](#); IMF (2013) [\[S08\]](#).

Note: This is the reporting framework—not a claim that a complete current Ghana IRFCL template was retrieved.

Private import demand is not identical to government FX debt

Reserve adequacy and official cash execution use related but different denominators.

Table 17. Private import demand is not identical to government FX debt

Flow / obligation	Who normally settles?	Treatment
Public external debt service	Named public borrower or paying agent	Include once in the official payment ledger.
Private import invoice	Firm and its bank, using their FX funding	Monitor market pressure; do not add all imports as automatic state debt.
Resident foreign-currency deposit	Bank owes depositor; central-bank claims depend on arrangement	Map bank liquidity and potential official support separately.
Public guarantee called	Government when contractual trigger is met	Model contingent drain and fiscal exposure explicitly.

Sources: IMF TMU (2026) [\[S03\]](#); IMF IRFCL [\[S07\]](#); IMF (2013) [\[S08\]](#).

Define available resources at each horizon and in each currency

The same gross amount can imply different payment capacities.

Availability

Which unencumbered assets can be realised by the date, at executable prices and after settlement costs?

Contracted cash flows

Which receipts are collectible and which payments are unavoidable? Avoid double counting maturity principal and sale proceeds.

Stress behaviour

Which contingent calls, delays, market haircuts or price falls could reduce the buffer? Do not attach invented probabilities.

The model starts from a gross foreign-asset inventory—not Ghana’s GIR

US\$ billion. All composition, restrictions and cash-flow schedules below are assumptions.

Table 18. The model starts from a gross foreign-asset inventory—not Ghana’s GIR

Asset inventory	Gross	Restricted	Unencumbered
Cash/deposits	2.00	0.00	2.00
Foreign securities	4.00	0.50	3.50
Monetary gold	3.00	0.30	2.70
Other FX assets	1.00	0.00	1.00
Total	10.00	0.80	9.20

Source: IDER methods [\[S12\]](#).

Note: Restricted assets are deliberately excluded before operational availability. The US\$10bn inventory is not definition-compliant GIR.

Horizon, price and haircut assumptions are separately controlled

Normal versus stressed cumulative monetisation fractions; 30 / 90 / 365 days.

Table 19. Horizon, price and haircut assumptions are separately controlled

Asset	Normal fractions	Stress fractions	Additional stress
Cash / deposits	100% / 100% / 100%	100% / 100% / 100%	No price or sale haircut assumed.
Foreign securities	80% / 100% / 100%	50% / 85% / 100%	Sale haircut rises from 2% to 10%.
Monetary gold	25% / 75% / 100%	0% / 40% / 80%	Normal sale haircut 5%; stress price–30% and sale haircut 15% after revaluation.
Other FX assets	0% / 50% / 100%	0% / 0% / 50%	10% haircut; delayed availability.

Source: IDER methods [\[S12\]](#).

Note: Fractions are cumulative, not independent tranches to add. No new policy support or endogenous market response is assumed.

Start from gross assets or net assets—but never deduct a liability twice

The operational model starts from gross unencumbered assets and deducts each cash drain once.

First: identify free assets that can settle in the required currency by the payment date

Next: apply executable prices, availability limits and sale costs. Add collectible receipts; deduct each scheduled and triggered contingent payment once. The 30/90/365-day results are horizon ceilings—not a verified daily execution path. Test every intervening settlement date and currency.

Cumulative totals

Do not sum the three horizon totals.

No duplicate cash

Exclude maturity principal already counted in opening-asset proceeds.

No double netting

Do not deduct all IMF credit in NIR and then deduct the same payments again.

Contractual and contingent drains are not combined without a trigger

Cumulative US\$ billion; illustrative schedules only.

Table 20. Contractual and contingent drains are not combined without a trigger

Horizon	Contracted inflows	Scheduled drains	Contingent drains in stress
30 days	0.40	1.80	0.20
90 days	1.20	3.60	0.60
365 days	3.00	8.00	1.50

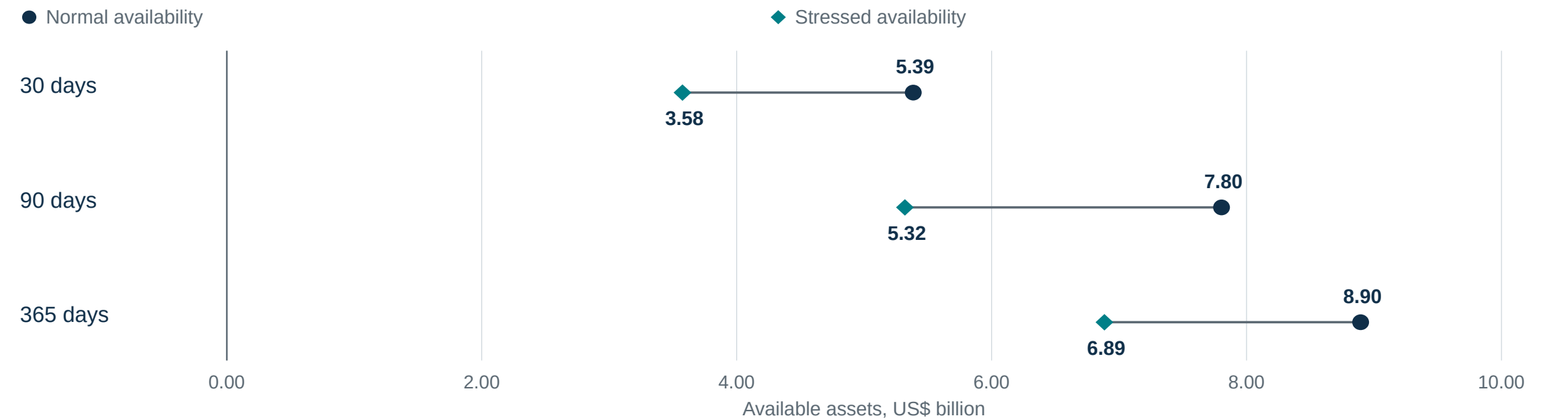
Source: IDER methods [\[S12\]](#).

Note: Normal: full inflow realisation and no contingent call. Stress: 50% inflow realisation and all stated contingent drains triggered.

Monetisable capacity differs from the gross asset inventory

Illustrative US\$10bn inventory; all unencumbered-asset, price and execution assumptions retained.

Figure 16. Monetisable asset ceilings under the assumed scenarios



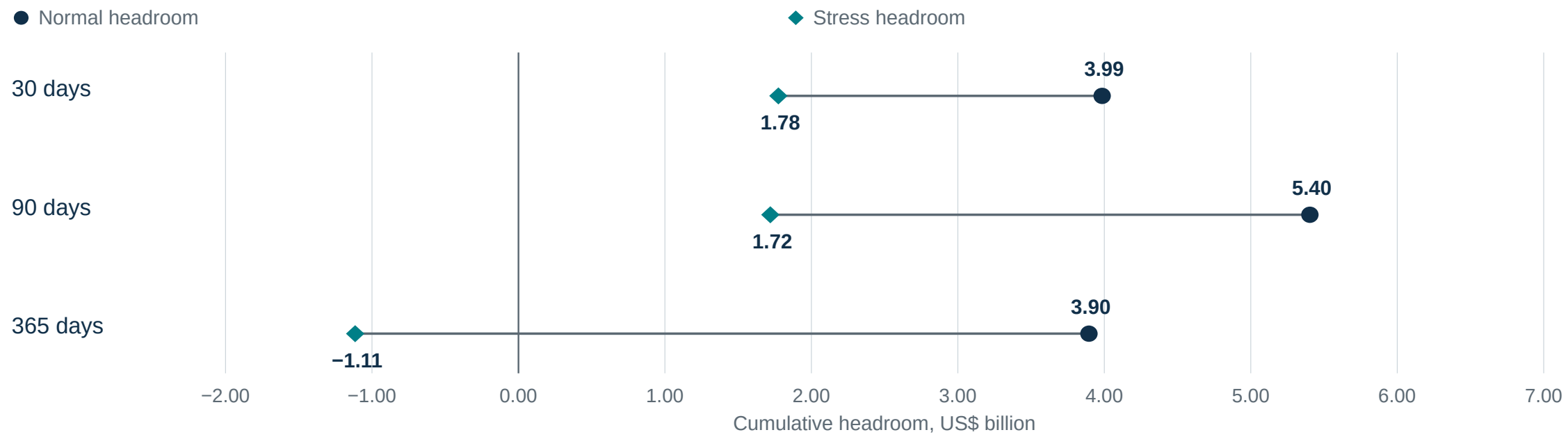
Source: IDER methods [\[S12\]](#).

Note: Both scenarios start from the same US\$10bn inventory; stress then changes value and usability. These are not Ghana reserve estimates.

A positive gross inventory can coexist with a stressed annual shortfall

Available assets plus collectible inflows less scheduled and contingent drains; US\$ billion.

Figure 17. Cumulative scenario headroom at each stated horizon



Source: IDER methods [\[S12\]](#).

Note: The negative 365-day scenario is a model result, not an estimate of Ghana’s actual payment shortfall.

The 365-day stressed result can be traced to each component

All values in US\$ billion; no unrecorded buffer or rescue financing is added.

Table 21. The 365-day stressed result can be traced to each component

Component	Amount	Calculation
Available cash / deposits	2.0000	Opening cash; fully available.
Available securities	3.1500	Free securities 3.5; fully available;10% execution haircut.
Available gold	1.2852	Free gold 2.7; price factor 70%; availability 80%; net-sale factor 85%.
Available other assets	0.4500	Other assets 1.0;50% available;10% haircut.
Net cash flows	−8.0000	Receipts 1.5; scheduled payments 8.0; contingent payments 1.5.
Net headroom	−1.1148	Sum; conditional shortfall.

Source: IDER methods [\[S12\]](#).

The required inflow realisation can be solved rather than guessed

Hold all other stressed 365-day assumptions fixed; no probability of breach is estimated.

INFLOWS NEEDED

US\$2.615bn

To reach zero 365-day headroom.

SHARE OF CONTRACTED INFLOWS

87.16%

Compared with 50% in the stress.

90-DAY ADDITIONAL DRAIN

US\$1.720bn

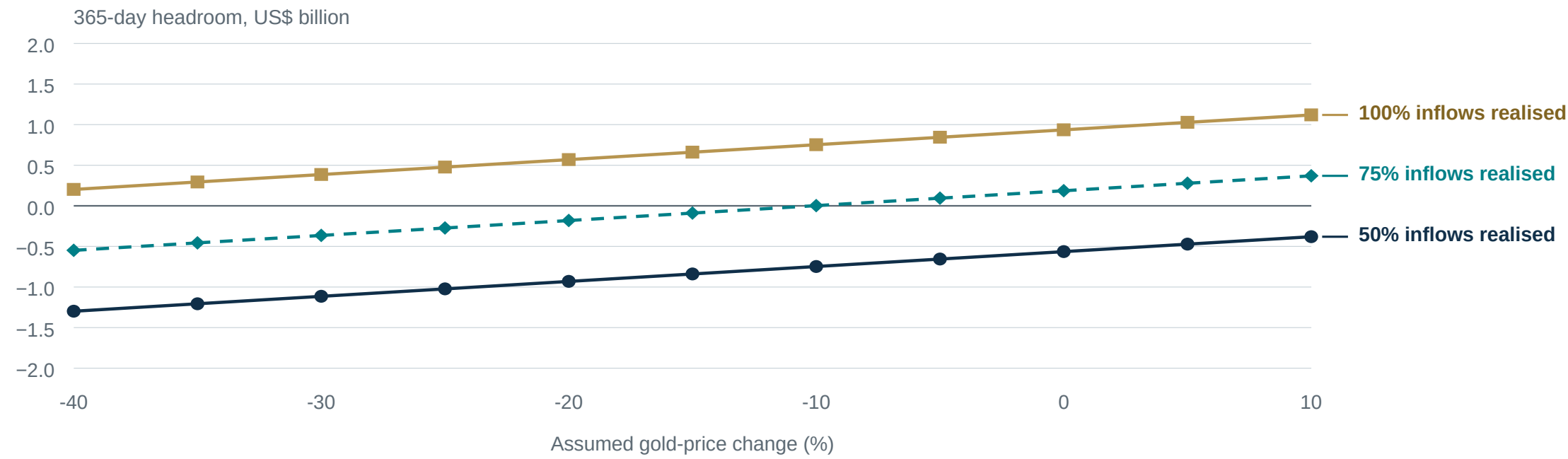
Exhausts the model's 90-day buffer.

A reverse boundary measures scenario tolerance. It is not a forecast, a legal threshold or a recommended reserve level.

Gold prices and receipt delays jointly change the cash buffer

Illustrative stressed 365-day liquidity; horizontal axis is assumed gold-price change (%).

Figure 18. Annual headroom under joint price and receipt-realisation assumptions



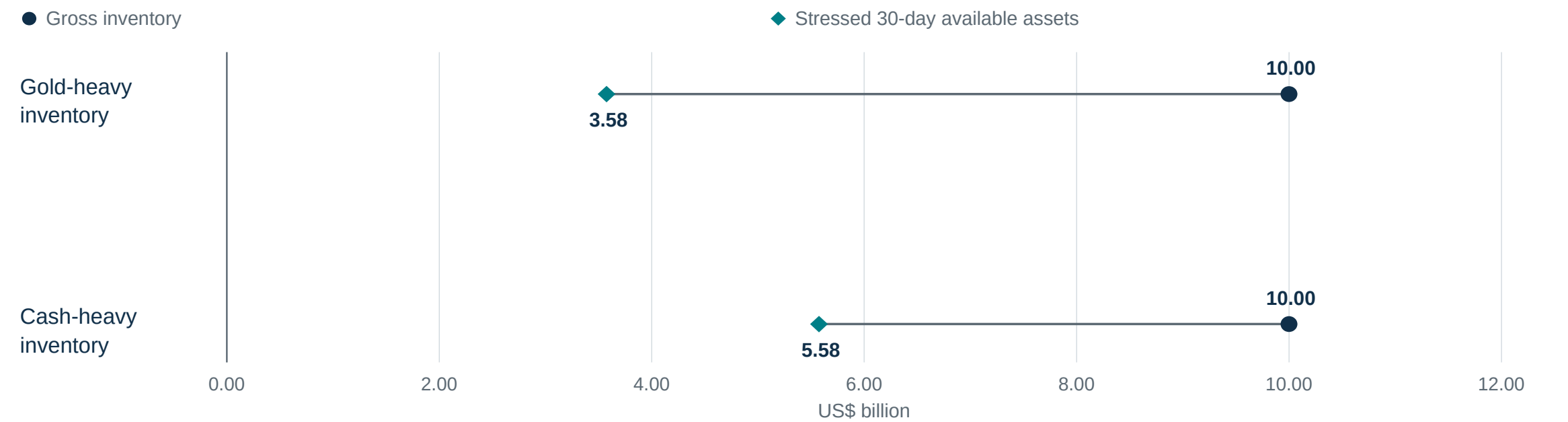
Source: IDER methods [\[S12\]](#).

Note: Other parameters fixed. Conditional lines are not confidence bands, forecasts or estimated Ghana policy responses.

Equal opening gross inventories can produce different 30-day capacity

Hypothetical reallocation of US\$2bn from unencumbered gold to cash; restrictions otherwise unchanged.

Figure 19. Same gross inventory, different assumed near-term asset availability



Source: IDER methods [\[S12\]](#).

Note: Not a portfolio recommendation: income, diversification, market impact and reserve-management costs are not optimised.

A balanced aggregate can hide a currency-specific shortage

Illustrative foreign-currency resources and payments, expressed in US\$ equivalent only for display.

Table 22. A balanced aggregate can hide a currency-specific shortage

Currency bucket	Available	Payments	Gap
US dollars	2.0	3.0	-1.0
Euro assets/payments, USD equivalent	2.0	1.0	+1.0
Aggregate	4.0	4.0	0.0

Source: IDER methods [\[S12\]](#).

Note: The euro surplus cures the dollar shortage only if conversion and settlement are feasible before payment.

Reserve availability, central-bank equity and fiscal spending space differ

A revaluation gain or loss can affect one measure without the same cash effect in another.

Liquidity

Can the required currency be delivered on time from unencumbered assets and reliable receipts?

Solvency / capital

What is the valuation of assets relative to liabilities under the relevant accounting and economic framework?

Fiscal authority

Who legally owns or may use the resources? A reserve asset is not automatically an unallocated budget appropriation.

Exact valuation accounting is not a causal policy evaluation

Measurement is strengthened by new empirical accounting (pp.79–82); causal identification requires a separate design (pp.87–90).

Table 23. Exact valuation accounting is not a causal policy evaluation

Evidence class	Completed in this report	Causal boundary
Observed public records	Stocks, cover, current-account components, public cash and dated projection lines	Reporting, valuation and scope limitations remain.
Reproduced arithmetic	Growth, stock–flow, current-account, cash-timing and symmetric denominator bridges	An identity does not identify the policy causing the change.
Illustrative scenario	Horizon, haircut, price and inflow sensitivities	Conditional results do not identify actual national vulnerability.
Causal policy effects	Not estimated	Identification gates specified; no valid instrument or actual randomised comparison obtained.

Sources: IMF IRFCL [\[S07\]](#); IMF reserve guidelines [\[S09\]](#); IDER methods [\[S12\]](#).

Reserve accumulation and official sales respond to market pressure

Missing balance-sheet information is a coverage problem, not a statistical zero.

Table 24. Reserve accumulation and official sales respond to market pressure

Threat	Research safeguard	What is not claimed
Policy reaction	Separate routine intermediation and unexpected operations; audit concurrent news	Higher sales during depreciation prove effectiveness or failure.
Gold-price common shock	Separate quantity, revaluation, receipts and downstream conversion	A raw gold-price coefficient isolates reserve-management policy.
Missing / selected reports	Full custodian and counterparty roster; missing flags, reconciliation and disclosure	Available accounts represent the full reserve and obligation universe.
Post-treatment controls	Define total versus direct policy effects before controlling for reserves or rates	Lagged variables or robust standard errors eliminate endogeneity.

Sources: Nolin / IMF (2026) [\[S05\]](#); IMF IRFCL [\[S07\]](#); IDER methods [\[S12\]](#).

Rounding envelopes are not statistical confidence intervals

Assume reported cover rounded to the nearest 0.1 month and reserve stocks to their displayed precision.

Table 25. Rounding envelopes are not statistical confidence intervals

Source measure / date	Implied imports (US\$bn)	Conditional rounding envelope
Headline gross reserves, 2024	26.672	[26.350, 27.001]
Headline gross reserves, 2025	29.114	[28.861, 29.372]
Programme gross reserves, 2024	32.590	[31.922, 33.286]
Programme gross reserves, 2025	35.718	[35.276, 36.172]

Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#).

Note: The envelope excludes source revisions, reporting omissions, forecast error and disagreement over the reserve perimeter.

Test numerical consistency and assumptions at the correct level

The checks do not certify the original regulatory submissions or external policy effectiveness.

Table 26. Test numerical consistency and assumptions at the correct level

Test	Completed result	Remaining limitation
Reserve and cover identities	Exact bridges and high-precision ratio checks	Source definitions, preliminary outturns and rounded cover.
Gold price–quantity accounting	Components reconcile exactly to value change	Inputs are illustrative, not Ghana bullion data.
Horizon stress and reverse boundary	Monotone availability, no repeated assets, exact break-even inflow	No actual payment ledger or endogenous response.
Source consistency	Material incompatible entries retained in exception register	Primary images checked; source inconsistencies retained.
Reproducibility	Same-input scripts regenerate numerical tables and editable figures	Repeatability is not source authentication or causality.

Source: IDER methods [\[S12\]](#).

Track stocks, usability and drains in the same release

Proposed institutional indicators—not achieved targets, existing legal minima or exchange-rate goals.

Table 27. Track stocks, usability and drains in the same release

Indicator	Definition	Cadence / proposed owner
Reserve bridge	Headline → eligible gross → NIR, with each adjustment identified	Monthly; BoG statistics + reserve operations.
Gold reconciliation	Ounces, unit price, eligibility, realised cash and valuation bridge	Monthly; BoG + GoldBod + custodians.
Operational headroom	By currency: collectible resources less unique scheduled and stressed drains	Weekly 13-week ladder; BoG + MoF Treasury.
Coverage and quality	Share of gross value linked to custodian/obligation records; missing reported separately	Every release; independent data checker.
Adequacy dashboard	Named import base; remaining-maturity debt; other risk indicators	Quarterly; MoF + BoG research.

Sources: IMF TMU (2026) [\[S03\]](#); IMF IRFCL [\[S07\]](#); IDER methods [\[S12\]](#).

Build a 13-week ledger before adding forecast sophistication

Each record has a source, date, currency, legal entity and probability-free status label.

Table 28. Build a 13-week ledger before adding forecast sophistication

Block	Minimum fields	Control
Opening assets	Custodian, instrument, currency, free value, market price, settlement lag	One asset ID; restricted portion separately.
Contracted inflows	Counterparty, value date, amount, conditions, actual collection	Expected versus received; no repeat of opening-asset maturities.
Scheduled payments	Creditor, due date, currency, paid flag, principal/interest, source of funds	Mark early payments and refinancings.
Contingent payments	Trigger, expiry, collateral, guarantee terms, stress rule	Not mixed into actual outturns.
Exceptions	Late, unverified, disputed, netted or missing record	Resolve material unmatched values before release.

Sources: IMF IRFCL [\[S07\]](#); IMF (2013) [\[S08\]](#); IDER methods [\[S12\]](#).

Publish complementary measures rather than one headline verdict

The disclosure objective is useful distinctions—not disclosure of sensitive live dealing positions.

MoF and Treasury

Align foreign-currency debt, public imports, official receipts and reserve transfers. Report cash needs and fiscal costs separately.

Bank of Ghana

Show reserve eligibility, valuation and short-term drains on consistent dates. Distinguish public aggregate disclosure from confidential supervision.

Regulators and partners

Evaluate the matched risk perimeter, contingent support and statistical revisions before comparing countries or conditioning assistance.

National reserves are context—not a substitute for an entity’s cash plan

Implications depend on the user’s contractual exposure and financing arrangements.

Table 29. National reserves are context—not a substitute for an entity’s cash plan

Audience	Action supported by this report	Avoid
Importers, MSMEs and associations	Maintain invoice and funding dates; compare executable quotes and settlement terms	Assuming headline import cover guarantees bank FX on demand.
Exporters	Map receipts, local conversion, foreign costs and debt service	Treating reserve accumulation as the same as exporter cash generation.
Banks and asset managers	Match own liquid currency assets and customer obligations; stress counterparties	Transferring a national stock ratio into a bank’s risk limit.
Pensions, insurers and retirees	Match assets to liability currency, liquidity and spending horizon	A universal recommendation to hold gold, dollars or cedis.
DFIs / institutional investors	Request cash-flow, commitment and country-transfer risk evidence	Treating an adequacy statistic as a guarantee of transfer or repayment.

Source: IDER methods [\[S12\]](#).

Prioritise controls that do not depend on a disputed forecast

Proposed programme starts after access agreements; targets are research quality controls.

Table 30. Prioritise controls that do not depend on a disputed forecast

Period / lead	Deliverable and baseline	Proposed acceptance / resources
Days 0–30: BoG + MoF	Define perimeter and reconcile source records; current public bridge incomplete	Document ≥95% of captured gross value; treasury/statistics time and secure linkage.
Days 31–60: operations + risk	Build currency/horizon ledger; no verified public operational baseline	Resolve all material duplications; ≥98% mandatory-field completion; risk and IT input.
Days 61–90: IDER + independent reviewer	Replay calculations, review exceptions and publish a dated briefing	Unresolved gaps visible; zero undocumented data changes; peer review and disclosure approval.

Source: IDER methods [\[S12\]](#).

Note: Completeness percentages use an explicitly stated captured-data denominator; they do not prove national coverage.

Sustain the data system and review the cost of reserve accumulation

Actions are conditional on mandate, resources and confidentiality protections.

Table 31. Sustain the data system and review the cost of reserve accumulation

Horizon	Proposed action / lead	Indicator and review trigger
3–12 months	BoG/MoF: versioned public aggregate liquidity release; improve payment calendars	Monthly issue with history, revisions and exceptions; investigate missed settlements.
3–12 months	Reserve manager: test custody, mobilisation and market depth under stress	Document execution-lag/haircut evidence; reassess after counterparty or market changes.
1–3 years	Authorities: durable reporting standards and cost-risk evaluation of accumulation	Independent review of composition, financing and fiscal/quasi-fiscal costs.
Ongoing	IDER/research partners: update evidence, not just reporting dates	Release only after source and arithmetic checks; preserve prior vintages.

Sources: IMF reserve guidelines [\[S09\]](#); IDER methods [\[S12\]](#).

Use clear headlines without turning a reserve measure into a guarantee

Every headline should state its date, source, definition and level of inference.

Table 32. Use clear headlines without turning a reserve measure into a guarantee

Supported statement	Unsupported interpretation
Headline GIR reached US\$13.829bn at end-2025.	US\$13.829bn was immediately available for discretionary spending.
Programme cover was 4.0 months on the stated prospective basis.	All published cover ratios use the same import bill.
A US\$532m stock-flow difference remains unallocated.	Gold valuation alone generated US\$532m of new cash.
GoldBod reported US\$646.59m made available to BoG in August.	Reserve stocks necessarily rose by exactly that amount.
The hypothetical annual stress has negative headroom.	Ghana has a verified national payment shortfall of that amount.

Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#); GoldBod (Aug 2026) [\[S06\]](#); IDER methods [\[S12\]](#).

Preserve material discrepancies rather than hiding them in a residual

Selected unresolved items; the complete register is in the companion package.

Table 33. Preserve material discrepancies rather than hiding them in a residual

Issue	Treatment retained	Effect on the conclusion
Current NIR stock and short-horizon drains not recovered	No national point estimate of operational free FX	Near-term liquidity verdict remains conditional.
Programme reserve flow and projection differences	Table 5 retained; Table 6 alternatives disclosed	No fully reconciled gold-valuation or payment-account attribution.
Headline / programme definitions and implied imports differ	Compare both stock and denominator	Published months are not directly like-for-like.
Primary financial source images now verified	Primary images inspected; source-table exceptions documented	Transcription verified; underlying source submissions not audited.
No refreshed matched 2026 asset/liability dataset incorporated	Preserve this edition’s frozen observation window	Latest stock update used here is end-May programme GIR.

Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#); IMF TMU (2026) [\[S03\]](#).

Calculation definitions used throughout the report

Monetary data retain their source units; US\$ billion displays divide US\$ million by 1,000.

Table 34. Calculation definitions used throughout the report

Quantity	Calculation procedure	Interpretation
Stock growth	Divide closing stock by opening stock; subtract one and express as a percentage.	Not an investment return or a cash-flow measure.
Import cover	Multiply the reserve stock by 12; divide by the stated annual import bill.	State goods/services, period and vintage.
Implied imports	Multiply reserves by 12; divide by the published months of cover.	Algebraic diagnostic from rounded cover.
Gold value change	Value the price change at average ounces and the quantity change at average price; add the two components.	Exact symmetric price–quantity identity.
Available resources	Apply price, date-specific availability and net-sale factors to each unencumbered asset; aggregate once.	Conditional cumulative asset capacity.
Liquidity headroom	Add collectible inflows to available assets; deduct each unique scheduled and triggered payment once.	Deduct each liability once; preserve currency and date.

Source: IDER methods [\[S12\]](#).

The reserve and cover comparison retains the original values

Observed source rows reproduced; separate programme prices and current-market values where applicable.

Table 35. The reserve and cover comparison retains the original values

Source record	Date	Value	Unit / status
Headline GIR / cover	End-2024	9,112.8 / 4.1	US\$m / months; MoF comparator
Headline GIR / cover	End-2025	13,829.2 / 5.7	US\$m / months; reported
Programme GIR / cover	End-2024	6,518 / 2.4	US\$m / months; IMF actual
Programme GIR / cover	End-2025	11,906 / 4.0	US\$m / months; IMF preliminary
Programme GIR	End-May 2026	12,200	US\$m; rounded monitoring observation
Programme NIR change	2025 / 2026Q1	+3,232 / -132	US\$m; cumulative since each January 1

Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#); IMF TMU (2026) [\[S03\]](#).

Projected obligations are not converted into invented daily records

Calendar-year IMF Table 8 entries and Table 5 reserves; US\$ million.

Table 36. Projected obligations are not converted into invented daily records

Year	External debt service	Of which IMF obligations	Programme GIR projection
2026	3,630	366	14,037
2027	4,307	333	16,246
2028	4,126	358	18,813
2029	4,168	446	21,591
2030	4,418	537	23,366

Source: IMF (2026) [\[S02\]](#).

Note: Source coverage differences remain unresolved. IMF obligations are not added again to the external-service total.

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

The companion archive provides source-labelled inputs, scenario parameters, code and verification records.

Table 37. Inputs, calculations and the report’s data can be checked separately

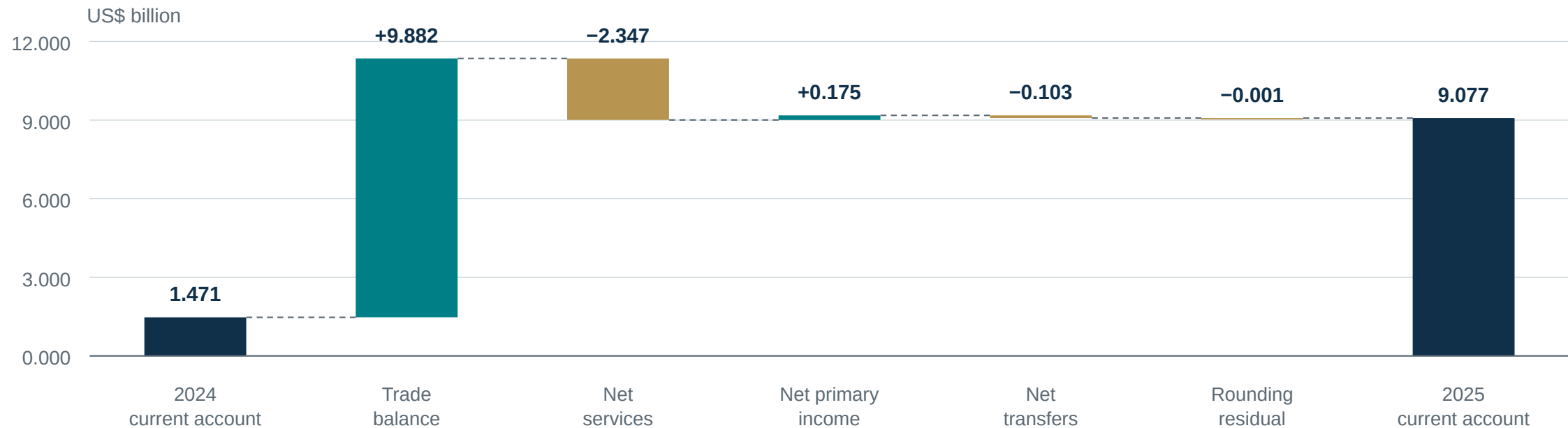
Layer	Supplied record	Boundary
Provenance	Source IDs, original table/paragraph locations, observation status and package-file hashes	Primary table-image checks, not an audit of regulatory returns.
Arithmetic	Exact ratios, symmetric identities, cumulative cash and reverse-stress checks	Conditional on inputs and stated conventions.
Reproducible figures	Editable vector figures generated from executed full-precision numerical outputs	Offline regeneration, not a live market feed.
Publication	Page, table and figure registers; author’s notes; rendered review	No institutional or formal accessibility certification.
Next-stage data	Empty asset, obligation, gold and cash-ledger templates	No confidential records or invented counterparties.

Source: IDER methods [\[S12\]](#).

The 2025 current-account improvement is dominated by the trade balance

IMF Table 5: 2024 actual versus 2025 preliminary; source-vintage accounting, not a causal model.

Figure 20. The 2025 current-account improvement is dominated by the trade balance



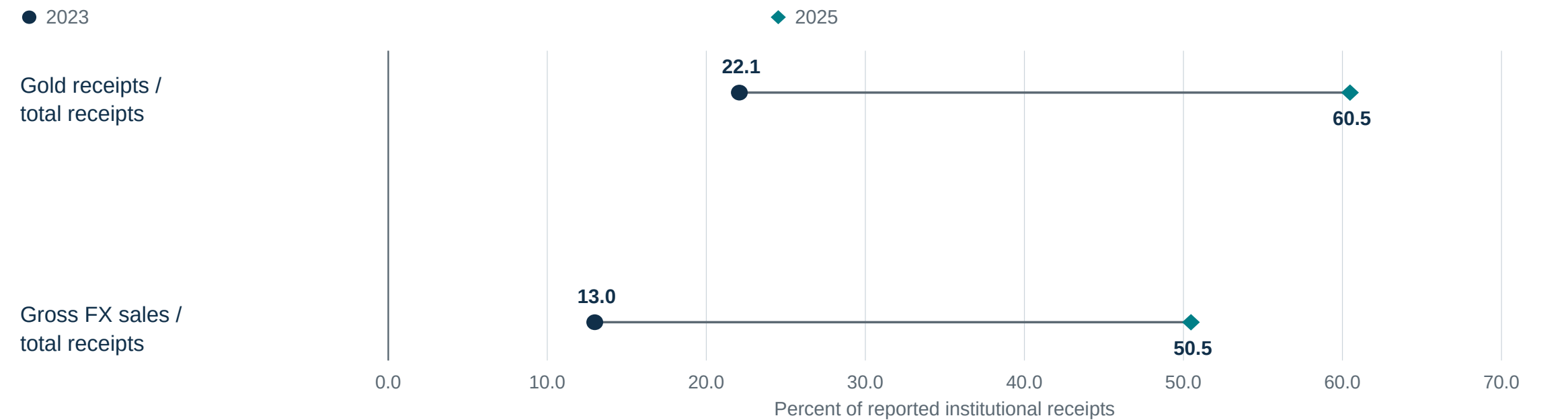
Sources: IMF (2026) [\[S02\]](#); IDER methods [\[S12\]](#).

Note: Total increase: US\$7.606bn. Components reconcile after a -US\$0.001bn displayed-source rounding residual; no observation is invented.

Gold became a larger share of BoG’s reported FX receipts

Ratios calculated from Nolin’s rounded institutional-flow figures; not the gold share of the reserve portfolio.

Figure 21. Gold became a larger share of BoG’s reported FX receipts



Sources: Nolin / IMF (2026) [\[S05\]](#); IDER methods [\[S12\]](#).

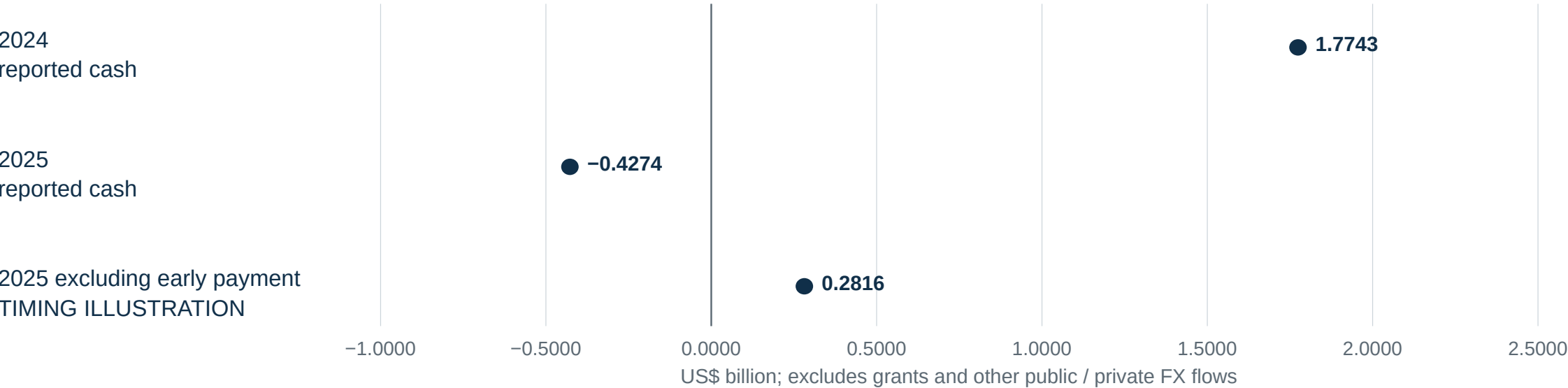
Note: 2025 receipts include US\$1.1bn of source-reported net bullion-sale gains. Gross sales are not net intervention or a measure of policy effectiveness.

The public external cash balance is sensitive to early debt payment

External loan disbursements less external debt-service payments; MoF public-debt perimeter only.

Figure 22. The public external cash balance is sensitive to early debt payment

SOURCE / DERIVED



Sources: MoF (2026) [\[S01\]](#); IDER methods [\[S12\]](#).

Note: Removing the identified US\$709m early payment changes 2025 by exactly US\$0.709bn; it does not revise the official cash outturn.

Both reporting choices contribute to the 1.70-month cover gap

Symmetric allocation averages the two possible orderings; the endpoints propagate stated source rounding.

Figure 23. Both reporting choices contribute to the 1.70-month cover gap

CONDITIONAL BOUNDS — NOT CONFIDENCE INTERVALS



Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#); IDER methods [\[S12\]](#).

Note: Numerator contribution: 42.3%; implied denominator: 57.7%. These are accounting shares, not causal effects or shares of usable reserves.

Source-image verification resolves access gaps—not source inconsistencies

Checked against original financial table images on 22 September 2026; preserve the 21 September information cut-off.

Table 38. Source-image verification resolves access gaps—not source inconsistencies

Source / location	Observed discrepancy	Treatment in this edition
MoF Table 8.7, PDF p.44	2025 printed principal subtotal 356.8m; service less interest implies 1,109.2m; narrative 1,109.3m.	Do not use the printed principal subtotal. Retain verified total service 1,799.4m; seek official correction.
IMF Tables 5 /6, pp.56–57	2025 reserve flows 4,856m versus 3,979m; 2026 reserve projections 14,037m versus 14,070m.	Keep source concepts separate; no forced balancing entry or silent vintage substitution.
Nolin p.11 / IMF annex p.75	2023 gross FX sales 1.0bn versus 0.5bn.	Receipt-mix comparison uses Nolin only; scope difference remains unresolved.
MoF Table 8.6 / IMF Table 5	Rounded components can differ slightly from published totals.	Retain totals and expose small arithmetic residuals; do not manufacture new transactions.

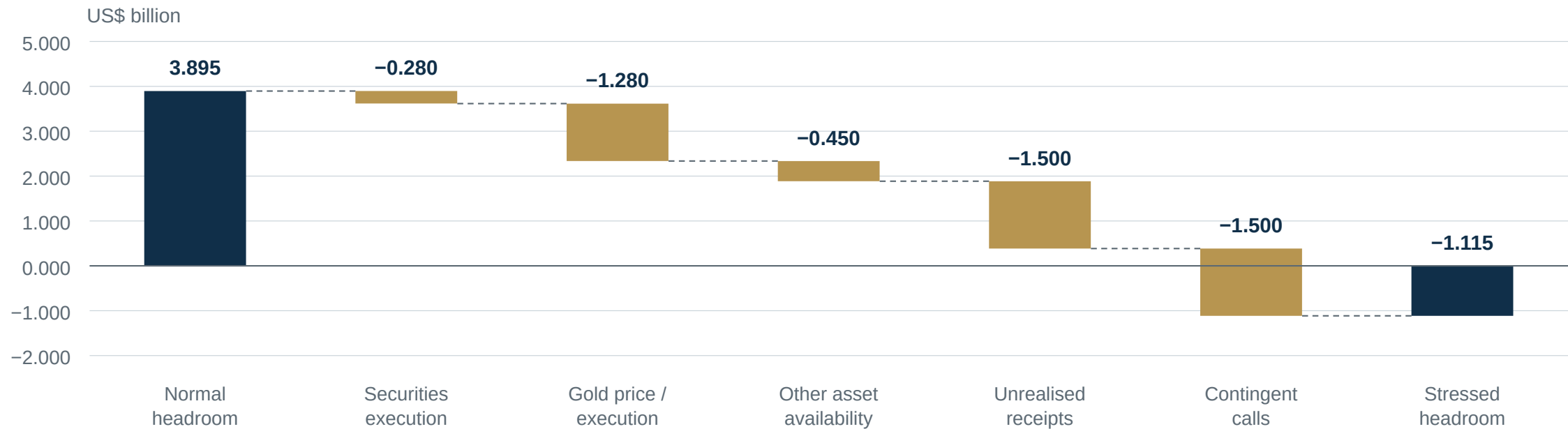
Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#); IMF adequacy (2026) [\[S04\]](#); Nolin / IMF (2026) [\[S05\]](#).

Note: The source audit authenticates what these documents display. It is not an audit of the underlying regulatory, custodian or transaction records.

The annual stress deterioration can be attributed without a residual

Same hypothetical opening inventory and obligations; all five changes are imposed assumptions.

Figure 24. The annual stress deterioration can be attributed without a residual



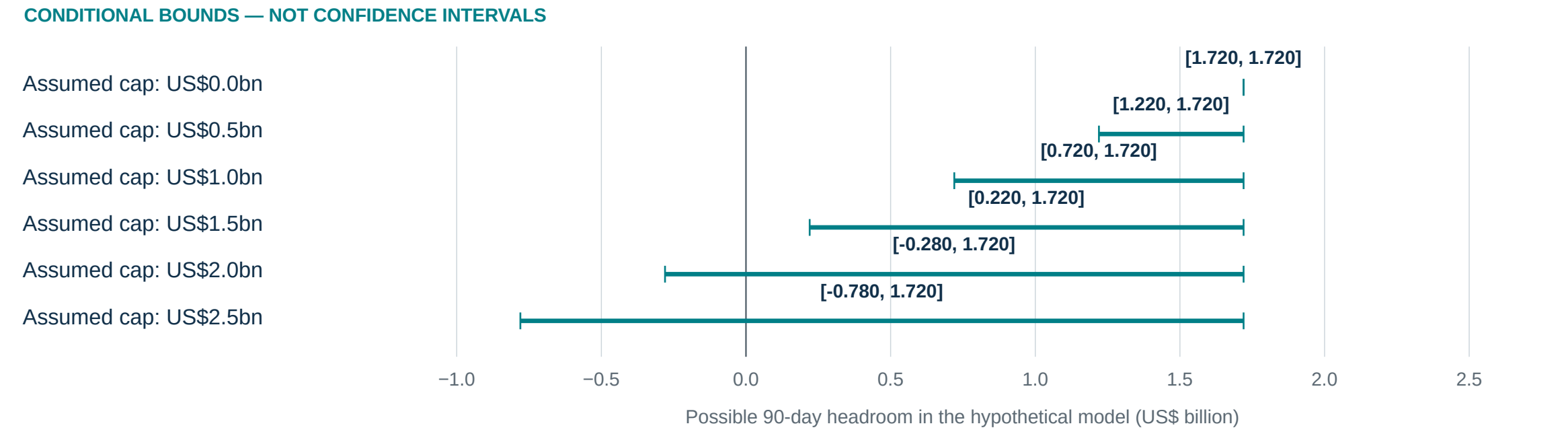
Source: IDER methods [\[S12\]](#).

Note: US\$5.0098bn total deterioration: securities 0.2800; gold 1.2798; other assets 0.4500; unrealised receipts 1.5000; contingent calls 1.5000.

Unobserved adverse exposure can overturn a positive model buffer

Assume omitted net adverse cash exposure lies between zero and the cap shown; no national exposure cap is estimated.

Figure 25. Unobserved adverse exposure can overturn a positive model buffer



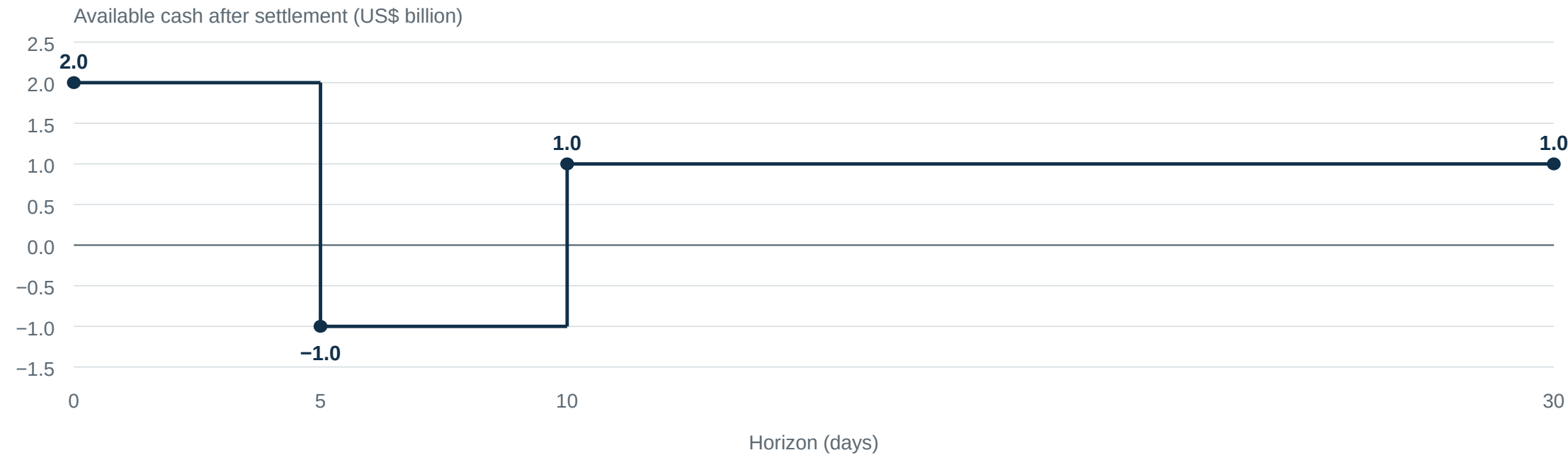
Source: IDER methods [\[S12\]](#).

Note: The model's tipping point is US\$1.7201bn. Without a defensible exposure cap, the public data do not supply a finite national lower bound.

A positive month-end balance can conceal a payment-date shortfall

Synthetic example: opening cash US\$2bn; day 5 payment US\$3bn; day 10 receipt US\$2bn. No borrowing or overdraft assumed.

Figure 26. A positive month-end balance can conceal a payment-date shortfall

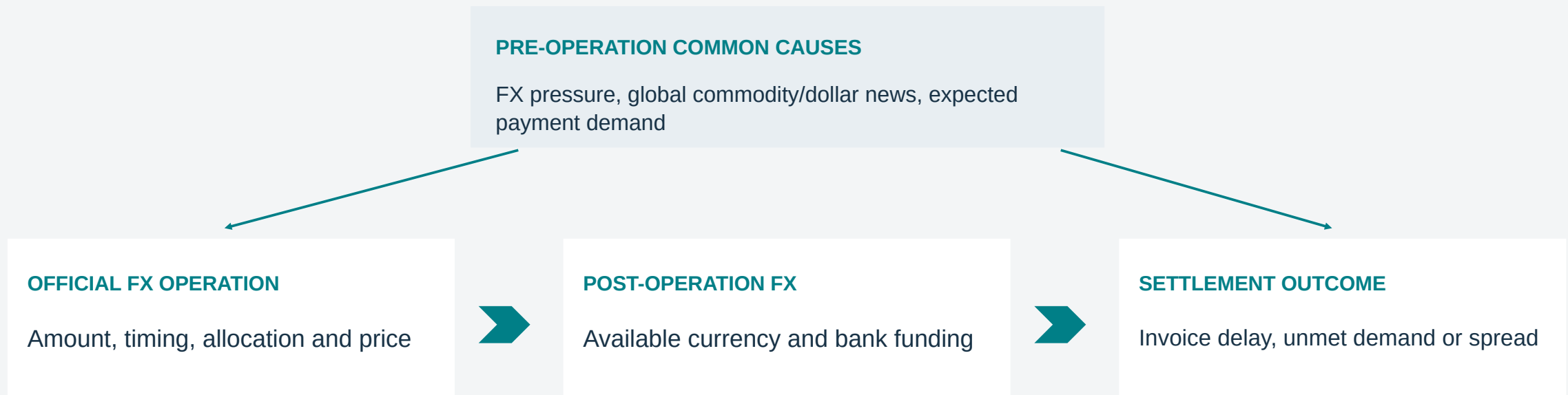


Source: IDER methods [\[S12\]](#).

Note: Day 5 cash is -US\$1bn even though day 30 cash is +US\$1bn. The negative balance denotes an unmet payment, not authorised overdraft financing.

FX pressure can influence both official operations and subsequent outcomes

A causal graph identifies the required design problem; it does not itself identify a treatment effect.



TOTAL-EFFECT RULE

Do not mechanically control for post-operation FX availability: it can be a mediator. Address pre-operation common causes and assignment first.

Specify the counterfactual before choosing an estimator

Proposed future study; the report’s two matched annual reserve observations cannot implement these gates.

Table 39. Specify the counterfactual before choosing an estimator

Design component	Prespecified requirement	Release rule
Target estimand	Effect of a policy-independent change in official FX supplied on settlement delay over 1,5 and 20 business days.	Specify whose invoices and which bank/currency; do not equate this with the effect of higher GIR.
Assignment / instrument	Document a genuinely exogenous allocation feature or shock; assess direct paths and anticipation.	No valid instrument is established here. Gold-price changes and lagged sales are not automatic instruments.
Estimation if gates pass	High-frequency event or local-projection analysis; IV only with defensible relevance and exclusion.	Use weak-instrument-robust inference when needed; cluster for actual assignment and common-date shocks.
Falsification / robustness	Pre-event outcomes, concurrent-news audit, alternative windows and sample definitions; preregister primary outcomes.	Placebo success does not prove exclusion. With inadequate support, report description or bounds, not causality.

Sources: Hernán et al. (2018) [\[S13\]](#); Adler et al. / IMF (2015) [\[S15\]](#); IDER methods [\[S12\]](#).

Note: A statistically significant association is not enough. No fitted causal model, simulated standard error or invented transaction series is included.

A complete reporting frame comes before any selection adjustment

Asset and liability records should form an auditable census; reporting completeness is not a random sample.

Table 40. A complete reporting frame comes before any selection adjustment

Problem	Required treatment	What remains conditional
Unknown reporting universe	Create a custodian, instrument, creditor and settlement roster; reconcile value and record counts.	≥95% of captured value is not 95% of national exposure. Missing creditors can dominate the result.
Missing at random claim	Use weighting or imputation only with a defensible conditional-observation model and overlap.	Observation propensities are not estimated here; these procedures are not applied to missing liabilities.
Missing not at random	Use explicit exposure caps, adverse-case bounds and tipping-point sensitivity; seek counterpart confirmations.	The executed example on p.85 is conditional on an assumed cap, not an identified Ghana range.
Selective events / survivorship	Retain failed, cancelled and delayed settlements; freeze event inclusion rules before examining outcomes.	A model of successful trades alone cannot establish market-wide effects.

Sources: Sun et al. (2016) [\[S14\]](#); IDER methods [\[S12\]](#).

Note: Unobserved confounding and non-random reporting cannot be certified as eliminated with the available aggregate inputs.

Test whether the cash-ledger upgrade improves settlement performance

Proposed cluster-randomised rollout of a non-safety-critical workflow improvement—not an experiment on national reserve policy.

Define the units

List all eligible operational teams or processing units. Establish baseline volume, delay and currency mix; plan power using actual cluster counts and dependence.

Randomise the rollout

Randomly assign upgrade start dates within comparable blocks. Preserve mandatory controls and safety-critical support. Record compliance, spillovers and all assignments.

Evaluate the effect

Prespecify late settlements per 100 obligations and amount-weighted delay separately. Estimate intention-to-treat effects using design-based inference and report costs.

No trial has been run. Few units, spillovers or selective reporting may prevent informative inference; the design must be approved before implementation.

The arithmetic has been independently recomputed; the inference limit remains

Two code paths: original numerical implementation and a separate high-precision Decimal calculation for the six scenarios.

Table 41. The arithmetic has been independently recomputed; the inference limit remains

Completed test	Result	Interpretation
Source and units	Primary key table images checked; source, date, unit, status and exception records retained.	Verifies transcription; does not audit confidential source submissions.
Six scenario combinations	Independent Decimal assets and headroom agree with the numerical implementation.	Conditional on supplied portfolio and cash-flow assumptions.
Accounting closure	Reserve, cover, current-account, public-cash, stress and gold-factor bridges reconcile.	Small source-rounding residuals are shown rather than forced into a policy driver.
Rounding and bounds	16 endpoint combinations and 729 grid cases checked for the cover decomposition.	Rounding envelope only; no sampling, forecast or causal confidence coverage.
Date / duplication logic	Unique synthetic cash IDs; monotone availability ceilings; a dated counterexample tests endpoint sufficiency.	An actual Ghana ledger is still required for national daily feasibility.

Source: IDER methods [\[S12\]](#).

Note: The machine-readable audit distinguishes repeated parameter-grid checks from independent empirical evidence; no p-values are reported.

What the additional empirical analysis changes for decisions

These conclusions draw on observed source records or clearly labelled conditional calculations—not unsupported policy attribution.

Table 42. What the additional empirical analysis changes for decisions

New evidence	Measured result	Business / policy use
External-flow accounting	Current account improved US\$7.606bn; trade contributed US\$9.882bn, partly offset by services.	Track several external-flow channels; do not assign the current-account gain wholly to official usable reserves.
Institutional receipt concentration	Gold share of Nolin’s BoG receipt series:22.1% to 60.5%.	Stress receipt concentration and cash-conversion timing; this is not the gold share of GIR.
Public cash timing	2025 narrow net cash–US\$0.4274bn; excluding the early payment gives+US\$0.2816bn.	Match already-paid flags and actual dates before declaring an upcoming financing need.
Import-cover comparability	57.7% of the central 1.70-month gap is allocated to the implied denominator.	Request the numerator, import scope, forecast vintage and rounding convention in every adequacy statement.

Sources: MoF (2026) [\[S01\]](#); IMF (2026) [\[S02\]](#); Nolin / IMF (2026) [\[S05\]](#); IDER methods [\[S12\]](#).

Note: A stronger accounting diagnosis supports better decisions; it does not identify an exchange-rate effect, default probability or investment return.

Catalogue of models, equations and identifying assumptions

A separate technical reference: what was calculated, what was assumed and what has not been estimated.

E01–E14

ACCOUNTING AND BENCHMARKS

Reserve stocks; NIR definitions; gold; receipts; current account; public cash; import cover; rounding; debt coverage.

pp. 95–101

E15–E24

CONDITIONAL MODELS AND CONTROLS

Available assets; cash headroom; reverse stress; composition; dates and currencies; missing exposure; quality targets.

pp. 102–106

P01–P07

PROSPECTIVE RESEARCH ONLY

Counterfactual targets; local projections; instruments; selection weighting; imputation; workflow outcomes and rollout.

pp. 107–110

IMPORTANT DISTINCTION

No econometric causal model has been fitted in this report. An accounting identity is exact given its inputs; a stress model is conditional on imposed assumptions. Definitions and quality targets are not measured estimates. Prospective equations formalise the research designs already discussed on pages 87–90.

Common axioms, notation and limits of interpretation

Each model inherits the relevant A1–A6 conditions below; additional identification assumptions are stated separately.

A1 Match the measurement

Use the same date, units, currency, institutional scope and valuation basis before adding or comparing values. Keep observations, projections and scenarios separate.

A3 Distinguish arithmetic from inference

Use full precision, then round for display. A rounding envelope is a conditional value range—not a statistical confidence interval or a forecast-error band.

A5 Respect every currency and date

Horizon totals are cumulative, not additive tranches. Test each intervening payment date; a positive aggregate or closing balance need not imply feasible settlement.

A2 Reconcile without double counting

Track unique asset, liability and cash-flow IDs. An asset sale, maturity and its proceeds cannot all be treated as independent resources; retain unresolved residuals.

A4 State imposed scenario assumptions

Availability, haircuts, price changes and receipt fractions are assumptions in a deterministic illustration. There are no assigned shock probabilities or endogenous policy responses.

A6 Define the reporting universe

Captured records are not automatically representative of all exposure. Missingness is not zero. Weighting, imputation and bounds require their own support and identification conditions.

NOTATION

Δ = difference; $\bar{}$ = average; Σ = sum; $\hat{}$ = statistical estimator; $E[\cdot]$ = expectation. Superscripts H/P distinguish headline/programme; N/S distinguish normal/stress. Unlabelled monetary scenario values are US\$ billion.

Reserve stocks and the net-reserve definition

E01: report pp. 18, 19, 20, 76 | E02: report pp. 15, 16, 22, 23, 24

E01 Reserve growth and perimeter comparison

REPRODUCED ACCOUNTING

$$\Delta R = R_1 - R_0, \quad g_R = 100(R_1/R_0 - 1) \quad (\text{E01.1})$$

$$G_t = R_t^H - R_t^P, \quad s_t = 100R_t^P/R_t^H \quad (\text{E01.2})$$

R: reserve stock; H/P: headline/programme gross. G: scope gap; g and s: percentages. Stocks use US\$ billion.

ASSUMPTIONS / AXIOMS

A1–A3. Compare matched dates and unchanged definitions within each growth rate; R_0 and R^H must be positive. Retain each source's status and precision.

The gap is not NIR, total reserve liabilities or available cash.

E02 NIR, NFA and cumulative changes

DEFINITIONS • STOCK NOT RECONSTRUCTED

$$NIR_t = A_t^{elig,*} - \sum_{j \in \mathcal{L}_{TMU} \cup \mathcal{L}_{IMF}} b_{jt}^* \quad (\text{E02.1})$$

$$NFA_t = FA_t - FL_t \quad (\text{E02.2})$$

$$\Delta NIR_{y,t} = NIR_t - NIR_{y,0} \quad (\text{E02.3})$$

A: eligible assets; b: unique liability balances; *: programme valuation. FA/FL: balance-sheet foreign assets/liabilities; y,0: annual base.

ASSUMPTIONS / AXIOMS

A1–A3. Apply the full TMU liability set, including qualifying derivatives and FX deliverable within 12 months; IMF credit spans maturities. Exclude SDR allocations from the IMF-credit deduction and deduplicate overlaps.

A cumulative change does not reveal the current NIR level.

Stock–flow reconciliation and gold valuation

E03: report pp. 31, 32, 45, 74, 83 | E04: report pp. 24, 26, 75

E03 Reserve stock–flow residual

REPRODUCED ACCOUNTING

$$\Delta R^P = T + U, \quad U = \Delta R^P - T \quad (\text{E03.1})$$

$$U = 5.388 - 4.856 = 0.532 \text{ bn} \quad (\text{E03.2})$$

T: recorded BOP reserve acquisition, expressed as positive accumulation. U: unallocated stock–flow difference.

ASSUMPTIONS / AXIOMS

A1–A3. Align time, units and sign conventions. U can contain valuation, scope and other adjustments; without a reconciled ledger its components cannot be separated.

The alternative Table 6 flow is retained, not silently substituted.

E04 Gold valuation and factor accounting

EXECUTED ILLUSTRATION / DEFINITION

$$V_t = P_t Q_t, \quad V_t^{prog} = P^* Q_t \quad (\text{E04.1})$$

$$\Delta V = \bar{Q} \Delta P + \bar{P} \Delta Q \quad (\text{E04.2})$$

$$\bar{Q} = (Q_0 + Q_1)/2, \quad \bar{P} = (P_0 + P_1)/2 \quad (\text{E04.3})$$

P: US\$/fine troy ounce; Q: fine ounces; V: US\$. Convert units before displaying US\$ billion; * is the fixed programme price.

ASSUMPTIONS / AXIOMS

A1–A3. Same eligible bullion perimeter. Two-factor identity splits the interaction equally. At a fixed programme price, price-only market revaluation does not change programme gold value.

Illustration: US\$0.33bn price + US\$0.33bn quantity, not Ghana data.

Gold concentration, receipts and allocations

E05: report pp. 27 | E06: report pp. 29, 30, 80, 83

E05 Gold-price concentration sensitivity

EXECUTED ILLUSTRATION

$$\text{Loss}(\%) = 100 s_g d \quad (\text{E05.1})$$

$$R^{\text{shock}} = R_0(1 - s_g d) \quad (\text{E05.2})$$

s_g : opening gold share of the inventory; d : proportional gold-price decline. Both are fractions, not percentage numbers.

ASSUMPTIONS / AXIOMS

A4. Hold gold quantity and all other asset values fixed; $0 \leq s_g, d \leq 1$. No sales, hedges, cash receipts, price feedback or current Ghana portfolio calibration is assumed.

A 20% gold share with a 30% price fall gives a 6% inventory loss.

E06 Receipt mix and allocation checks

REPRODUCED ACCOUNTING

$$F = F_g + F_o, \quad s_g^F = 100 F_g / F \quad (\text{E06.1})$$

$$s_S^F = 100 S / F, \quad q = 100 S / (F_g - G) \quad (\text{E06.2})$$

$$F_{\text{Aug}} = F_{\text{banks}} + F_{\text{BoG}} \quad (\text{E06.3})$$

F_g/F_o : gold/other institutional receipts; S : gross FX sales; G : bullion-sale gains. August allocations use US\$ million.

ASSUMPTIONS / AXIOMS

A1–A3. Use positive, source-matched denominators. q removes only the identified gains. Rounding bounds use extremal numerator/denominator values; no source differences are reconciled by assumption.

Receipt shares are not reserve-portfolio shares or net intervention.

External-flow accounting and payment timing

E07: report pp. 79, 83, 92 | E08: report pp. 41, 42, 81, 83, 92

E07 Trade and current-account bridge

REPRODUCED ACCOUNTING

$$TB = X - M \quad (E07.1)$$

$$CA = TB + NS + PI + TR + \rho \quad (E07.2)$$

$$\Delta CA = \Delta TB + \Delta NS + \Delta PI + \Delta TR + \Delta \rho \quad (E07.3)$$

X/M: exports/imports; NS: net services; PI: net primary income; TR: net transfers; ρ : displayed-source rounding residual.

ASSUMPTIONS / AXIOMS

A1–A3. Retain the IMF table’s classifications, dates and published totals. Changes are signed accounting contributions; small rounding residuals are not newly inferred transactions.

US\$7.606bn improvement is not an equal addition to usable reserves.

E08 Public cash and early-payment timing

REPRODUCED / TIMING ILLUSTRATION

$$N_t = L_t - DS_t \quad (E08.1)$$

$$DS_{25}^{excl} = DS_{25} - E, \quad N_{25}^{excl} = N_{25} + E \quad (E08.2)$$

$$s_E = 100E / (DS_{25} - DS_{24}) \quad (E08.3)$$

L: external loan disbursements; DS: external debt-service cash payments; E: identified early payment; N: narrow net cash.

ASSUMPTIONS / AXIOMS

A1–A3. Same public-debt perimeter; E is included in reported 2025 service. Excluding E is a timing illustration, not an official revision. Remove settled obligations from future drains.

Grants and other public/private FX flows are outside this balance.

Import-cover ratios and rounding uncertainty

E09: report pp. 33, 34, 35, 37, 75 | E10: report pp. 65, 82, 91

E09 Import cover and implied imports

REPRODUCED ACCOUNTING

$$C(R, M) = 12R/M, \quad \widetilde{M} = 12R/C_{pub} \tag{E09.1}$$

$$C_H^{common} = 12R^H/\widetilde{M}_P \tag{E09.2}$$

C: months of cover; R: reserves; M: annual import bill in the same currency/units. A tilde marks an implied, not observed, import bill.

ASSUMPTIONS / AXIOMS

A1–A3. M and published cover must be positive. State goods/services, backward/prospective horizon and vintage. Source rounding propagates into implied imports.

US\$35.718bn common imports yields headline cover of 4.65 months.

E10 Rounding envelopes

EXECUTED CONDITIONAL BOUNDS

$$\widetilde{M}_L = \frac{12(R - e_R)}{C + e_C} \tag{E10.1}$$

$$\widetilde{M}_U = \frac{12(R + e_R)}{C - e_C} \tag{E10.2}$$

$$e_C = 0.05 \text{ month}, \quad C > e_C \tag{E10.3}$$

e_R and e_C: half the displayed rounding increments. For reserves in US\$bn, e_R is 0.00005 headline and 0.0005 programme.

ASSUMPTIONS / AXIOMS

A3. Nearest-unit rounding is assumed; underlying values lie in the stated box. Source revisions, omissions and forecast error are excluded. Ratio bounds require a strictly positive denominator.

These ranges are not confidence intervals and have no coverage probability.

Symmetric decomposition: time and source differences

E11: report pp. 36, 75 | E12: report pp. 35, 82, 91, 92

E11 Time-change decomposition of cover

REPRODUCED SYMMETRIC ACCOUNTING

$$E_R = 6(R_1 - R_0)(1/M_0 + 1/M_1) \tag{E11.1}$$

$$E_M = 6(R_0 + R_1)(1/M_1 - 1/M_0) \tag{E11.2}$$

$$C_1 - C_0 = E_R + E_M \tag{E11.3}$$

E_R/E_M: reserve-stock/import-denominator contributions, in months. M uses each source’s own implied annual imports.

ASSUMPTIONS / AXIOMS

A1–A3. Both denominators positive. Average the two substitution orders; the identity closes exactly before rounding. It does not presume exogenous reserve or import changes.

Both published cover measures rose 1.6 months; drivers are accounting terms.

E12 Cross-source cover-gap decomposition

REPRODUCED SYMMETRIC ACCOUNTING

$$E_R = 6(R^H - R^P)(1/M_H + 1/M_P) \tag{E12.1}$$

$$E_M = 6(R^H + R^P)(1/M_H - 1/M_P) \tag{E12.2}$$

$$C_H - C_P = E_R + E_M = 1.70 \tag{E12.3}$$

H/P: headline/programme. E_R and E_M allocate the same-date gap to reserve scope and implied import denominator.

ASSUMPTIONS / AXIOMS

A1–A3. Same comparison date and positive denominators. The earlier sequential bridge holds M_P fixed; the symmetric version averages both paths. Joint source-rounding combinations set conditional endpoints.

0.719/0.981 months are accounting contributions, not causal effects.

Import-pressure and debt-service benchmarks

E13: report pp. 38, 39, 40 | E14: report pp. 43, 44, 45, 46, 77

E13 Import pressure and static adequacy

EXECUTED BENCHMARK ILLUSTRATIONS

$$I_h^{uniform} = M_{goods} h/365 \tag{E13.1}$$

$$R^{target} = c^{target} M/12 \tag{E13.2}$$

$$Gap = R^{target} - R, \quad B_h = R/I_h^{uniform} \tag{E13.3}$$

h: days; c_target: assumed months. M_goods: projected goods imports. M: separately named annual adequacy denominator.

ASSUMPTIONS / AXIOMS

A1–A4. Uniform timing applies only to the pressure benchmark. Static adequacy holds the import bill fixed; no optimal reserve level, future path or state obligation to pay all private imports is inferred.

At the stated base, six months means US\$17.859bn, a US\$5.953bn gap.

E14 Reserve-to-debt-service coverage

REPRODUCED DESCRIPTIVE RATIO

$$K = R_{end25}/DS_{2026}^{proj} \tag{E14.1}$$

$$IMF \text{ share} = 100DS_{IMF}/DS_{total} \tag{E14.2}$$

K: times coverage. DS_proj: IMF calendar-year debt-service projection. IMF obligations are an identified subset of total service.

ASSUMPTIONS / AXIOMS

A1–A3. Positive denominator; reserve stock and projection have different time meanings. Keep source coverage differences visible. Do not add the IMF subset a second time.

This is not remaining-maturity short-term debt cover or a daily liquidity test.

Available assets and cumulative cash headroom

E15: report pp. 50, 51, 52, 53, 55, 57, 75 | E16: report pp. 53, 54, 56, 57, 61, 86

E15 Horizon-specific available assets

EXECUTED HYPOTHETICAL MODEL

$$U_i = G_i - E_i \quad (\text{E15.1})$$

$$A_h^s = \sum_i U_i p_i^s a_{ih}^s (1 - k_i^s) \quad (\text{E15.2})$$

$$0 \leq a_{i,30}^s \leq a_{i,90}^s \leq a_{i,365}^s \leq 1 \quad (\text{E15.3})$$

G/E/U: gross/restricted/free value; p: price factor; a: cumulative availability; k: sale haircut. s: normal or stress scenario.

ASSUMPTIONS / AXIOMS

A1–A5. $0 \leq E \leq G$; $p \geq 0$; $0 \leq k \leq 1$. Remove restrictions first and keep price losses separate from sale costs. The same asset cannot be sold or matured twice.

Computed capacity is a horizon ceiling, not an observed execution path.

E16 Cash headroom and resource coverage

EXECUTED HYPOTHETICAL MODEL

$$H_h^s = A_h^s + r_h^s I_h - D_h - C_h^s \quad (\text{E16.1})$$

$$LCR_h^s = \frac{A_h^s + r_h^s I_h}{D_h + C_h^s} \quad (\text{E16.2})$$

I: contracted receipts; r: fraction collected; D: scheduled drains; C: triggered contingent drains. H is US\$bn; coverage is a ratio.

ASSUMPTIONS / AXIOMS

A1–A5. $0 \leq r \leq 1$; each payment and receipt appears once. Do not start from NIR and deduct the same liability again. Denominator must be positive; LCR here is not a regulatory bank LCR.

A positive endpoint does not prove all earlier payments can be met.

Reverse stress and joint sensitivity

E17: report pp. 58 | E18: report pp. 59

E17 Reverse-stress break-even point

EXECUTED HYPOTHETICAL MODEL

$$I_{need} = \max(0, D + C - A) \tag{E17.1}$$

$$r^* = I_{need}/I \quad (I > 0) \tag{E17.2}$$

$$D_{extra}^{max} = H \quad (H \geq 0) \tag{E17.3}$$

r*: minimum collection fraction for zero headroom with other assumptions fixed. Extra-drain tolerance applies at the specified horizon.

ASSUMPTIONS / AXIOMS

A4–A5. No new support or parameter adjustment. If r* exceeds 1, existing contracted receipts cannot close the gap; if I = 0, solve in amounts rather than divide.

Annual stress: US\$2.6148bn receipts, or 87.16% of the contracts.

E18 Joint gold-price / collection sensitivity

EXECUTED HYPOTHETICAL MODEL

$$H_{365}(d, r) = -3.9 + 1.836(1 + d) + 3r \tag{E18.1}$$

$$-0.40 \leq d \leq 0.10, \quad r \in \{0.50, 0.75, 1\} \tag{E18.2}$$

d: proportional gold-price change, negative for a fall; r: receipt-collection fraction. Headroom is US\$ billion.

ASSUMPTIONS / AXIOMS

A4–A5. Other stressed asset availability, sale haircuts, scheduled drains and contingent calls are fixed. The coefficient 1.836 is an accounting product, not an estimated behavioural parameter.

Lines show conditional sensitivity, not forecasts or confidence bands.

Stress attribution and inventory composition

E19: report pp. 84, 91 | E20: report pp. 60

E19 Stress-loss bridge and gold Shapley split

EXECUTED ACCOUNTING OF A SCENARIO

$$L_H = \sum_i L_{A_i} + L_I + L_C, \quad f(p, a, n) = U_g p a n \tag{E19.1}$$

$$\phi_k = \frac{1}{3!} \sum_{\pi} \left[f(x_{\pi, k}^{before}) - f(x_{\pi, k}^{after}) \right] \tag{E19.2}$$

L_H: normal less stressed headroom; L_A: asset loss; L_I: lost receipts; L_C: extra calls. U_g: free gold; n = 1 – haircut; π orders the price/availability/net-sale switches.

ASSUMPTIONS / AXIOMS

A4–A5. Opening inventory and scheduled drains are unchanged. Each switch moves normal to stressed values. Average all permutations; factor losses sum to the total gold loss without residual.

US\$5.0098bn total deterioration reflects imposed assumptions only.

E20 Composition reallocation sensitivity

EXECUTED HYPOTHETICAL MODEL

$$\Delta A_h = x(q_{ch} - q_{gh}), \quad q_{ih} = p_i a_{ih} (1 - k_i) \tag{E20.1}$$

$$\Delta A_{30}^{stress} = 2(1 - 0) = 2 \text{ bn} \tag{E20.2}$$

x: opening value shifted from free gold to cash; c/g: cash/gold. The report holds gross inventory at US\$10bn.

ASSUMPTIONS / AXIOMS

A4–A5. Reallocate only unencumbered value; restrictions on remaining assets are unchanged. No reallocation transaction costs, income loss, market impact or portfolio optimisation is modelled.

Equal gross stocks need not provide equal short-horizon capacity.

Currency matching and payment-date feasibility

E21: report pp. 61 | E22: report pp. 53, 68, 86, 91

E21 Currency-specific funding gaps

EXECUTED HYPOTHETICAL MODEL

$$H_{c,h} = A_{c,h} + I_{c,h} - D_{c,h} - C_{c,h} \quad (\text{E21.1})$$

$$H_h^{USD \text{ equiv}} = \sum_c e_c H_{c,h} \quad (\text{E21.2})$$

c: currency; e_c: US\$ per unit of currency c. The example displays both currency buckets in US\$ equivalent.

ASSUMPTIONS / AXIOMS

A1–A5. Keep native-currency ledgers first. Aggregation does not establish executable conversion: dealing capacity, value dates, costs and settlement permission must be checked separately.

The example's zero aggregate gap coexists with a US\$1bn dollar shortage.

E22 Payment-date feasibility

EXECUTED SYNTHETIC COUNTEREXAMPLE

$$B_c(t) = B_c(0) + \sum_{j: t_j \leq t} I_{jc} - \sum_{k: t_k \leq t} D_{kc} \quad (\text{E22.1})$$

$$\min_{t \in \mathcal{T}_c} B_c(t) \geq 0 \quad (\text{E22.2})$$

B: cash after settlement; T_c: every relevant receipt/payment date in currency c. Only realised available receipts enter the path.

ASSUMPTIONS / AXIOMS

A1–A5. Unique cash IDs, no borrowing/overdraft and no duplicate sale/maturity proceeds. An endpoint ceiling is not a cash path. A negative model balance denotes an unmet payment.

Opening 2, day-5 payment 3 and day-10 receipt 2: minimum -1, closing +1.

Missing exposure and reporting-quality controls

E23: report pp. 85, 89 | E24: report pp. 7, 67, 68, 71, 89

E23 Missing adverse-exposure bounds

EXECUTED CONDITIONAL BOUNDS

$$H^{true} = H^{captured} - U, \quad 0 \leq U \leq \bar{U} \tag{E23.1}$$

$$H^{true} \in [H^{captured} - \bar{U}, H^{captured}] \tag{E23.2}$$

U: omitted net adverse cash exposure; $\bar{U}$: externally justified or explicitly assumed cap. The report illustrates caps, not Ghana exposures.

ASSUMPTIONS / AXIOMS

A4–A6. The one-sided bound assumes omitted effects are adverse. Omitted positive resources require a separately stated two-sided model. Without a defensible cap there is no finite national lower bound here.

The hypothetical 90-day buffer is exhausted at US\$1.7201bn omitted exposure.

E24 Completeness and control targets

PROPOSED MONITORING DEFINITIONS

$$Q_{link} = 100(\sum_{i \in C} v_i \ell_i) / (\sum_{i \in C} v_i) \tag{E24.1}$$

$$Q_{field} = 100N_{complete} / N_{required} \tag{E24.2}$$

$$Q_{link} \geq 95\%, \quad Q_{field} \geq 98\% \tag{E24.3}$$

C: captured-data roster; v: gross value; ℓ : linked-record indicator. N counts mandatory fields in captured records.

ASSUMPTIONS / AXIOMS

A1, A2, A6. Freeze roster and required-field definitions before measuring; denominators must be positive. Test duplicate obligation IDs and undocumented changes separately. These targets have not been measured nationally.

95% of captured value is not 95% of all national exposure.

Causal targets and event-aligned estimation

P01: report pp. 87, 88 | P02: report pp. 87, 88

P01 Counterfactual target effect

PROPOSED • NOT ESTIMATED

$$\tau_h(\delta; x) = E[Y_h(x + \delta) - Y_h(x)] \tag{P01.1}$$
$$h \in \{1, 5, 20\} \text{ business days} \tag{P01.2}$$

x: official FX supplied under a defined operation; δ : prespecified increment.
 Y_h : settlement outcome for a fixed bank/currency/invoice population.

ASSUMPTIONS / AXIOMS

Specify the intervention and other policy responses. Require consistency and a credible comparison; observational identification also needs conditional exchangeability and overlap. Define interference rather than assume it away.

This is an operation effect, not the effect of increasing headline GIR.

P02 Event-aligned local projections

PROPOSED • NOT ESTIMATED

$$Y_{t+h} = \alpha_h + \beta_h D_t + \Gamma_h' X_{t-1} + u_{t+h} \tag{P02.1}$$
$$E[u_{t+h} | D_t, X_{t-1}] = 0 \tag{P02.2}$$

D_t : operation increment/shock; X : pre-operation controls/lags; β_h : horizon-specific slope. Align observations to operation dates; pre-events can test anticipation.

ASSUMPTIONS / AXIOMS

Conditional mean restriction is an identification assumption, not a result. Prespecify functional form, lag length and stable transformations; audit common news. Use sufficient independent events and dependence-appropriate inference.

An event window or robust standard error does not remove confounding.

Instrument validity and selected observations

P03: report pp. 88 | P04: report pp. 89

P03 External-instrument local projections

PROPOSED • NO VALID INSTRUMENT FOUND

$$D_t = \pi Z_t + \Lambda' X_{t-1} + v_t \tag{P03.1}$$

$$Y_{t+h} = \alpha_h + \beta_h D_t + \Gamma_h' X_{t-1} + u_{t+h} \tag{P03.2}$$

$$E[\tilde{Z}_t \tilde{D}_t] \neq 0, \quad E[\tilde{Z}_t \tilde{u}_{t+h}] = 0 \tag{P03.3}$$

Z: instrument; tildes: residuals after controls. IV means instrumental variables: first-stage variation in D identifies the second-equation slope only under the restrictions below.

ASSUMPTIONS / AXIOMS

Require relevance, exclusion and horizon-specific exogeneity, including relevant lead-lag shock restrictions. A unit FX-supply normalisation and treatment-effect interpretation must be stated. Use weak-IV-robust inference when needed.

Gold prices and lagged sales are not automatically valid instruments.

P04 Observation-probability weighting

PROPOSED • NOT APPLIED

$$\pi(X_i) = Pr(S_i = 1 | X_i) \tag{P04.1}$$

$$\hat{\mu}_w = \frac{\sum_{i: S_i=1} Y_i / \hat{\pi}(X_i)}{\sum_{i: S_i=1} 1 / \hat{\pi}(X_i)} \tag{P04.2}$$

S: outcome observed; X: roster covariates; Y: operational outcome. This is a weighted mean for a defined roster, not a liability-stock estimator.

ASSUMPTIONS / AXIOMS

A6 plus MAR: conditional on X, observation does not depend on Y; observation probabilities are positive and correctly modelled. The eligible roster and dependence structure must be known.

Weights cannot recover unknown creditors from an undefined reporting universe.

Imputation and workflow outcome definitions

P05: report pp. 89 | P06: report pp. 90

P05 Model-based multiple imputation

PROPOSED • NO VALUES IMPUTED

$$Y_{mis}^{(m)} \sim p(Y_{mis} \mid Y_{obs}, X) \tag{P05.1}$$

$$\bar{\theta} = \frac{1}{M} \sum_{m=1}^M \hat{\theta}^{(m)} \tag{P05.2}$$

m: imputed dataset; M: number of datasets; θ : prespecified outcome estimand. Draws must include fitted-model uncertainty.

ASSUMPTIONS / AXIOMS

A6 plus a defensible observation/imputation model, covariate support and compatibility with the analysis. Under MAR, observed variables explain selection; MNAR needs additional restrictions or sensitivity analysis.

Use within- and between-imputation uncertainty; do not fill missing liabilities with guesses.

P06 Workflow-evaluation outcome measures

PROPOSED OPERATIONAL DEFINITIONS

$$Late100 = 100 N_{late} / N_{due} \tag{P06.1}$$

$$\bar{d}_w = \frac{\sum_{j \in J} v_j d_j}{\sum_{j \in J} v_j} \tag{P06.2}$$

J: prespecified due-obligation cohort; v: amount in a consistent valuation basis; d: nonnegative settlement delay in business days.

ASSUMPTIONS / AXIOMS

Define time zero, due dates and follow-up. Retain failed/cancelled/delayed cases under prespecified rules. Unsettled cases are censored, not zero-delay; eventual mean delay needs adequate follow-up or censoring methods.

Report lateness frequency and value-weighted delay separately.

Randomised workflow evaluation: target and inference

P07: report pp. 90

P07 Blocked cluster-randomised rollout ITT

PROPOSED • NO TRIAL RUN

$$\hat{\tau}_{ITT} = \sum_b w_b (\bar{Y}_{b,1} - \bar{Y}_{b,0}) \quad (\text{P07.1})$$

$$w_b = n_b / \sum_b n_b \quad (\text{P07.2})$$

ITT: intention-to-treat. b: block; n_b: eligible teams; $\bar{Y}$: mean team outcome by assigned early/delayed rollout. The target is an equal-team effect at a fixed window.

ASSUMPTIONS / AXIOMS

Randomise within blocks; compare teams at one prespecified window before delayed adoption. Require complete outcomes and no unmodelled spillovers or anticipation. Base inference on the actual allocation and account for few clusters.

Keep assignment groups regardless of compliance. Mandatory safeguards remain in place.

INFERENCE AND RELEASE GATES

Assignment, not uptake

Analyse teams as assigned. The equation is for a defined first comparison window, not an unrestricted staggered-adoption fixed-effects regression.

Design-based uncertainty

Respect the blocked assignment. A sharp-null randomisation test differs from inference on a heterogeneous average effect.

Dependence and power

Use team-level assignment and clustering, prespecified outcomes and actual cluster counts. No trial, simulated standard errors or power claim is reported.

Scope and protection

This is a proposed non-safety-critical workflow trial. Maintain required controls, document spillovers and do not treat its effect as a reserve-policy effect.

Trace every equation to the report and executable evidence

The machine-readable registry names every model, equation, status, assumption, report location and relevant output file.

SOURCE RECORDS → ACCOUNTING	SCENARIO INPUTS → CONDITIONAL RESULTS	DESIGN DOCUMENTATION → NO ESTIMATES
E01–E14 code/analyse.py; code/extend_analysis.py Reserve, import-cover, current-account, institutional-receipt and public-cash outputs retain the frozen source-labelled inputs.	E15–E23 inputs/scenario_assumptions.json; both analysis scripts Assets, headroom, reverse stress, Shapley losses, composition, currency, dated cash and missing-exposure bounds are reproducible illustrations.	E02, E24; P01–P07 docs/model_registry.json; docs/model_catalogue.md NIR is not reconstructed. Reporting targets are not measured. Proposed causal/selection/rollout equations have no fitted coefficients or empirical standard errors.

REGENERATION

The existing 35 analytical outputs are preserved. Model-registry links include supporting reconciliation checks not drawn as separate charts. Equation images are regenerated from the supplied LaTeX; prose and all original figures remain editable in PowerPoint.

Four substitutions show what the model outputs mean

Exact substitutions into existing calculations; illustrative values remain separate from Ghana observations.

E09 COMMON IMPORT DENOMINATOR

$$12 \times 13.8292 \div 35.718 = 4.6461 \text{ months}$$

Rounded to 4.65 months. This rescales the headline stock; it does not create more cash or a payment guarantee.

E04 GOLD PRICE–QUANTITY IDENTITY

$$0.55\text{m oz} \times \text{US\$}600 + \text{US\$}3,300 \times 0.10\text{m oz}$$

US\$0.33bn + US\$0.33bn = US\$0.66bn. Price and quantity contributions are an illustrative accounting split.

E16 STRESSED ANNUAL HEADROOM

$$6.8852 + 0.50 \times 3 - 8 - 1.5 = -1.1148\text{bn}$$

Available assets plus collectible receipts less scheduled and contingent drains. This is not Ghana's measured shortfall.

E17 REQUIRED RECEIPT COLLECTION

$$(8 + 1.5 - 6.8852) \div 3 = 0.8716$$

The model needs 87.16% of its existing contracted receipts to break even. This is a threshold, not a probability.

References and source links 1 / 6

Clickable titles; observation dates, source scope and retrieval limitations are recorded in the companion register.

S01 Ministry of Finance, Ghana | 2026

Annual Public Debt Report for the 2025 Financial Year

Paragraph 24, PDF p.18; Tables 8.6–8.7, pp.43–44; paragraph 45, p.22.

S02 International Monetary Fund | 2026

Ghana: 2026 Article IV Consultation and Sixth ECF Review

Country Report 26/212. Table 5 PDF p.56; Table 6 p.57; Table 8 p.59; paragraph 5 p.13; MEFP p.91.

S03 International Monetary Fund / Ghanaian authorities | 2026

Ghana: Technical Memorandum of Understanding and programme monitoring tables

MEFP Table 1, PDF p.114; TMU paragraphs 1–2 p.123 and 6–9 pp.124–125; reporting schedule pp.134–137.

References and source links 2 / 6

Clickable titles; observation dates, source scope and retrieval limitations are recorded in the companion register.

S04 International Monetary Fund | 2026

Ghana external-sector assessment and reserve adequacy

Annex IV, reserve adequacy PDF pp.75–76; main paragraph 54 p.34; gold share discussion p.31.

S05 Nolin, Guillaume / International Monetary Fund | 2026

Lessons from the Bank of Ghana's Domestic Gold Purchase Programme

Selected Issues Paper 26/084; paragraphs 10–14, PDF pp.11–12. DOI 10.5089/9798229055536.018.

S06 Ghana Gold Board | 31 August 2026

GoldBod Generates US\$1.315bn FX in August Under New Financing Model

Finance and Trading Directorate statement; August allocations and start date 3 August 2026.

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S07 International Monetary Fund | accessed 22 September 2026

International Reserves and Foreign Currency Liquidity: dataset description

Sections I–IV: official assets, predetermined drains, contingent drains and memoranda.

S08 International Monetary Fund, Statistics Department | 2013

International Reserves and Foreign Currency Liquidity: Guidelines for a Data Template

Manuals & Guides; DOI 10.5089/9781484304228.069. Framework for asset availability, remaining maturity and contingent drains.

S09 International Monetary Fund | 2013

Revised Guidelines for Foreign Exchange Reserve Management

Policy Papers 2013/001. DOI 10.5089/9781498342377.007. Objectives, institutional responsibilities, liquidity and risk management.

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S10 International Monetary Fund | 2013

Assessing Reserve Adequacy—Further Considerations: Supplementary Information

Box 4: EM ARA risk channels; remaining-maturity debt, other liabilities, broad money and export earnings.

S11 International Monetary Fund | 2009 edition; published 2010

Balance of Payments and International Investment Position Manual, Sixth Edition

Reserve-asset, monetary-gold and stock-flow framework; source publications' own classifications retained.

S12 Institute of Development and Economic Research | 2026

External Liquidity: Calculation, Scenario and Release Protocol

Companion ZIP: code/analyse.py; extend_analysis.py; source audit; parameter inputs; figure CSVs; numerical and publication checks.

References and source links 5 / 6

Clickable titles; observation dates, source scope and retrieval limitations are recorded in the companion register.

S13 [Hernán, Miguel A.; Hsu, John; Healy, Brian | 2018 manuscript](#)

[Data science is science's second chance to get causal inference right](#)

Original-author manuscript. Distinguishes description, prediction and counterfactual prediction; methods require subject-matter assumptions.

S14 [Sun, BaoLuo; Liu, Lan; Miao, Wang; et al. | 2016 manuscript](#)

[Semiparametric Estimation with Data Missing Not at Random Using an Instrumental Variable](#)

Original-author manuscript. Identification under non-random missingness requires additional assumptions; an instrument needs an exclusion restriction.

S15 [Adler, Gustavo; Lisack, Noemie; Mano, Rui C. / IMF | 2015](#)

[Unveiling the Effects of Foreign Exchange Intervention: A Panel Approach](#)

IMF Working Paper 15/130, original-author paper on AEA; introduction and section 2.1, PDF pp.3–6.

References and source links 6 / 6

Clickable titles; observation dates, source scope and retrieval limitations are recorded in the companion register.

S16 Jordà, Òscar | 2005

Estimation and Inference of Impulse Responses by Local Projections

American Economic Review 95(1): 161–182. DOI 10.1257/0002828053828518. Horizon-specific local projections.

S17 Stock, James H.; Watson, Mark W. | 2018

Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments

The Economic Journal 128: 917–948. DOI 10.1111/eoj.12593. Section 1, especially LP-IV conditions (PDF pp.4–8).

S18 Ding, Peng; Li, Fan | 2017 manuscript

Causal Inference: A Missing Data Perspective

Original-author manuscript, arXiv:1712.06170. Sections 1–4: missingness, weighting, imputation and randomisation-based inference.

A stronger reserve stock is valuable—but cash readiness must be demonstrated

The report supports a multidimensional external-liquidity assessment, not a single unconditional reserve verdict.

What improved

Both headline and programme gross reserves rose substantially in 2025. The increase survives the perimeter comparison.

What remains conditional

Net reserve stock, gold valuation attribution and 30/90-day cash readiness cannot be pinned down from the retrieved aggregates alone.

What to do next

Link assets, gold quantities, valuation, liabilities and settlements. Publish distinct adequacy and operational liquidity measures with a clear audit trail.



Institute of Development and Economic Research

EVIDENCE FOR YOUR NEXT DECISION

Evidence for informed decisions.

For research enquiries, supporting data, methodological documentation or corrections to this report, contact the Institute of Development and Economic Research.

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