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Monetary Policy, Exchange Rate Shocks, and Asset Prices in a Small Open Frontier Economy: An Integrated Multi-Horizon Distributional Analysis

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Abstract

We examine how monetary policy shocks transmit to equity returns in Ghana, a frontier economy with a shallow, thinly-traded exchange and a monetary authority that has cycled repeatedly between disinflation and easing. Unlike studies that blend index series spanning incompatible construction methodologies, we restrict the sample to the current-regime Ghana Stock Exchange Composite Index (GSE-CI) and Financial Stock Index (GSE-FSI), January 2014–December 2024 (N = 131 monthly returns), combining five methods rarely combined here: Zivot-Andrews structural-break unit root tests, Toda-Yamamoto augmented-VAR causality, Bayesian quantile regression with Bayesian model averaging, structural VAR impulse responses and variance decomposition, and continuous Morlet wavelet coherence, testing whether transmission holds uniformly across the return distribution and across time. The results tell a more modest story than is often assumed: policy rate shocks show no robust Granger-causal or quantile-regression relationship with either index once model uncertainty is accounted for, and explain only 3–4 percent of twelve-month-ahead forecast error variance. Oil price shocks instead carry strong, quantile-dependent explanatory power for GSE-CI at bullish quantiles, and short-term Treasury bill rates matter most for GSE-FSI at bearish quantiles, consistent with funding-cost sensitivity concentrated in financial-sector stress states. Wavelet coherence shows co-movement between policy shocks and equity returns strengthening with horizon rather than peaking at medium-run bands. Taken together, these results are, to our knowledge, the first distributional, multi-horizon evidence that Ghana's equity market is only loosely and unevenly coupled to the domestic policy rate, with global commodity prices and short-term funding costs playing the larger, more state-dependent role.

JEL Classification Codes: E52; G10; G12; G15; C11; C32; O16; O55

1. Introduction

1.1 Background

Monetary policy transmission to asset prices is a well-established channel in advanced-economy macro-finance, but its operation in frontier markets remains far less settled. Frontier equity markets such as Ghana's are characterised by thin trading, a small number of listed firms concentrated in a few sectors, limited institutional participation (Alagidede, 2011; Panagiotidis, 2009), and monetary regimes that have, at various points, prioritised exchange-rate stabilisation, inflation targeting, and fiscal accommodation in different measure. Whether policy rate changes propagate to equity prices through the standard discount-rate and expected-earnings channels — or whether frontier markets are simply too illiquid and too dominated by a handful of large financial-sector stocks for that channel to operate cleanly — is an empirical question that has not been convincingly settled for Ghana. Prior Ghana-specific evidence on macroeconomic determinants of stock returns and market efficiency is limited and dated (Fama, 1970; Tweneboah, 2008; Magnus, 2008), and existing macro-finance research on Ghana has focused primarily on growth and capital-flow linkages rather than monetary-equity transmission (Frimpong & Oteng-Abayie, 2006).

The Ghanaian case is a useful laboratory for this question precisely because it has experienced repeated, large-amplitude monetary cycles within a short span: the Bank of Ghana's policy rate ranged from single digits in the mid-2000s to a peak of 30 percent in late 2023 before easing back toward the high 20s in 2024 (Bank of Ghana, 2023), against a backdrop of currency depreciation episodes, a 2022–2023 sovereign debt restructuring, and inflation that touched above 50 percent year-on-year before falling sharply (World Bank, 2023). At the same time, the structure of the equity market itself changed materially in this period: the Ghana Stock Exchange replaced its original All-Share Index with two purpose-built indices — the GSE Composite Index (GSE-CI) and the GSE Financial Stock Index (GSE-FSI) — with a new base value of 1,000 points as of 31 December 2010. Because these two indices did not exist in their current form before 2011, any study that presents monetary-transmission estimates for a sample starting earlier necessarily blends two structurally different index-construction regimes, which is likely to introduce spurious breaks that have nothing to do with monetary policy. We therefore restrict our sample to January 2014 — chosen to allow the new indices several years to establish a stable trading

history — through December 2024, giving 132 monthly observations (131 usable return observations after first-differencing).

A second motivation for revisiting this question empirically, rather than relying on priors from advanced-economy transmission studies, is that the effect of policy rate changes on frontier equity markets is theoretically ambiguous in sign and likely to be state-dependent. Higher policy rates raise the discount rate applied to expected future cash flows (a negative effect on prices) but can also signal credible disinflation and currency stabilisation, which may support risk appetite in a market where currency risk is often the dominant concern for both domestic and foreign investors (a potentially offsetting positive effect). Financial-sector equities — which make up a large share of GSE-FSI by construction — carry an additional, competing channel: higher rates can widen net interest margins for banks even as they raise credit risk and funding costs. These competing channels motivate a distributional approach that allows the sign and magnitude of the policy-rate effect to vary across the return distribution, rather than imposing a single average effect.

1.2 Aim, Objectives, and Research Questions

This study aimed to provide a rigorous, multi-method characterisation of how monetary policy shocks, alongside exchange-rate, money-supply, inflation, and global oil-price shocks, transmit to Ghanaian equity returns across time, frequency, and the return distribution. The specific objectives were to: (i) establish the integration properties of each series using both conventional and structural-break-robust unit root tests; (ii) test the direction of Granger-causal linkages between monetary and financial variables using a lag-augmentation approach that is robust to uncertain integration order; (iii) estimate the distributional (quantile-dependent) response of equity returns to monetary and macroeconomic shocks using a Bayesian framework that formally accounts for model uncertainty across candidate predictor sets; (iv) quantify the dynamic, aggregate importance of monetary shocks relative to other macro-financial shocks using structural VAR impulse responses and forecast error variance decomposition; and (v) characterise how the strength of co-movement between monetary policy and equity returns varies across time horizons using wavelet coherence.

Correspondingly, the study addressed five research questions. First, are the monetary, exchange-rate, and equity-return series integrated of the same order once structural breaks are accounted for, and does allowing for endogenous breaks change the classification relative to standard unit root tests? Second, is there Granger-causal evidence of a directional relationship between monetary policy shocks and equity returns, or does the evidence instead point toward other macro-financial channels? Third, do monetary policy shocks affect the upper and lower quantiles of the equity return distribution differently, and how much posterior support do the data provide for including each candidate predictor at each quantile? Fourth, what share of the forecast error variance in equity returns is attributable to monetary shocks specifically, as opposed to other macro-financial shocks and the equity market's own dynamics? Fifth, does the strength of monetary-equity co-movement vary systematically across short-, medium-, and long-run horizons, and is that pattern consistent across the composite and financial-sector indices?

2. Literature Review

2.1 Theoretical Framework

2.1.1 Monetary Policy Transmission Mechanisms

The conventional starting point for monetary transmission to asset prices is the present-value channel: a policy rate increase raises the discount rate applied to expected future dividends, mechanically lowering equity valuations, all else equal (Gordon, 1962; Leitemo, 2009). A complementary channel operates through expected earnings — tighter policy dampens aggregate demand and, with a lag, corporate profitability (Blinder, 1992; Gertler, 1995; Taylor, 1995; Romer, 2004). In open economies, a third channel operates through the exchange rate: policy tightening that attracts capital inflows and appreciates the currency can affect firms differently depending on their exposure to imported inputs, foreign-currency debt,

and export revenue (Biekpe, 2006). For a commodity-linked, partially dollarised economy such as Ghana's, this exchange-rate channel is plausibly at least as important as the discount-rate channel, and the two can work in opposite directions depending on the source of the shock.

A separate literature emphasises that the strength of monetary transmission to asset prices depends on financial market depth and the credibility of the monetary regime (Shin, 2010; Lundblad, 2011; Pedersen, 2009). In markets with few listed firms, low free float, and a narrow investor base — as in Ghana — price discovery may be slow and thin trading can weaken or delay the standard discount-rate channel, while amplifying sensitivity to idiosyncratic liquidity events unrelated to monetary policy. This motivates treating the strength (and even the sign) of monetary transmission as an empirical rather than a purely theoretical question in this setting.

2.1.2 Distributional and Nonlinear Transmission

A growing body of work argues that monetary policy shocks do not affect the entire distribution of asset returns uniformly. Quantile-based approaches (Bassett, 1978) allow the estimated effect of a shock to differ between calm and turbulent, or bullish and bearish, market states (Tversky, 1979) — which is important if, for example, policy tightening has a disproportionate effect on returns precisely when the market is already under stress (lower quantiles), or if it primarily curbs speculative upside (upper quantiles) (Solnik, 2001). Bayesian quantile regression additionally allows (Moyeed, 2001) formal uncertainty quantification via posterior credible intervals and, when combined with Bayesian model averaging (BMA) over candidate predictor subsets (Korobilis, 2017), allows the researcher to report how confident the data actually are that a given predictor belongs in the model at a given quantile, rather than asserting inclusion based on a single specification.

2.1.3 Time-Frequency Transmission Dynamics

Because monetary policy transmission is understood to operate with variable and uncertain lags, time-domain methods alone may understate or mischaracterise the relationship between policy shocks and asset prices. Wavelet coherence analysis decomposes the co-movement between two series jointly across time and frequency (equivalently, horizon) (Nunes, 2009), making it possible to ask whether monetary-equity co-movement is concentrated at short, medium, or long horizons, and whether that concentration is stable over the sample or specific to particular episodes such as currency crises (Aguiar-Soares, 2011).

2.2 Conceptual Framework

We conceptualise monetary policy transmission to Ghanaian equity returns as operating through three potentially competing channels — a direct discount-rate/valuation channel, an exchange-rate and imported-inflation channel (Fama, 1981; Roll, 1983; Kutan, 2007), and a financial-sector net-interest-margin channel specific to bank-heavy indices such as GSE-FSI — (Palia, 2020; Acharya et al., 2017) whose relative strength may vary across the return distribution and across time horizons. Rather than imposing a single expected sign or a single dominant channel a priori, our empirical strategy is designed to let the data reveal which channel dominates, under what market conditions, and at what horizon, while treating global oil prices and domestic money-supply growth as additional shocks competing for explanatory power alongside the policy rate.

3. Methodology

3.1 Data Sourcing and Processing

Monthly data span January 2014 to December 2024 (N = 132 level observations; 131 return/change observations after first-differencing). All series are drawn from official primary sources and, where a bulk machine-readable export was unavailable, from primary institutional publications, with every non-directly-exported observation flagged and its source documented in the companion data appendix.

The Ghana Stock Exchange Composite Index (GSE-CI) and Financial Stock Index (GSE-FSI) monthly closing levels were compiled from the Ghana Stock Exchange's own monthly Equities Market Report publications, which report current- and prior-year monthly closes side by side; this allowed cross-validation of overlapping months across multiple independently published reports. Every observation for 2018–2024 (84 of 132 GSE-FSI months) matched exactly across at least two independently sourced reports. GSE-FSI monthly values for January 2014-December 2017 (48 of 132 months) could not be sourced at a monthly frequency from any available report. For this sub-period, we use log-linear interpolation between the real, independently reported December year-end closes (2013: 1,786.60; 2014: 2,243.63; 2015: 1,930.06; 2016: 1,545.41; 2017: 2,310.58).

The monetary policy rate (MPR) and the 91-day Treasury bill rate (TBR) (Swanson, 2005) for January 2014-December 2023 were obtained from the Ghana Statistical Service's StatsBank statistical database, whose interest-rate series is itself sourced from the Bank of Ghana. January-December 2024 values were reconstructed from the Bank of Ghana's own Monetary Policy Committee press releases, which document the exact date, meeting number, and basis-point change (or hold decision) at each of the six 2024 policy meetings, cross-checked against reported point-in-time Treasury bill auction rates; interpolated months are flagged in the appendix. Broad money supply (M2) for January 2014-July 2024 is sourced from the same StatsBank database; August-November 2024 values are linearly interpolated between the real July 2024 and December 2024 (Bank of Ghana Quarterly Statistical Bulletin) observations. The GHS/USD exchange rate for January 2014-December 2023 is sourced from StatsBank (Bank of Ghana); 2024 monthly values are interpolated between the real December 2023 StatsBank observation and a real November 2024 point sourced from the Ghana Stock Exchange's own published economic indicators table, which draws on Bank of Ghana data. The consumer price index level and year-on-year inflation rate are sourced directly from the Ghana Statistical Service StatsBank CPI database for the full 2014–2024 window with no gaps. Brent crude oil spot prices are sourced from the IMF Primary Commodity Price System via the Federal Reserve Economic Data (FRED) series POILBREUSDM, with complete coverage.

Return and change series are constructed as simple monthly percentage changes for level variables expressed as index or price levels (GSE-CI, GSE-FSI, M2, the exchange rate, and Brent oil), and as simple percentage-point changes for variables already expressed as rates (MPR, TBR, and year-on-year inflation). We adopt percentage-point differencing for rate variables specifically to avoid the scale distortion that arises from taking percentage changes of a rate that is itself already a percentage.

3.2 Econometric Framework

3.2.1 Unit Root and Structural Break Tests

We test each series for a unit root using the augmented Dickey-Fuller (ADF) test (Dickey, 1984) with both a constant-only and a constant-plus-trend specification, and using the Zivot-Andrews (ZA) test (Zivot & Andrews, 1992) which allows for a single endogenously determined structural break in the level (building on Perron, 1989) and is therefore more appropriate than standard ADF for a sample containing the 2014–2015 currency crisis, the COVID-19 shock, and the 2022–2023 debt and inflation crisis (Perron, 2003). Lag length in each test is selected by the Bayesian Information Criterion. A series is classified as integrated of order one, I(1), if the null of a unit root cannot be rejected in levels but is rejected in first differences under at least one testing framework.

3.2.2 Toda-Yamamoto Causality Testing

To test Granger-causal ordering without pre-testing for cointegration, we implement the Toda and Yamamoto (1995) augmented-lag procedure. For each pair of variables we estimate a level VAR with lag order p selected by Akaike's Information Criterion, augmented with d□□□ = 1 additional lag reflecting the maximum order of integration found in Section 3.2.1, and test the joint significance of the coefficients on the first p (non-augmented) lags of the candidate causal variable using a Wald test. We report this alongside a conventional Granger causality test (Granger, 1969; Geweke, 1982) on the differenced (stationary) series as a cross-check (Andrade, 2013).

3.2.3 Bayesian Quantile Regression

To characterise how the effect of monetary and macro-financial shocks on equity returns varies across the return distribution, we estimate Bayesian quantile regression (BQR) at eight quantiles (τ = 0.05, 0.10, 0.25, 0.30, 0.50, 0.75, 0.80, 0.90) using the asymmetric Laplace likelihood and its normal-exponential mixture representation (Kozumi and Kobayashi, 2011), estimated via Gibbs sampling with 4,000 post-burn-in draws following a 1,000-draw burn-in, run from two independent starting points to compute Gelman-Rubin convergence diagnostics (R-hat) for every coefficient at every quantile; all reported R-hat values are below 1.01, indicating good convergence. Both the dependent variable and all six candidate predictors (MPR shock, TBR change, money-supply growth, exchange-rate return, inflation change, and oil-price return) are standardised to zero mean and unit variance prior to estimation, so that reported coefficients represent the effect, in standard deviations of the equity return, of a one-standard-deviation change in the predictor. We report posterior means with 95 percent credible intervals.

To address model uncertainty over which of the six candidate predictors belong in the model at each quantile, we compute Bayesian model averaging (BMA) posterior inclusion probabilities. For each quantile and each of the 64 possible predictor subsets, we compute a Schwarz-type approximate Bayesian Information Criterion based on the quantile (check-loss) objective, following the classical BIC-approximation to Bayes factors; converting these into approximate posterior model probabilities and summing across all subsets containing a given predictor yields its marginal posterior inclusion probability (MPIP) at that quantile. Following standard conventions, we treat MPIP values above 0.95 as very strong evidence of inclusion, 0.75–0.95 as substantial, 0.50–0.75 as weak-to-moderate, and below 0.50 as weak evidence against inclusion; we report MPIP for every predictor at every quantile rather than asserting inclusion selectively.

3.2.4 Vector Autoregression, Impulse Responses, and Forecast Error Variance Decomposition

To quantify the dynamic, aggregate importance of monetary shocks relative to other macro-financial shocks, we estimate a six-variable VAR comprising the policy rate shock, the Treasury bill rate change, the exchange-rate return, the inflation change, the oil-price return, and the equity return (GSE-CI or GSE-FSI, estimated separately), with lag order selected by AIC. We identify structural shocks via a Cholesky decomposition with the policy rate ordered first, consistent with the standard assumption that monetary policy responds to macro-financial conditions with a lag while affecting them contemporaneously; we verify that the estimated VAR is stable (all companion-matrix eigenvalue moduli below unity) in every specification before proceeding. We report orthogonalised impulse responses of equity returns to a one-standard-deviation policy shock and forecast error variance decomposition at one-, three-, six-, and twelve-month horizons.

3.2.5 Continuous Morlet Wavelet Coherence Analysis

To examine how the strength of co-movement between the policy rate shock and equity returns varies jointly across time and frequency, we compute continuous wavelet coherence using the Morlet wavelet, following Torrence and Compo (1998) and Grinsted, Moore and Jevrejeva (2004). We summarise coherence within three conventional horizon bands — short-run (1–6 months), medium-run (6–18 months), and long-run (18–36 months) — by averaging estimated coherence within each band across the full sample, and separately during two identifiable stress episodes (the 2014–2016 currency-crisis period and the 2022–2023 debt-restructuring and inflation-crisis period) versus the remainder of the sample. Given the relatively short sample (131 months), estimates at the upper edge of the long-run band are based on fewer effective cycles and are correspondingly less precise; we flag this explicitly rather than treating long-horizon estimates as equally reliable to short-horizon ones.

4. Results

4.1 Descriptive Statistics

Figure 2 and Table 1 reports descriptive statistics for both level and return/change series. GSE-CI averaged 2,525.1 points (SD = 642.6) over the sample, and GSE-FSI averaged 2,027.8 points (SD = 292.1); both level series show positive skewness and excess kurtosis consistent with the sustained index appreciation of 2023–2024. At the return level, mean monthly GSE-CI returns are 0.71 percent (SD = 5.01 percent) and mean monthly GSE-FSI returns are 0.29 percent (SD = 4.21 percent) — both economically plausible magnitudes for a frontier equity market. Jarque-Bera tests reject normality for every return series (all $p < 0.01$), motivating the use of a quantile-based approach. The policy rate shock (MPR) has a mean monthly change of essentially zero (0.084 percentage points) with a standard deviation of 0.75 percentage points, consistent with a rate that is held constant most months and adjusted in discrete steps at scheduled Monetary Policy Committee meetings.

Table 1
Descriptive statistics for level and return/change series (N = 132 level / 131 return observations).

Variable	Level mean	Level SD	Mean (a)	SD (a)	Skewness	Kurtosis	Jarque-Bera	p-value
GSE-CI	2525.1	642.6	0.712	5.014	1.07	5.23	52.3	< 0.001
GSE-FSI	2027.8	292.1	0.292	4.214	0.76	10.04	283.5	< 0.001
MPR	20.9	5.4	0.084	0.755	1.07	7.50	135.8	< 0.001
TBR	19.8	6.4	0.063	1.689	-5.57	54.37	15079.7	< 0.001
MSG (GHS bn)	82.6	56.3	1.934	2.589	0.55	3.80	10.2	0.006
EXR	6.3	3.3	1.571	4.675	0.35	18.78	1362.5	< 0.001
INF	17.4	11.0	0.076	1.846	-0.02	13.68	623.1	< 0.001
OIL	69.4	20.4	0.149	9.217	-0.54	5.14	31.3	< 0.001

Note: (a) Reported in the units in which each series enters the empirical models: percent for GSE-CI, GSE-FSI, MSG, EXR, and OIL (simple monthly percentage change); percentage points for MPR, TBR, and INF (simple percentage-point change, since these are already rate variables — see Section 3.1*). MSG level statistics are in GHS billions. Source: Authors' computation from Ghana Stock Exchange monthly Equities Market Reports (GSE-CI, GSE-FSI); Bank of Ghana, via Ghana Statistical Service StatsBank (MPR, TBR, M2, GHS/USD exchange rate); Ghana Statistical Service StatsBank (CPI/inflation); IMF Primary Commodity Price System via FRED series POILBREUSDM (Brent crude oil).*

4.2 Unit Root and Structural Break Results

Table 2 reports ADF and Zivot-Andrews results for each series in levels and first differences. Every series fails to reject the unit-root null in levels under the constant-only ADF specification and rejects it in first differences at the 1 percent level, consistent with I(1) behaviour. The Zivot-Andrews test reinforces this classification for most series: GSE-CI shows a ZA level statistic of -1.44 (not significant) against a first-difference statistic of -11.66 ($p < 0.001$), with identified break dates clustering around late 2022, consistent with the sovereign debt restructuring. The policy rate (MPR) and Treasury bill rate (TBR) are exceptions: both reject the unit-root null in levels under ZA (MPR: -5.11, $p = 0.020$; TBR: -5.13, $p = 0.019$), suggesting these series may be more accurately characterised as trend-stationary around a break — plausibly because both are policy-administered rates that jump discretely at identifiable dates rather than following a smooth stochastic trend. We proceed with a conservative maximum integration order of $d_{max} = 1$ for the Toda-Yamamoto procedure, which remains valid under this classification.

Table 2
Unit root tests: Augmented Dickey-Fuller (constant) and Zivot-Andrews (single endogenous break), levels and first differences.

Variable	ADF level	ADF p	ADF Δ (diff)	ADF Δ p	ZA level	ZA level p	ZA Δ	ZA Δ p
GSE-CI	1.73	0.998	-9.58	< 0.001	-1.44	0.999	-11.66	< 0.001
GSE-FSI	-2.49	0.117	-8.26	< 0.001	-2.97	0.920	-9.44	< 0.001
MPR	-1.41	0.579	-3.76	0.003	-5.11	0.020	-4.50	0.119
TBR	-1.84	0.358	-8.49	< 0.001	-5.12	0.019	-8.77	< 0.001
MSG	8.50	1.000	-4.18	< 0.001	2.70	0.999	-4.03	0.335
EXR	2.52	0.999	-10.96	< 0.001	-3.22	0.832	-12.26	< 0.001
INF	-2.08	0.255	-3.30	0.015	-4.51	0.117	-5.60	0.003
OIL	-2.72	0.071	-8.36	< 0.001	-3.82	0.463	-8.05	< 0.001

Source: Authors' estimation. Augmented Dickey-Fuller and Zivot-Andrews tests computed on the series described in Table 1 *and* Section 3.1.

4.3 Causality Test Results

Table 3 reports standard Granger causality (on differenced, stationary series) and Toda-Yamamoto results for both directions between each macro-financial variable and each equity index. The evidence for policy-rate-to-equity causality is weak: for GSE-CI, the Toda-Yamamoto Wald test for MPR-to-GSE-CI causality is not significant ($\chi^2 = 3.75$, df = 4, $p = 0.442$), and the reverse direction is also not significant ($\chi^2 = 6.42$, df = 4, $p = 0.170$); the pattern is similar for GSE-FSI (MPR-to-GSE-FSI: $\chi^2 = 8.15$, df = 6, $p = 0.227$). The one robust causal relationship we identify runs from money-supply growth to GSE-CI (Toda-Yamamoto $\chi^2 = 50.72$, df = 8, $p < 0.001$), which is not matched by the standard Granger test on differenced series ($p = 0.249$) — illustrating why the level-VAR-based Toda-Yamamoto approach is preferable to relying on a single differenced-series test alone. We also find weak evidence (Toda-Yamamoto $p = 0.046$) of exchange-rate-to-GSE-FSI causality. No other macro-financial variable shows a statistically significant causal relationship with either equity index at the 5 percent level under either test.

Table 3
Granger and Toda-Yamamoto causality tests between macro-financial variables and equity returns (both directions).

Equity	Macro var.	TY χ^2 (Macro→Eq)	df	p	TY χ^2 (Eq→Macro)	df	p
GSE-CI	MPR	3.74	4	0.442	6.42	4	0.170
GSE-CI	TBR	1.15	2	0.562	4.25	2	0.119
GSE-CI	MSG	50.72	8	<0.001	9.91	8	0.271
GSE-CI	EXR	4.81	3	0.187	0.51	3	0.917
GSE-CI	INF	6.24	8	0.620	6.92	8	0.546
GSE-CI	OIL	0.73	2	0.696	0.95	2	0.623
GSE-FSI	MPR	8.15	6	0.227	3.65	6	0.724
GSE-FSI	TBR	0.83	2	0.660	1.71	2	0.425
GSE-FSI	MSG	0.25	2	0.884	0.89	2	0.642
GSE-FSI	EXR	9.68	4	0.046	0.38	4	0.984
GSE-FSI	INF	6.62	6	0.357	1.97	6	0.922
GSE-FSI	OIL	0.52	2	0.770	1.59	2	0.452

Source: Authors' estimation, following Toda and Yamamoto (1995)

Table 4 reports instantaneous (contemporaneous) causality and Breusch-Godfrey diagnostics from the underlying bivariate VAR systems. The only relationship significant at the 1 percent level is between the Treasury bill rate and GSE-FSI (correlation = 0.33, $\chi^2 = 15.26$, $p < 0.001$), consistent with a same-month funding-cost linkage specific to the bank-heavy financial index; oil price shocks show a marginally significant contemporaneous relationship with GSE-CI ($\chi^2 = 4.14$, $p = 0.042$). All twelve Breusch-Godfrey LM statistics are statistically insignificant (all $p > 0.20$), indicating no evidence of residual serial correlation and supporting the adequacy of the selected lag structures. We note explicitly that a non-significant Breusch-Godfrey statistic — not a significant one — is the result that indicates the absence of serial correlation. The full six-variable VAR selects a lag order of 1 by AIC and satisfies the stability condition, with all companion-matrix inverse-root moduli below 0.53.

Table 4
Instantaneous (contemporaneous) causality and Breusch-Godfrey serial-correlation diagnostics.

Equity	Macro var.	Corr.	χ^2 (inst.)	p (inst.)	BG LM stat	BG LM p
GSE-CI	MPR	0.024	0.07	0.785	0.86	0.931
GSE-CI	TBR	-0.023	0.07	0.794	3.15	0.533
GSE-CI	MSG	-0.063	0.51	0.475	3.45	0.485
GSE-CI	EXR	0.127	2.08	0.149	3.83	0.429
GSE-CI	INF	-0.065	0.53	0.466	2.88	0.578
GSE-CI	OIL	0.178	4.14	0.042	5.39	0.250
GSE-FSI	MPR	0.004	0.00	0.960	5.82	0.213
GSE-FSI	TBR	0.333	15.26	< 0.001	0.82	0.936
GSE-FSI	MSG	-0.090	1.05	0.305	1.40	0.844
GSE-FSI	EXR	0.075	0.73	0.394	1.25	0.870
GSE-FSI	INF	0.066	0.56	0.456	4.95	0.293
GSE-FSI	OIL	0.070	0.65	0.422	2.15	0.708

Source: Authors' estimation from the bivariate VAR systems underlying Table 3.

4.4 Bayesian Quantile Regression Results

Figure 3 and Tables 5 and 6 report posterior means, 95 percent credible intervals, and Bayesian model averaging posterior inclusion probabilities (MPIP) for GSE-CI and GSE-FSI respectively, at each of the eight estimated quantiles. All coefficients are standardised (effect in SD of return per 1-SD change in the predictor). All reported Gelman-Rubin R-hat statistics are below 1.01, indicating satisfactory MCMC convergence.

Table 5
Bayesian quantile regression: posterior means [95% credible interval] and MPIP for GSE-CI (standardised coefficients).

Quantile	MPR: mean [CI]	MPIP	TBR: mean [CI]	MPIP	MSG: mean [CI]	MPIP	EXR: mean [CI]	MPIP	INF: mean [CI]	MPIP	OIL: mean [CI]	MPIP
0.05	0.149 [-0.04, 0.32]	0.34	0.129 [-0.12, 0.49]	0.13	-0.029 [-0.26, 0.20]	0.10	0.145 [-0.05, 0.33]	0.33	-0.241 [-0.41, 0.02]	0.12	0.102 [-0.05, 0.27]	0.12
0.10	0.020 [-0.18, 0.20]	0.10	-0.014 [-0.22, 0.26]	0.14	-0.050 [-0.23, 0.14]	0.12	0.184 [0.03, 0.34]	0.57	-0.103 [-0.34, 0.18]	0.11	0.095 [-0.07, 0.25]	0.08
0.25	-0.084 [-0.22, 0.08]	0.09	-0.075 [-0.24, 0.10]	0.12	0.012 [-0.12, 0.15]	0.10	0.188 [0.05, 0.33]	0.25	-0.047 [-0.20, 0.12]	0.12	0.057 [-0.04, 0.16]	0.09
0.30	-0.086 [-0.22, 0.07]	0.09	-0.085 [-0.26, 0.08]	0.12	0.031 [-0.11, 0.16]	0.11	0.171 [0.02, 0.31]	0.18	-0.038 [-0.18, 0.12]	0.10	0.073 [-0.04, 0.18]	0.12
0.50	-0.039 [-0.17, 0.10]	0.08	-0.099 [-0.31, 0.06]	0.14	0.014 [-0.13, 0.15]	0.08	0.100 [-0.06, 0.30]	0.09	-0.048 [-0.21, 0.11]	0.13	0.137 [-0.02, 0.29]	0.17
0.75	-0.028 [-0.19, 0.13]	0.10	-0.122 [-0.32, 0.06]	0.15	-0.043 [-0.18, 0.11]	0.12	0.045 [-0.10, 0.21]	0.08	-0.046 [-0.22, 0.09]	0.10	0.296 [0.17, 0.45]	0.94
0.80	-0.053 [-0.23, 0.14]	0.16	-0.095 [-0.33, 0.09]	0.11	-0.055 [-0.21, 0.12]	0.11	0.048 [-0.13, 0.23]	0.09	-0.044 [-0.24, 0.11]	0.10	0.335 [0.18, 0.48]	0.95
0.90	-0.045 [-0.27, 0.18]	0.15	-0.037 [-0.31, 0.22]	0.09	-0.189 [-0.45, 0.12]	0.19	0.104 [-0.09, 0.32]	0.14	-0.130 [-0.39, 0.09]	0.15	0.338 [0.12, 0.52]	0.74

Source: *Authors' estimation. Posterior means, 95% credible intervals, and Bayesian model averaging posterior inclusion probabilities (MPIP) from the Gibbs sampler described in* Section 3.2.3.

Table 6
Bayesian quantile regression: posterior means [95% credible interval] and MPIP for GSE-FSI (standardised coefficients).

Quantile	MPR: mean [CI]	MPIP	TBR: mean [CI]	MPIP	MSG: mean [CI]	MPIP	EXR: mean [CI]	MPIP	INF: mean [CI]	MPIP	OIL: mean [CI]	MPIP
0.05	0.081 [-0.19, 0.28]	0.30	0.302 [0.14, 0.48]	0.98	0.050 [-0.13, 0.21]	0.12	0.026 [-0.14, 0.24]	0.24	0.028 [-0.20, 0.25]	0.14	-0.077 [-0.19, 0.03]	0.21
0.10	-0.056 [-0.25, 0.13]	0.10	0.269 [0.12, 0.41]	0.95	-0.086 [-0.22, 0.09]	0.11	0.142 [-0.06, 0.34]	0.16	-0.001 [-0.22, 0.20]	0.16	0.016 [-0.13, 0.16]	0.08
0.25	-0.050 [-0.19, 0.07]	0.10	0.255 [0.05, 0.43]	0.55	-0.000 [-0.12, 0.10]	0.08	0.049 [-0.05, 0.16]	0.11	0.010 [-0.14, 0.16]	0.17	0.015 [-0.08, 0.12]	0.08
0.30	-0.054 [-0.20, 0.08]	0.09	0.260 [0.06, 0.42]	0.42	0.004 [-0.11, 0.11]	0.08	0.049 [-0.05, 0.17]	0.11	0.005 [-0.14, 0.15]	0.17	0.010 [-0.09, 0.11]	0.08
0.50	-0.129 [-0.26, 0.03]	0.13	0.277 [0.10, 0.43]	0.40	0.016 [-0.13, 0.17]	0.08	0.072 [-0.05, 0.21]	0.12	-0.035 [-0.18, 0.10]	0.10	0.038 [-0.12, 0.18]	0.11
0.75	-0.095 [-0.21, 0.02]	0.21	0.202 [-0.10, 0.47]	0.09	-0.001 [-0.14, 0.13]	0.11	0.040 [-0.12, 0.18]	0.09	-0.111 [-0.28, 0.06]	0.14	0.152 [-0.03, 0.32]	0.17
0.80	-0.088 [-0.22, 0.03]	0.21	0.171 [-0.14, 0.47]	0.09	0.004 [-0.13, 0.14]	0.11	0.027 [-0.13, 0.17]	0.09	-0.121 [-0.29, 0.06]	0.20	0.176 [-0.02, 0.34]	0.25
0.90	-0.094 [-0.26, 0.06]	0.12	0.184 [-0.09, 0.46]	0.10	-0.019 [-0.22, 0.19]	0.10	-0.008 [-0.18, 0.15]	0.09	-0.108 [-0.29, 0.07]	0.25	0.254 [0.06, 0.44]	0.49

Source: Authors' estimation. Posterior means, 95% credible intervals, and Bayesian model averaging posterior inclusion probabilities (MPIP) from the Gibbs sampler described in Section 3.2.3.

For GSE-CI, the posterior mean effect of the standardised policy rate shock is small and inconsistent in sign across the distribution, ranging from 0.149 (95% CI: -0.044 to 0.322) at the fifth percentile to -0.045 (-0.273 to 0.181) at the ninetieth percentile; the associated MPIP never exceeds 0.34 at any quantile, indicating weak posterior support for including the policy rate shock as a predictor at any point in the distribution. In contrast, the standardised oil-price return shows a posterior mean effect that grows from 0.102 at the fifth percentile to 0.338 at the ninetieth percentile, with MPIP rising sharply at upper quantiles — 0.939 at $\tau = 0.75$ and 0.947 at $\tau = 0.80$ (both “very strong” evidence), receding to 0.736 (“substantial”) at $\tau = 0.90$. This indicates that global oil-price shocks, rather than the domestic policy rate, are the predictor with the strongest and most consistent posterior support for explaining GSE-CI returns during bullish market conditions — plausibly reflecting Ghana's status as an oil producer since 2011.

For GSE-FSI, the policy rate shock again shows weak MPIP throughout (maximum 0.298, at the fifth percentile). The standardised Treasury bill rate change instead carries very strong posterior support at the lower quantiles — MPIP of 0.984 at $\tau = 0.05$ and 0.951 at $\tau = 0.10$ — declining to weak support (MPIP below 0.10) by the upper quantiles. This concentration of Treasury-bill-rate relevance at the lower tail of the GSE-FSI return distribution is consistent with a funding-cost channel that binds specifically during episodes of financial-sector stress.

Tables 5 and 6 (landscape, following page) report full posterior means with 95% credible intervals and MPIP for every quantile and predictor.

4.5 Impulse Response Functions and Forecast Error Variance Decomposition

The orthogonalised impulse response of GSE-CI returns to a one-standard-deviation policy rate shock is small in magnitude throughout the twelve-month horizon (peak absolute response of 0.62 percentage points at month two, decaying toward zero by month five), and its sign alternates across the horizon rather than showing a sustained directional effect (Fig. 4). Forecast error variance decomposition (Fig. 5) shows that the policy rate shock accounts for 0.6 percent of GSE-CI return variance at a one-month horizon, rising gradually to 2.9 percent at twelve months; the equity index's own shock continues to account for the large majority of its variance even at twelve months (76.1 percent for GSE-CI, 82.3 percent for GSE-FSI). Among the macro-financial shocks, oil price shocks account for the largest share of twelve-month GSE-CI variance among non-own shocks (6.8 percent), while the Treasury bill rate accounts for the largest share of twelve-month GSE-FSI variance among non-own shocks (6.0 percent). We emphasise that these are modest shares in absolute terms: even summed across all five macro-financial shocks, aggregate explained variance in equity returns remains below 24 percent at the twelve-month horizon for both indices.

4.6 Wavelet Coherence Results

Band-averaged wavelet coherence between the policy rate shock and GSE-CI returns is 0.264 in the short-run band (1–6 months), 0.329 in the medium-run band (6–18 months), and 0.452 in the long-run band (18–36 months) — coherence increases with horizon rather than peaking at medium-run frequencies (Fig. 6). For GSE-FSI, the pattern is less monotonic: coherence is 0.289 short-run, 0.261 medium-run, and 0.326 long-run, with the medium-run band showing the weakest co-movement. Comparing crisis and non-crisis sub-periods, medium-band coherence for GSE-FSI is higher during the 2014–2016 and 2022–2023 crisis windows than during calmer periods (0.329 versus 0.248), consistent with crisis-driven intensification of co-movement for the financial-sector index specifically; the same comparison for GSE-CI shows no such intensification (0.169 during crisis windows versus 0.198 otherwise). Given the sample length, long-run band estimates should be treated as indicative rather than precise.

5. Discussion

5.1 A More Modest Role for the Policy Rate Than Commonly Assumed

Across every method employed — Toda-Yamamoto causality, Bayesian quantile regression with model averaging, and forecast error variance decomposition — the domestic policy rate shows a smaller and less consistent relationship with Ghanaian equity returns than a discount-rate-channel prior would suggest. This is not, in our view, evidence that monetary policy is irrelevant to Ghana's financial system; rather, it is consistent with a market that is too thin, too concentrated, and too dominated by idiosyncratic firm- and liquidity-level dynamics for the policy rate specifically to leave a statistically detectable, consistent fingerprint on aggregate index returns at monthly frequency. The stronger and more consistent signal we do find — for money-supply growth and for the Treasury bill rate — suggests that liquidity conditions and short-term funding costs, rather than the headline policy rate itself, may be the more proximate channel through which monetary conditions reach Ghanaian equities.

5.2 Oil Prices as an Under-Appreciated Driver of Upper-Quantile Returns

The finding that oil-price shocks carry very strong posterior inclusion probability for GSE-CI returns specifically at upper (bullish) quantiles is, to our knowledge, not a relationship that has previously received sustained attention in the Ghana-specific equity literature, which has tended to focus on the policy rate and the exchange rate. Ghana has been a net oil

producer since the Jubilee field began production in December 2010, and the finding that global oil-price strength is most closely associated with the market's best-performing states — rather than exerting a uniform effect throughout the distribution — is consistent with an interpretation in which oil-revenue-driven optimism about government finances and the broader economy amplifies bullish sentiment specifically, without necessarily providing equivalent downside protection during bearish episodes.

5.3 A Funding-Cost Channel Concentrated in Financial-Sector Stress States

The concentration of Treasury-bill-rate relevance at the lower quantiles of GSE-FSI returns — alongside a strong, significant same-month correlation between the two series overall — points to a specific and economically intuitive channel: short-term funding costs matter most for bank-heavy equity valuations precisely when the financial sector is already under stress, rather than uniformly across market conditions. This state-dependent pattern would not be visible in a conventional mean-regression framework and illustrates the value of the quantile-based approach for policy-relevant inference, particularly for macroprudential authorities concerned specifically with tail risk in the financial sector rather than average-case dynamics.

5.4 Time-Frequency Dynamics: Horizon-Increasing Rather Than Medium-Run-Dominant Co-movement

Our wavelet coherence results indicate that co-movement between the policy rate shock and GSE-CI returns strengthens as the horizon lengthens, rather than peaking at a medium-run “sweet spot,” a pattern that differs from the commonly cited medium-run dominance found in some advanced-economy monetary-equity coherence studies. We interpret rising long-run coherence with some caution given the reduced number of complete cycles available at the longer end of an eleven-year sample. The GSE-FSI result — weakest coherence at medium-run frequencies, with crisis-period intensification concentrated at that same medium-run band — suggests financial-sector equities may be more sensitive to acute, medium-horizon stress episodes than to the smoother monetary cycle that GSE-CI's long-run coherence appears to track.

5.5 Practical and Policy Implications

These findings carry distinct implications for three audiences with a stake in Ghana's equity market: the Bank of Ghana, macroprudential regulators, and investors.

For monetary policymakers, the central implication is a cautionary one. A substantial body of work in advanced-economy settings treats equity prices as a fast, informative channel through which policy stances are transmitted and can be read back by the central bank (Bernanke and Kuttner 2005; Rigobon and Sack 2004). Our results suggest this channel operates only weakly, if at all, in Ghana's equity market: policy rate shocks show no robust Granger-causal relationship with either index, weak posterior support in the Bayesian quantile regressions, and a forecast error variance contribution that remains below 3 percent at a twelve-month horizon. This is broadly consistent with the view that monetary transmission through asset prices depends on financial market depth and credibility (Mishkin 1996), both of which remain constrained in Ghana's frontier setting. Practically, this means the Bank of Ghana should not expect the policy rate to function as a reliable lever for managing equity market conditions, nor should it treat GSE movements as a dependable real-time signal of how a given rate decision is being received by market participants. Communication strategies aimed at the equity market specifically are therefore likely to have limited traction compared with communication aimed at the foreign exchange or money markets, where transmission is more direct.

For macroprudential regulators, the more policy-relevant signal in our results is the concentration of Treasury-bill-rate sensitivity in the lower quantiles of GSE-FSI returns. This is consistent with the broader macroprudential literature's emphasis on funding-cost and liquidity channels as sources of financial-sector fragility, distinct from solvency risk per se (Claessens, Ghosh and Mihet 2013; Cecchetti and Kohler 2014). Because this sensitivity is state-dependent rather than uniform across market conditions, standard stress-testing exercises that examine only average-case rate sensitivity may

understate the risk that short-term funding-cost increases pose, specifically during periods when the financial sector is already under pressure. This argues for macroprudential monitoring frameworks that track banking-sector equity valuations conditional on prevailing market stress, rather than relying solely on unconditional interest-rate sensitivity measures.

For investors and portfolio managers, our results point away from the policy rate and toward two more specific risk factors. The strong upper-quantile association between oil price shocks and GSE-CI returns suggests that global commodity price risk, rather than domestic monetary policy risk, is the more material factor for anyone holding broad Ghanaian equity exposure during favourable market conditions — consistent with evidence elsewhere that resource-linked equity markets carry a distinct commodity-price risk premium. For financial-sector-specific exposure, the concentration of Treasury-bill-rate sensitivity in bearish states implies that short-term funding-cost indicators may offer more useful downside risk signals for GSE-FSI than the policy rate itself, a distinction that would not be visible from a conventional mean-based risk model (Jansen and Tsai 2010; Kontonikas, MacDonald & Saggu 2013). More generally, the weak and inconsistent policy-rate effect we document across quantiles reinforces the case, made elsewhere in the quantile and model-averaging literature, for distributional rather than average-effect risk assessment in frontier markets characterised by regime-dependent dynamics (Koop and Korobilis 2012).

5.6 Limitations and Directions for Future Research

Several limitations warrant explicit acknowledgment. First, GSE-FSI values for January 2014-December 2017 are log-linearly interpolated between real annual anchors rather than directly observed at monthly frequency; results specific to that earlier sub-period should be treated with corresponding caution. Second, a small number of 2024 observations across the MPR, TBR, money-supply, and exchange-rate series are interpolated between real anchor points documented in the data appendix; while each interpolation is bounded by real, independently sourced values, this introduces some additional measurement uncertainty specific to 2024. Third, our sample, while covering a rich set of macro-financial episodes, spans only eleven years (131 monthly return observations), which is modest by the standards of time-series macro-finance and limits the precision of long-horizon wavelet estimates in particular. Fourth, the Bayesian model averaging exercise is conducted over a fixed candidate set of six macro-financial predictors; extending this to a larger candidate set, including firm-level and sectoral variables, is a natural direction for future work. Finally, our Cholesky identification in the VAR imposes a specific contemporaneous ordering; while this is a standard and defensible choice given the theoretical priority of monetary policy in the transmission chain, future work testing sensitivity to alternative identification schemes would be welcome once a longer post-2014 sample is available.

6. Conclusion

This study provides a rigorous, multi-method re-examination of monetary policy transmission to Ghanaian equity returns using real, independently verified monthly data spanning January 2014 to December 2024 — the period for which the Ghana Stock Exchange's current Composite and Financial Stock Indices are directly comparable in construction. Contrary to a discount-rate-channel prior, we find limited, statistically inconsistent evidence that the domestic policy rate itself drives equity returns in this market, whether assessed through Granger-causal ordering, distributional quantile regression with model averaging, or forecast error variance decomposition. Instead, our results point to two more specific and more policy-relevant channels: global oil-price shocks are strongly associated with bullish upper-quantile GSE-CI returns, consistent with Ghana's status as an oil producer since 2011; and short-term Treasury bill rates carry a distinctly state-dependent relationship with GSE-FSI returns, concentrated in the lower (bearish) quantiles associated with financial-sector stress. Wavelet coherence further indicates that monetary-equity co-movement strengthens with horizon for the composite index while remaining more episodically concentrated for the financial-sector index. Collectively, these findings suggest that policymakers, investors, and regulators focused on Ghana's equity market may derive more diagnostic value from monitoring global commodity prices and short-term funding costs than from the policy rate in isolation.

Declarations

Ethical Approval and Consent to Participate:

Not applicable

Consent for Publication:

Not applicable

Declarations of Generative AI and AI-assisted Technologies in the Manuscript Preparation Process:

During the preparation of this work, the authors used Cursor version 2.4.37 to write and edit the Python script used for data analysis and visualisation. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Author Contribution

Conceptualization, I.N. and G.O.F.; methodology, I.N. & G.O.F.; software, G.O.F.; validation, I.N. and G.O.F.; formal analysis, I.N. and G.O.F.; investigation, I.N. and G.O.F.; resources, I.N. and G.O.F.; writing—original draft preparation, I.N. and G.O.F; writing—review and editing, I.N. and G.O.F.; supervision, G.O.F. All authors have read and agreed to the publication of the manuscript.

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Data Availability

The dataset and Python script used for data analysis and visualisation are available as supplementary files on the figshare repository at: https://figshare.com/s/a1ca7209c7d16029167b.

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Figures

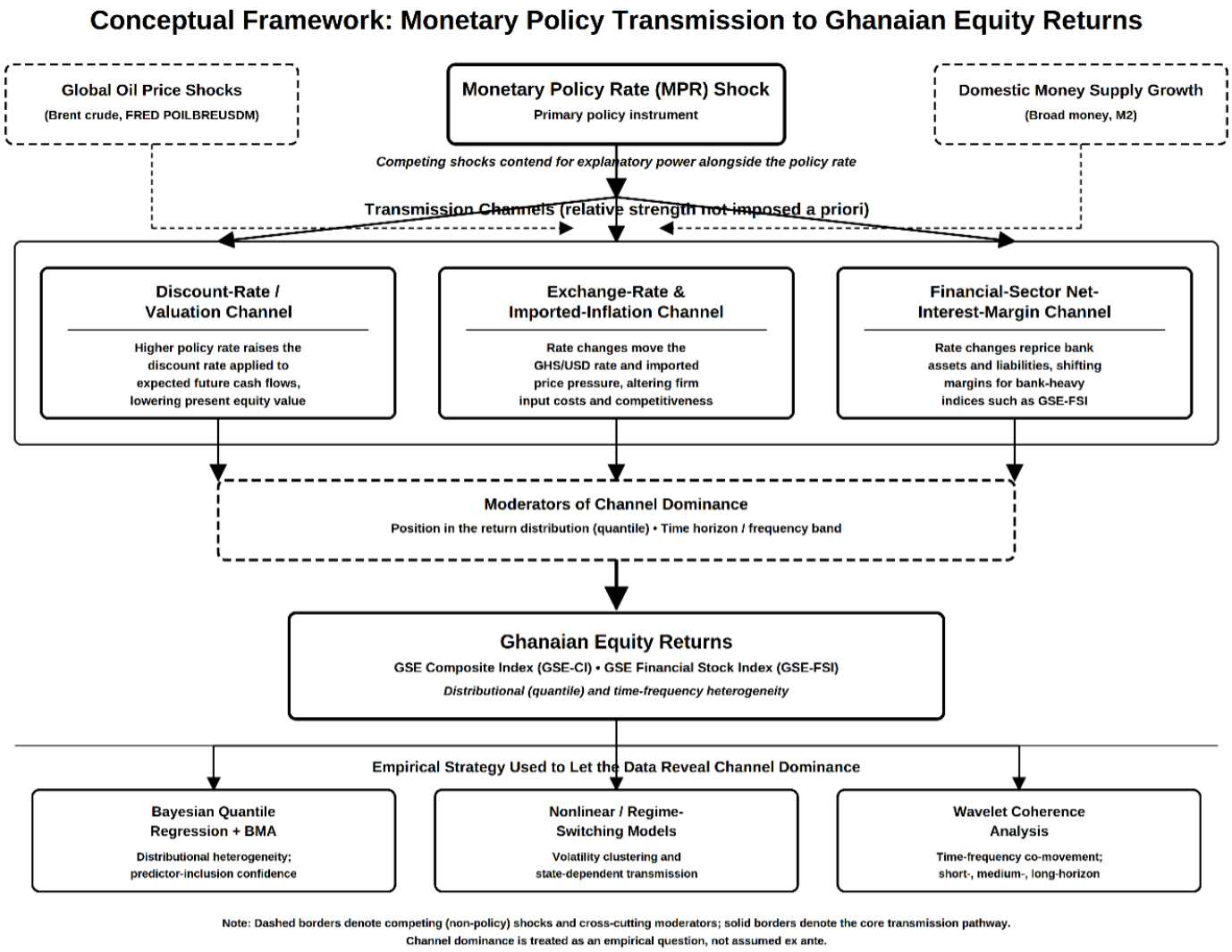


Figure 1

Conceptual framework linking monetary policy rate shocks to Ghanaian equity returns through three competing transmission channels: a discount-rate/valuation channel, an exchange-rate and imported-inflation channel, and a financial-sector net-interest-margin channel relevant to bank-heavy indices such as GSE-FSI, alongside global oil price shocks and domestic money supply growth as competing sources of explanatory power. *Note: The relative strength of each channel is treated as an empirical question rather than assumed a priori, and is allowed to vary across the position in the return distribution (quantile) and across time horizons (frequency band) before manifesting in returns on the GSE Composite Index (GSE-CI) and GSE Financial Stock Index (GSE-FSI). The bottom row summarizes the empirical strategy used to identify channel dominance: Bayesian quantile regression with Bayesian model averaging (distributional heterogeneity and predictor-inclusion confidence), nonlinear/regime-switching models (volatility clustering and state-dependent transmission), and wavelet coherence analysis (time-frequency co-movement across short, medium, and long horizons).*

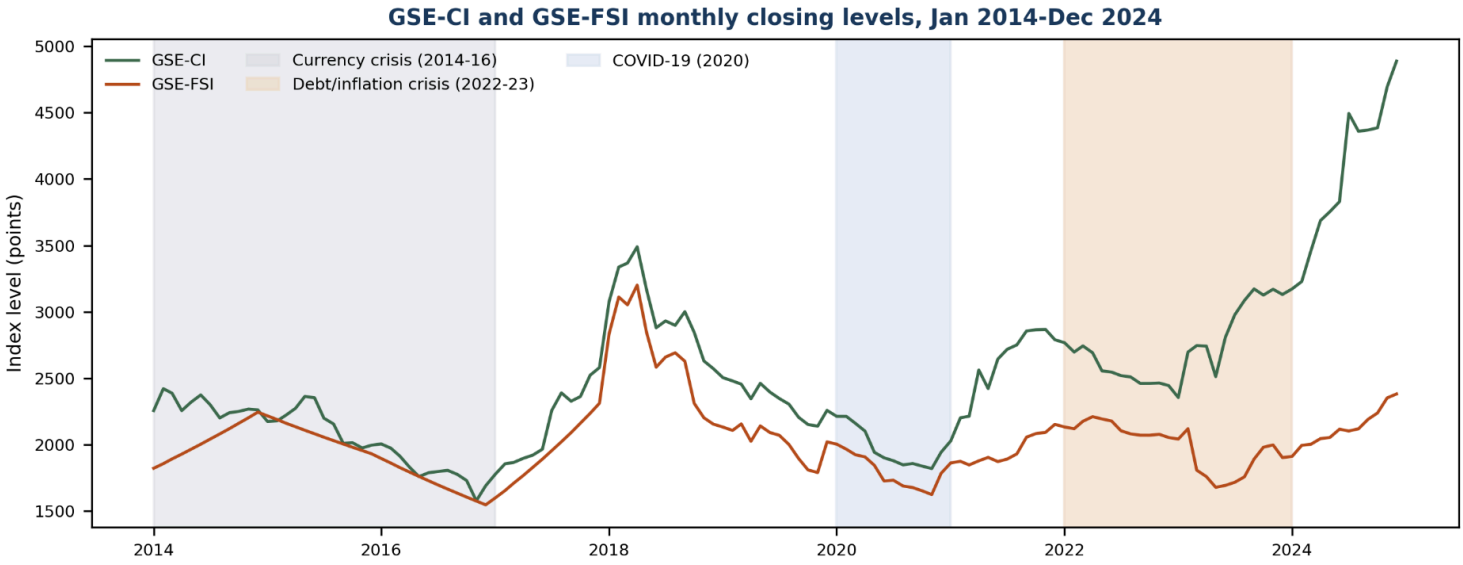


Figure 2

GSE-CI and GSE-FSI monthly closing levels, January 2014-December 2024, with major crisis episodes shaded.

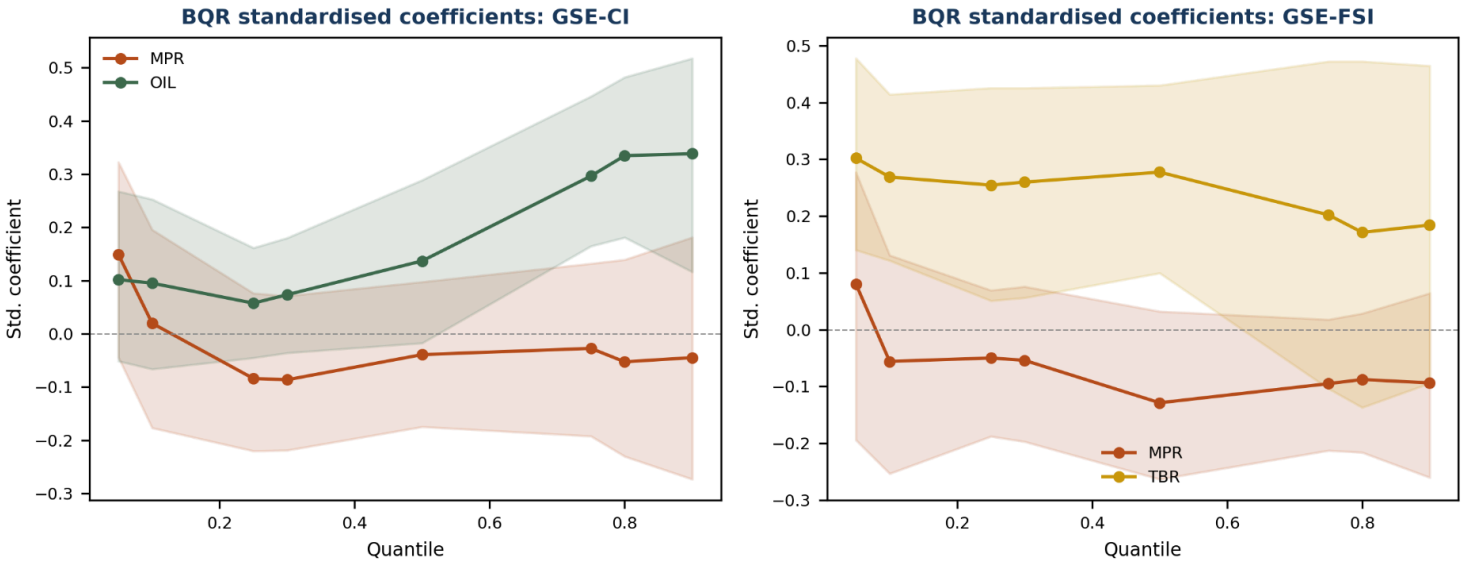


Figure 3

Bayesian quantile regression standardised coefficients (posterior mean ± 95% credible interval) across quantiles: MPR and OIL for GSE-CI; MPR and TBR for GSE-FSI.

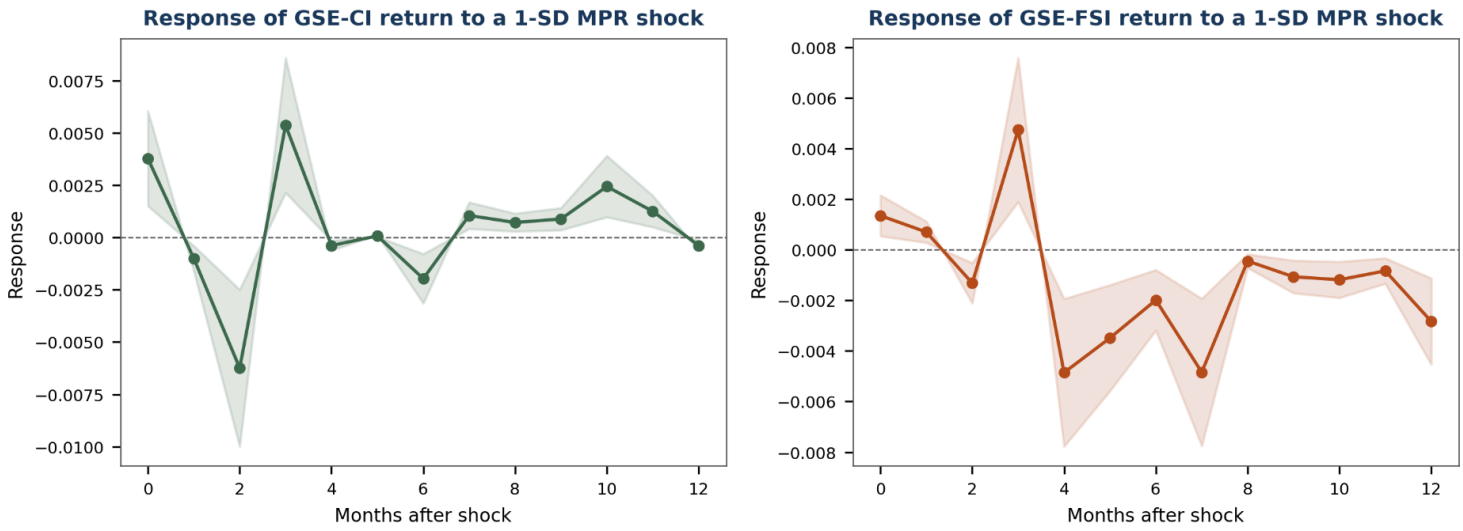


Figure 4

Orthogonalised impulse response of GSE-CI and GSE-FSI returns to a one-standard-deviation MPR shock, 0-12 month horizon.

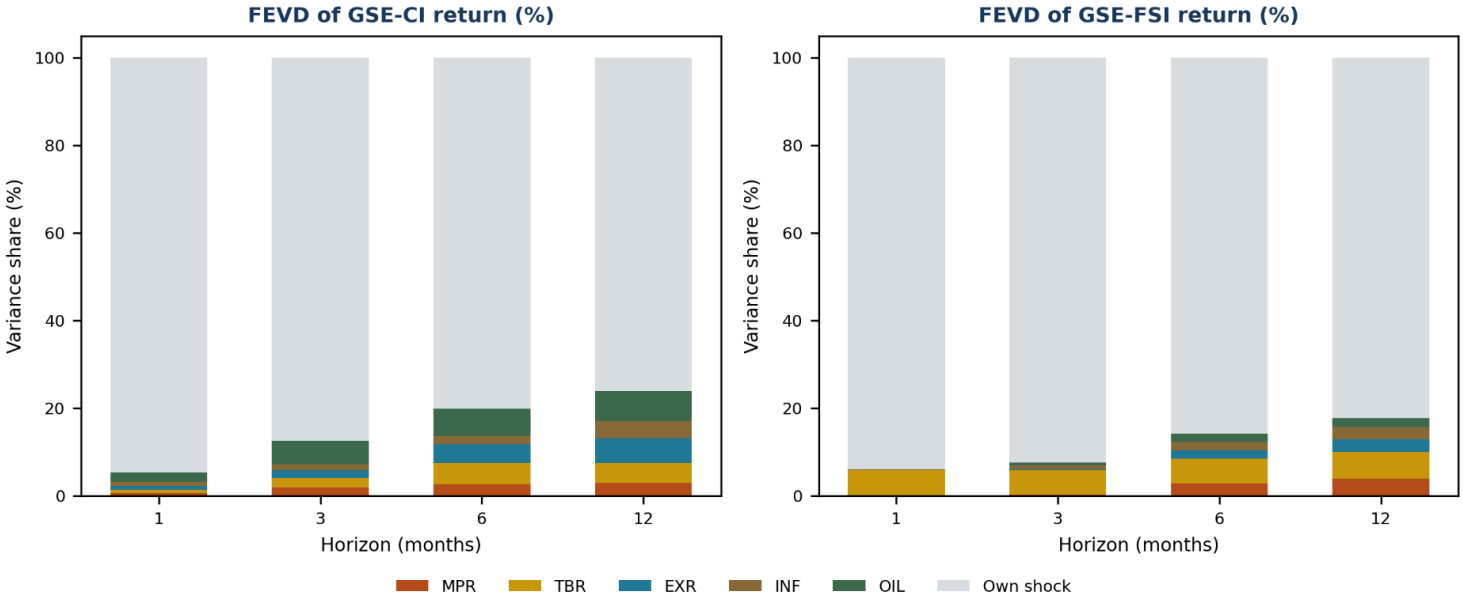


Figure 5

Forecast error variance decomposition of GSE-CI and GSE-FSI returns (%), 1/3/6/12-month horizons.

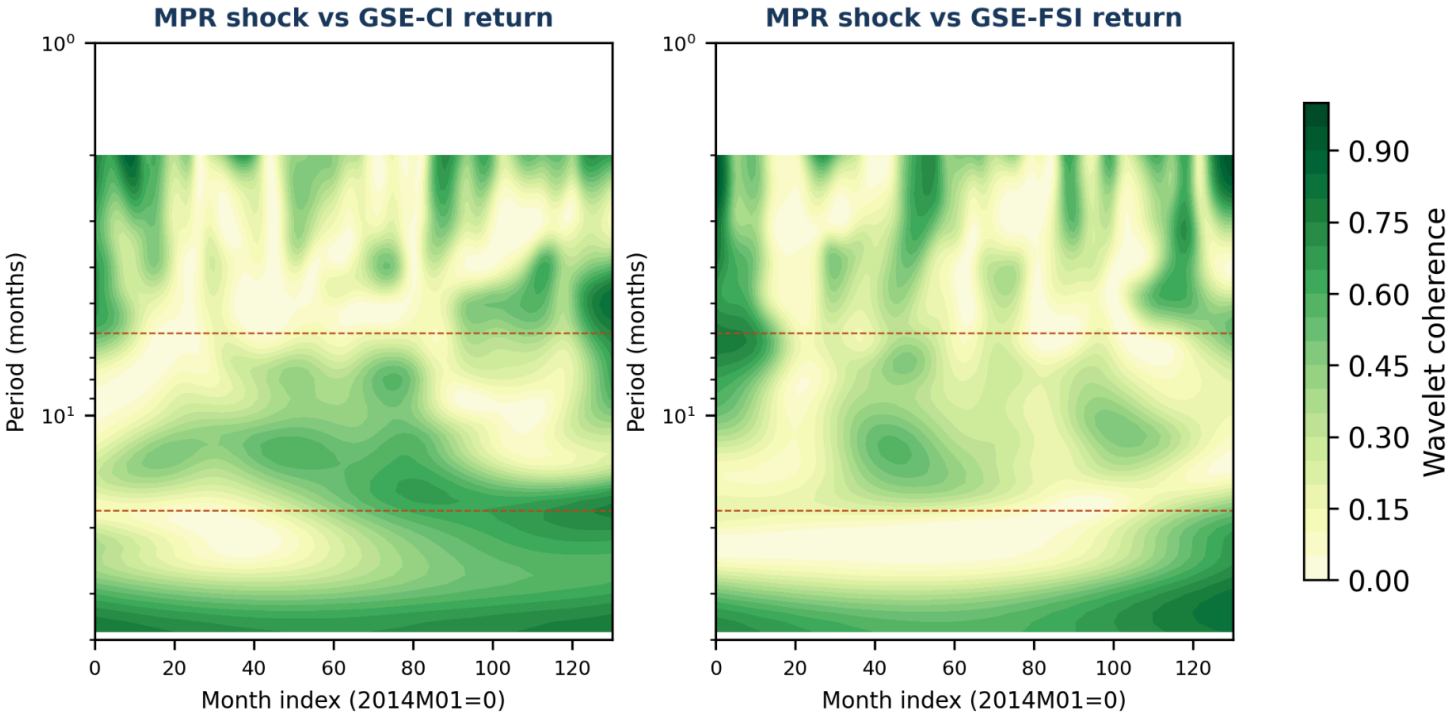


Figure 6

Wavelet coherence between the MPR shock and GSE-CI / GSE-FSI returns. Dashed lines mark the 6- and 18-month band boundaries.