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Currency Volatility and Indian Gold Prices: A Multi-Currency Analysis

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Outline

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Context

- India is the second-largest consumer of gold in the world, where the yellow metal holds not just financial value but also deep cultural significance. Thus, it remains integral to Indian households and the economy.
- Beyond traditional supply and demand factors, an important yet complex player comes into focus: currency exchange rates.
- The Indian rupee's strength—or weakness—against major global currencies like the US dollar, euro, or yen often ripples through the domestic gold market, can potentially affect millions of buyers and investors alike.
- In this context, understanding the intricate dynamics of currency exchange rate fluctuations and their impact on gold prices becomes crucial. This research dives into a multi-currency analysis, aiming to answer a key question: How do exchange rate fluctuations against the Indian rupee influence domestic gold prices?
- This study not only identifies these links but also highlights their implications for policymakers, investors, and everyday consumers in a globally interconnected economy.

Literature Review

- Gold acts as a hedge during both stable and stressed economic conditions ([Beckmann et al. 2019](#); [Harris & Shen, 2017](#)).
- Increased gold investment during economic underperformance ([Jain & Biswal, 2016](#)).
- Popular substitute hedge post-Global Financial Crisis ([Kirkulak Uludag & Lkhamazhapov, 2014](#)).
- Safe haven against exchange rate volatility ([Beckmann et al., 2019](#); [Ji et al., 2020](#)).
- Strong academic interest in gold investment over the past 20 years ([O'Connor et al., 2015](#)).
- Exchange rate fluctuations contribute to gold price volatility ([Jain & Biswal, 2016](#); [Pukthuanthong & Roll, 2011](#)).
- USD depreciation leads to rising gold prices in USD ([Pukthuanthong & Roll, 2011](#)).
- An overview of the ongoing COVID-19 crisis highlights that this outbreak has brought intense and widespread uncertainty to the financial markets, unprecedented even by the GFC ([Baker, Bloom, Davis, & Terry, 2020](#); [Goodell, 2020](#)).
- Recent studies ([Ilzetki, Reinhart, & Rogoff, 2020](#); [Yilmazkuday, 2021](#)) have indicated that many advanced and emerging economies have adopted unconventional macroeconomic measures in response to the COVID-19's impact on the exchange rate, promoting zero-bound interest rates to prevent disruption in the long-term downward trend in exchange rate volatility.

Research Gap

Most studies have primarily focused on the US dollar's influence on gold prices. There is a need to investigate the impact of a broader range of major currencies, particularly during periods of heightened global uncertainty.

This research gap suggests a need for a comprehensive analysis that:

- Examines the impact of major currency exchange rate fluctuations against the Indian Rupee on domestic gold prices, considering both normal and crisis periods.
- Compares the pre-COVID-19 and post-COVID-19 periods to assess any changes in the relationship between exchange rates and gold prices.
- Utilizes a multi-currency approach to capture the influence of various currencies on gold prices.

By addressing these gaps, this research can provide valuable insights into the role of gold as a safe-haven asset and its potential as a hedge against currency risk during periods of economic and financial turmoil.

Objectives

The research addresses several key questions (Objectives)

- How do fluctuations in each of the nine major currencies against the INR independently affect domestic gold prices in India?
- How do these relationships vary during periods of economic stability versus crisis?

Understanding these relationships is crucial for various stakeholders, including policymakers, financial institutions, investors, and the jewellery industry. The findings will contribute to more effective risk management strategies and policy formulation in India's gold market.

Data Specification - The study uses monthly timeseries data from Reserve Bank of India, outlined in the table.

Variables	Notations	Source
Dependent Variable		
Bullion Price(Mumbai Gold Standard) INR oer 10 grams	Gold Price	Reserve Bank of India
Independent Variables		
Indian Rupee to United States Dollar	INR-USD	Reserve Bank of India
Indian Rupee to Japanese Yen	INR-EUR	Reserve Bank of India
Indian Rupee to Euro	INR-JPY	Reserve Bank of India
Indian Rupee to Pound	INR-GBP	Reserve Bank of India
Indian Rupee to Danish Krone	INR-DKK	Reserve Bank of India
Indian Rupee to Norwegian Krone	INR-NOK	Reserve Bank of India
Indian Rupee to Swiss Franc	INR-CHF	Reserve Bank of India
Indian Rupee to United Arab Emirates dirham	INR-AED	Reserve Bank of India
Indian Rupee to Singapore Dollar	INR-SGD	Reserve Bank of India

Methodology

- This study will test the statistical properties of the time series of variables using unit root tests such as the Augmented Dicky Fuller Test and Phillips-Perron (pp) test to verify the stationary of these variables.
- The relationship between the interpretive variable and the dependent variable will be tested and estimated using the cointegration according to the ARDL and NARDL methodologies and then determine the optimal model using Stata data analysis program.

Unit Root Test								
Variable Name		ADF Test				PP Test		
		Z (t) t-stat	5% C.V.	p - Value	Result	Z (p) t-stat	5% C.V.	Result
Level Form	Gold Price	0.085	-2.904	0.965	NS	-0.162	-13.564	NS
	INR - USD	-1.146		0.6962	NS	-2.743		NS
	INR - JPY	-1.72		0.421	NS	-4.03		NS
	INR - EUR	-1.514		0.5264	NS	-3.197		NS
	INR - GBP	-1.165		0.6886	NS	-3.655		NS
	INR - NOK	-2.613		0.0903	NS	-13.387		NS
	INR - DKK	-1.075		0.7252	NS	-2.18		NS
	INR - CHF	-0.55		0.8819	NS	-0.597		NS
	INR - AED	-1.148		0.6958	NS	-2.745		NS
	INR - SGD	-0.518		0.8884	NS	-2.743		NS
1st Difference Form	dGold Price	-6.985	-2.904	0	S	-60.811	-13.564	S
	dINR - USD	-7.806		0	S	-67.749		S
	dINR - JPY	-7.66		0	S	-67.307		S
	dINR - EUR	-9.057		0	S	-76.961		S
	dINR - GBP	-8.958		0	S	-80.008		S
	dINR - NOK	-8.29		0	S	-60.699		S
	dINR - DKK	-8.817		0	S	-65.798		S
	dINR - CHF	-9.346		0	S	-79.167		S
	dINR - AED	-7.801		0	S	-67.647		S
	dINR - SGD	-7.41		0	S	-54.656		S

Cointegration Test and Descriptive Statistics

Bound Test for Cointegration Bound Test for Cointegration

	1	2	3	4	5	6	7	8	9	5% Critical Value	
x	INR - USD	INR - JPY	INR - EUR	INR - GBP	INR - DKK	INR - NOK	INR - CHF	INR - SGD	INR-AED	Lower	Upper
tbdm	-2.469	-1.715	-1.243	-0.026	-0.43	0.343	-0.794	-1.257	-2.631	-3.22	-2.86
fpss	4.017	3.619	1.129	0.001	0.127	1.567	0.344	0.904	4.729	4.94	5.73

Decision: We fail to reject the H_0 = There is no cointegration between the exchange rates

Descriptive Statistics of Raw Data

Variable	Observations	Mean	Std. Dev	Mim.	Max.
Gold Price	95	34962.86	8443.496	25207	52917
INR - USD	95	69.04262	4.027548	62.04	76.24
INR - JPY	95	62.33667	5.491151	51.61	71.1
INR - GBP	95	93.00988	6.167432	81.24	103.21
INR - EUR	95	79.35333	5.69888	69.17	89.55
INR - DKK	95	10.55667	0.8098926	9.06	12.03
INR - NOK	95	8.1075	0.3494915	7.27	8.92
INR - CHF	95	71.66845	5.775826	63.71	82.82
INR - SGD	95	49.73	2.98395	44.98	54.46
INR - AED	95	18.79888	1.096316	16.8913	20.7569

Correlation Table

Variable	Gold Price	INR - USD	INR - JPY	INR - GBP	INR - EUR	INR - DKK	INR - NOK	INR - CHF	INR - SGD	INR - AED
Gold Price	1									
INR - USD	0.8734	1								
INR - JPY	0.8536	0.8986	1							
INR - GBP	0.4575	0.4298	0.1837	1						
INR - EUR	0.8659	0.7869	0.7675	0.4037	1					
INR - DKK	0.8793	0.8606	0.8429	0.4885	0.898	1				
INR - NOK	0.3146	0.3146	0.2766	0.4171	0.3215	0.5831	1			
INR - CHF	0.9599	0.9112	0.8347	0.5927	0.8385	0.9205	0.4482	1		
INR - SGD	0.9054	0.9397	0.8879	0.5079	0.8407	0.9437	0.5093	0.9415	1	
INR - AED	0.8734	0.9783	0.8986	0.4298	0.787	0.8606	0.3146	0.9112	0.9397	1

The Nonlinear Autoregressive Distributed Lag Model

The NARDL (p,q) model, as suggested by Shin et al. (2014), is as follows

$$y_t = \sum_{j=1}^p \phi_j y_{t-1} + \sum_{j=0}^q (\theta_j^+ x_{t-j}^+ + \theta_j^- x_{t-j}^-) + \varepsilon_t$$

Where x_t is a $k \times 1$ vector of multiple regressors, defined in such a way that $x_t = x_0 + x_t^+ + x_t^-$, ϕ_j is the autoregressive parameter; θ_j^+ and θ_j^- are the asymmetrically distributed lag parameters; and ε_t is an i.i.d. process with zero mean and constant variance

NARDL Output Table for Pre - COVID -19 Crises Period (2017 Jan – 2019 Dec)

x:	INR - USD	INR - JPY	INR - EUR	INR - GBP	INR - DKK	INR - NOK	INR - CHF	INR - SGD	INR - AED
yt-1	-0.262	-0.082	-0.066	-0.217	-0.122	-0.138	-0.174	-0.280	-0.209
	0.088	0.074	0.074	0.082	0.079	0.072	0.073	0.108	0.106
xt-1+	0.282	0.072	0.057	0.134	0.076	-0.063	0.273	0.003	0.003
	0.133	0.073	0.095	0.077	0.096	0.122	0.144	0.003	0.009
xt-1-	0.044	0.004	0.038	-0.020	-0.011	-0.173	0.174	-0.010	-0.018
	0.170	0.078	0.156	0.067	0.141	0.131	0.160	0.006	0.016
Δyt-1	0.380	0.104	0.140	0.279	0.348	0.226	0.277	0.267	0.347
	0.146	0.136	0.145	0.141	0.154	0.140	0.142	0.174	0.183
Δxt+	0.556	0.730	-0.424	0.612	0.376	0.325	0.500	0.011	0.041
	0.454	0.197	0.286	0.327	0.336	0.285	0.277	0.011	0.024
Δxt-1+	-0.892	0.682	-0.904	-0.171	-0.100	0.082	-0.289	-0.010	-0.026
	0.493	0.233	0.312	0.347	0.343	0.318	0.305	0.012	0.027
Δxt-	0.738	0.960	1.903	-0.239	1.098	0.556	1.196	0.021	0.012
	0.634	0.252	0.445	0.269	0.417	0.293	0.422	0.016	0.039
Δxt-1-	0.518	-0.402	0.615	-0.438	-0.201	-0.005	0.071	0.003	-0.006
	0.574	0.271	0.457	0.255	0.300	0.245	0.419	0.015	0.030
Constant	2.337	0.652	0.649	1.906	1.062	1.213	1.411	2.790	2.104
	0.805	0.696	0.652	0.767	0.721	0.669	0.642	1.083	1.071
Statistics and Diagnostics									
Obs. (Months)	35	35	35	35	35	35	35	35.000	35.000
F - Statistics	2.46	10.25	4.35	2.05	3.31	3.00	3.91	2.420	1.870
RMSE	0.026	0.019	0.023	0.026	0.024	0.025	0.024	0.021	0.022
Portmanteau test up to lag 5 (chi2)	15.990	23.290	19.920	18.740	19.330	19.250	15.680	12.010	12.810
Breusch/Pagan heteroskedasticity test (chi2)	0.019	3.404	1.140	0.264	0.183	0.093	0.243	1.069	0.007
Ramsey RESET test (F)	1.620	0.209	2.003	0.713	4.096	0.484	1.067	2.322	2.468
Jarque-Bera test on normality (chi2)	0.349	0.008	0.773	0.468	0.326	2.139	1.355	0.182	1.231

Standard errors are presented in bracket and statistics at the 1% and 5% levels are denoted by Green and Yellow cells respectively.

NARDL Output Table for COVID -19 Crises Period (2020 Jan – 2021 Dec)

x:	INR - USD	INR - JPY	INR - EUR	INR - GBP	INR - DKK	INR - NOK	INR - CHF	INR - SGD	INR - AED
yt-1	0.037	-0.323	-0.002	0.472	-0.395	0.014	-0.348	-0.365	-0.296
	0.338	0.218	0.340	0.244	0.244	0.177	0.300	0.118	0.141
xt-1+	0.356	0.544	0.643	-0.732	1.026	0.271	0.761	-0.005	0.055
	1.057	0.631	1.689	0.560	0.735	0.327	0.845	0.015	0.025
xt-1-	2.093	-0.165	2.356	2.472	4.100	1.252	1.343	0.004	0.064
	1.057	2.279	2.048	1.797	1.852	0.532	2.838	0.024	0.027
Δyt-1	-0.224	0.474	-0.291	-0.619	-0.170	0.242	0.324	0.087	-0.035
	0.554	0.577	0.489	0.567	0.346	0.349	0.883	0.204	0.227
Δxt+	0.151	-0.105	1.489	0.331	-0.006	0.724	0.361	-0.015	0.051
	1.357	0.636	1.592	0.858	0.499	0.650	0.630	0.024	0.037
Δxt-1+	0.287	0.101	0.214	0.701	0.078	0.579	0.577	-0.022	0.003
	1.230	0.616	1.222	0.897	0.477	0.418	0.873	0.018	0.037
Δxt-	1.724	4.270	1.238	3.588	4.051	1.742	2.544	0.091	-0.016
	3.285	2.152	2.285	1.449	1.117	0.609	1.342	0.026	0.083
Δxt-1-	-0.895	-2.975	-0.570	0.934	-0.783	-1.905	-1.968	0.064	-0.066
	2.775	2.621	2.438	1.251	1.470	0.697	2.214	0.031	0.072
Constant	1.459	1.449	3.142	2.054	10.390	2.156	4.258	4.125	3.060
	2.337	4.402	2.768	1.657	4.271	1.155	5.596	1.294	1.474
Statistics and Diagnostics									
Obs. (Months)	24	24	24	24	24	24	24	24	24
F - Statistics	1.52	2.88	1.24	6.18	7.29	5.76	3.30	4.98	2.41
RMSE	0.035	0.027	0.037	0.020	0.018	0.037	0.084	0.021	0.027
Portmanteau test up to lag 5 (chi2)	7.317	3.762	4.095	7.679	2.216	9.727	1.809	12.300	15.000
Breusch/Pagan heteroskedasticity test (chi2)	0.168	3.775	0.060	1.013	0.732	0.000	0.098	0.287	0.013
Ramsey RESET test (F)	2.216	0.215	0.136	1.662	0.915	0.855	2.004	0.937	13.070
Jarque-Bera test on normality (chi2)	0.876	0.018	0.337	2.741	0.823	1.002	1.196	1.095	0.367

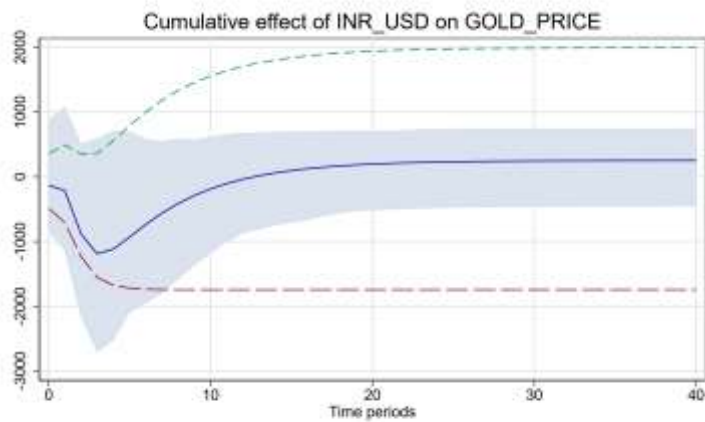
Standard errors are presented in bracket and statistics at the 1%, 5% levels are denoted by green, yellow cells respectively.

NARDL Output Table for Post COVID -19 Crises Period (2022 Jan – 2024 Dec)

x:	INR - USD	INR - JPY	INR - EUR	INR - GBP	INR - DKK	INR - NOK	INR - CHF	INR - SGD	INR - AED
yt-1	-0.220	-0.689	-0.330	-0.890	-0.066	-0.217	-0.122	-0.138	-0.174
	0.332	0.403	0.297	0.384	0.074	0.082	0.079	0.072	0.073
xt-1+	0.095	0.015	-0.018	-0.001	0.057	0.134	0.076	-0.063	0.273
	0.110	0.038	0.035	0.034	0.095	0.077	0.096	0.122	0.144
xt-1-	0.082	-0.018	-0.022	-0.012	0.038	-0.020	-0.011	-0.173	0.174
	0.110	0.041	0.030	0.034	0.156	0.067	0.141	0.131	0.160
Δyt-1	0.873	0.748	0.505	1.005	0.140	0.279	0.348	0.226	0.277
	0.494	0.484	0.417	0.375	0.145	0.141	0.154	0.140	0.142
Δxt+	0.021	-0.002	0.002	0.556	-0.424	0.612	0.376	0.325	0.500
	0.017	0.012	0.013	0.454	0.286	0.327	0.336	0.285	0.277
Δxt-1+	-0.042	0.007	0.017	-0.892	-0.904	-0.171	-0.100	0.082	-0.289
	0.089	0.038	0.030	0.493	0.312	0.347	0.343	0.318	0.305
Δxt-	0.053	0.012	0.005	0.738	1.903	-0.239	1.098	0.556	1.196
	0.040	0.023	0.019	0.634	0.445	0.269	0.417	0.293	0.422
Δxt-1-	0.016	0.014	0.007	0.518	0.615	-0.438	-0.201	-0.005	0.071
	0.062	0.019	0.020	0.574	0.457	0.255	0.300	0.245	0.419
Constant	2.278	6.372	3.274	2.337	0.649	1.906	1.062	1.213	1.411
	3.649	3.951	2.936	0.805	0.652	0.767	0.721	0.669	0.642
Statistics and Diagnostics									
Obs. (Months)	36	36	36	36	36	36	36	36	36
F - Statistics	0.31	0.07	0.31	3.91	10.25	4.35	2.05	3.31	3.00
RMSE	0.022	0.018	0.022	0.024	0.019	0.023	0.026	0.024	0.025
Portmanteau test up to lag 5 (chi2)	16.73	14.39	12.15	8.924	23.290	19.920	18.740	19.330	19.250
Breusch/Pagan heteroskedasticity test (chi2)	1.522	2.714	4.711	4.301	3.404	1.140	0.264	0.183	0.093
Ramsey RESET test (F)	1.153	1.493	1.395	1.595	0.209	2.003	0.713	4.096	0.484
Jarque-Bera test on normality (chi2)	7.673	4.817	3.033	2.06	0.008	0.773	0.468	0.326	2.139

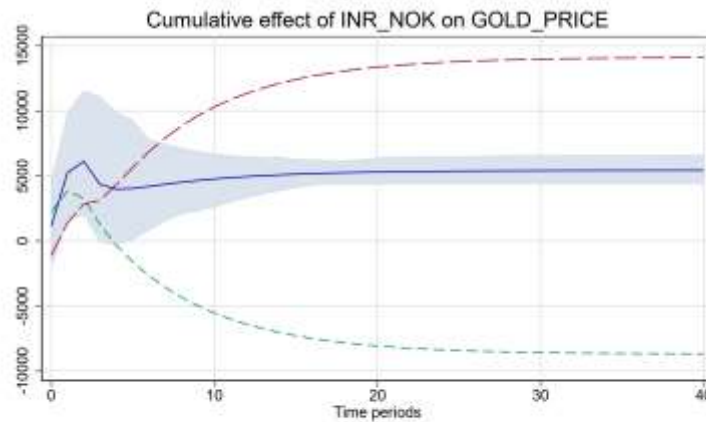
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Cumulative Dynamic Multiplier Effects



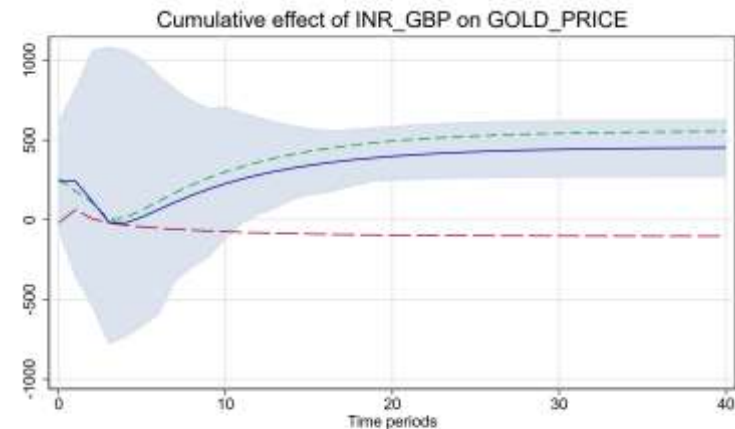
--- positive change
— asymmetry
--- negative change
■ CI for asymmetry

Note: 90% bootstrap CI is based on 100 replications



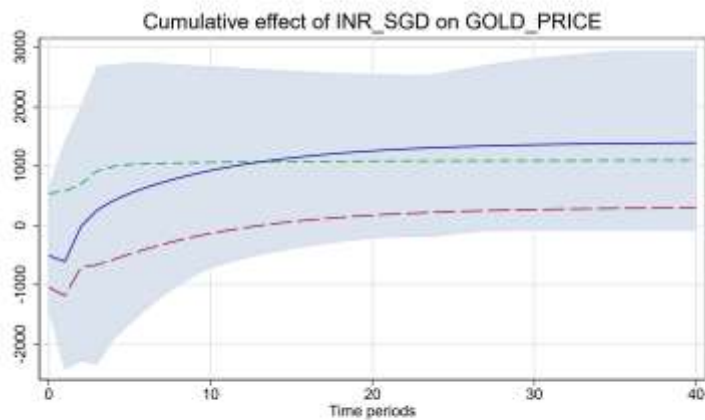
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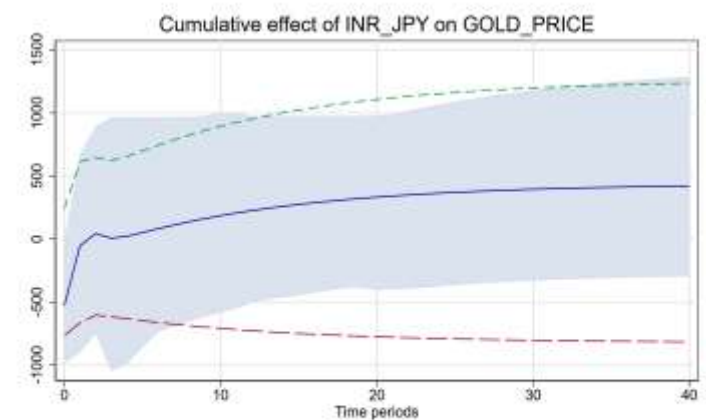
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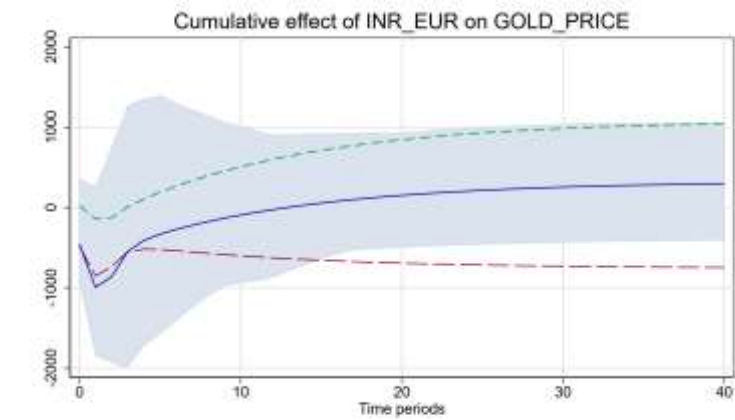
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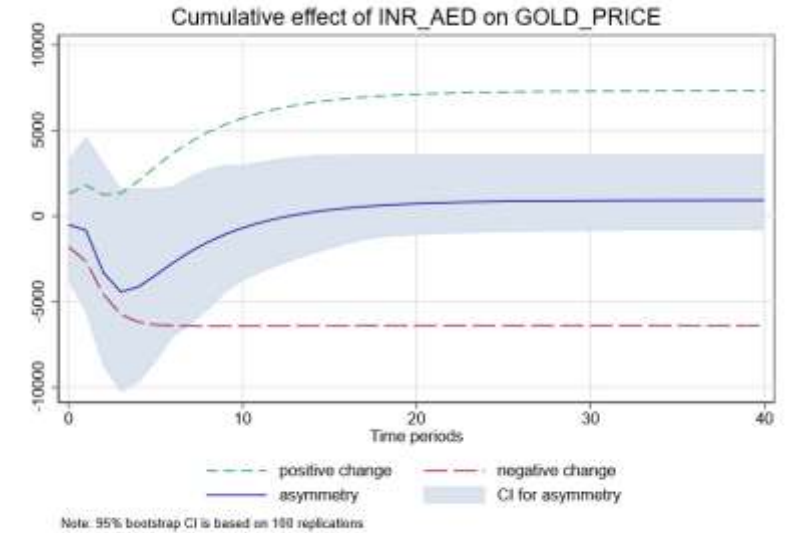
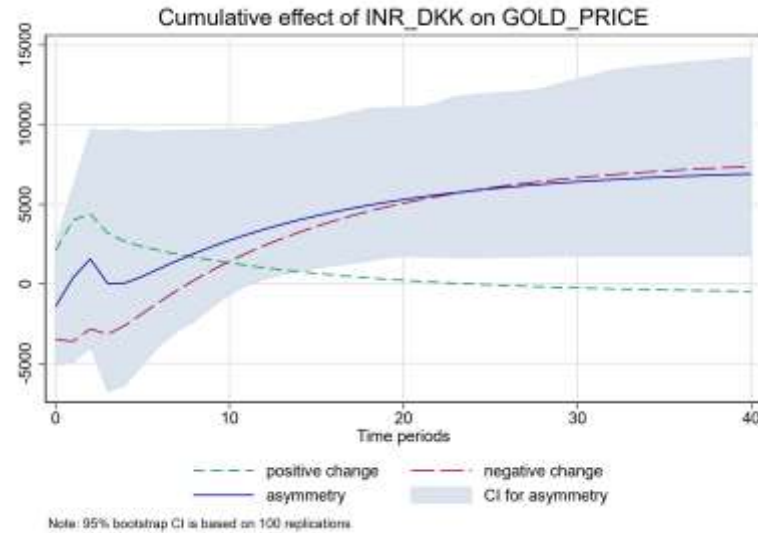
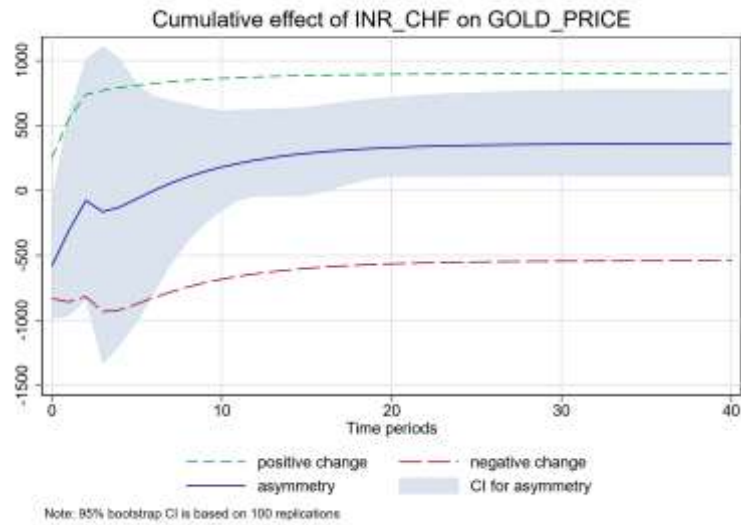
Note: 95% bootstrap CI is based on 100 replications



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— asymmetry
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Note: 90% bootstrap CI is based on 100 replications

Cumulative Dynamic Multiplier Effects



Conclusion

- The analysis reveals that none of the leading nine exchange rates has demonstrated a long-term impact on gold prices during or before the crisis.
- However, exchange rates have, as a result of the stress of the pandemic, sometimes exhibited unpredictable behavior compared to that in the normal period preceding COVID-19.
- All exchange rates show a weak asymmetric link with gold prices, and the positive impacts of exchange rates most likely outweigh the negative impacts.
- Gold's safe-haven properties are most likely to remain intact over time.
- This research findings highlight the efficiency of the gold market, in agreement with the market efficiency hypothesis and random walk theory.
- Investors may consider adding gold to their portfolios, despite the fact that this study confirms the recent uneven effects of exchange rates on gold prices have been due to COVID-19.
- Our study follows a suggestion by Harris and Shen (2017) that a price index free of global exchange rates would safeguard gold from changes in such rates.

Importance

This study brings six-fold contributions to the literature

- It demonstrates the asymmetric, dynamic, and nonlinear impacts of exchange rates on gold prices in India in the short term with no impact in the long term.
- This study is the first to explore the effects of prevailing exchange rates on India's domestic gold prices during the ongoing COVID-19 pandemic and the subsequent disturbances.
- To some extent, this study suggests that leading exchange rates have unpredictably impacted gold prices on occasion during and post COVID-19.
- The results reveal that exchange rates do not contribute evenly to gold prices.
- To some degree, this study endorses the findings of Bredin, Conlon, and Potì (2015), who suggest that gold can serve as a hedging tool for 1 year.

Limitations

- The study is limited to a few currency exchange rates.
- Considers the disturbances that occurred post 2019 only.



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Thank You