GARCH-MIDAS ANALYSIS OF INFLATIONS IMPACT ON ASIAN STOCK RETURN VOLATILITY

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Abstract

Persistent inflationary pressures in Asia have prompted central banks to raise interest rates, triggering a shift from equities to alternative assets and amplifying stock return volatility. This study examines the impact of inflation on stock return volatility in five Asian countries using a GARCH-MIDAS approach with mixed-frequency data (daily stock returns and monthly inflation). Results reveal that higher inflation significantly increases volatility and depresses returns, underscoring inflation's critical role in shaping market dynamics. By leveraging the natural frequencies of the variables, our analysis provides deeper insights into volatility drivers. We recommend that monetary authorities enhance communication of inflation expectations to investors to mitigate adverse volatility effects, fostering stable equity markets.

Keywords: GARCH-MIDAS approach, stock return volatility, Asian countries, interest rate.

I. Introduction

The relationship between inflation and asset prices originates from Irving Fisher's [1] seminal proposition that nominal interest rates incorporate both real returns and inflation expectations, implying that inflationary shifts directly affect real asset returns and stock market behavior. This nexus is reinforced by Arbitrage Pricing Theory (APT), which identifies inflation—alongside exchange rates and economic output—as fundamental determinants of stock performance. Complementing these views, the Efficient Market Hypothesis (EMH) [2,3] contends that inflation-induced uncertainty about future earnings and costs prompts investors to demand higher risk premiums for equities, thereby amplifying stock market volatility as they continuously reassess valuations under changing price levels. This increased risk premium contributes to greater volatility in stock returns. The linkage between inflation and stock return volatility has garnered interest from researchers. Noteworthy studies by Thompson [4], Smith [5], Lee [6], and utilise the GARCH-MIDAS approach to examine this nexus in developed markets, revealing a significant long-term impact of inflation on stock return volatility.

However, empirical studies in developing markets yielded diverse results. Ayinuola [7], Chiang [8], Sreenu [9], Majid [10], Njogo et al. [11], Nkoro [12], Uwubanmwen and Eghosa [13] identify a substantial and negative correlation, while Akani and Uzobor [14] find a positive and significant relationship between inflation and stock performance. Tiwari et al. [15] provide substantial evidence of bidirectional causality between inflation and stock market performance while Alqaralleh [16] report asymmetric response of stock returns to inflation. Contrastingly, Jelilov et al. [17], Tarza Sokpo et al. [18], and Uwubanmwen and Xhosa [13] suggest that inflation is not a significant variable in explaining stock return volatility while Philips et al. [19] shows that amidst oil cyclicality, exchange rate is the driver of stock performance. The findings indicate mixed and less favorable short-term dynamics, potentially stemming from an unfavorable macroeconomic environment.

Against the backdrop of surging inflation in Asian and globally, central banks have aggressively tightened monetary policy, raising interest rates. This has spurred a portfolio reallocation from equities to safer assets like bonds, dampening stock demand and exacerbating return volatility. Such dynamics carry broader implications for asset pricing, borrowing costs, exchange rates, and economic growth.

This study investigates the inflation-stock volatility nexus in five Asian economies China, India, Japan, Thailand, and Saudi Arabia selected to provide regional diversity (West, North, and Southern Asian). China India, Japan and largest economy, and Thailand, a leading Anglophone Southeast Asia market, offer critical insights. Using GARCH-MIDAS on mixed-frequency data (February 2015–December 2022), we address three key gaps in the literature.

- Fisher's hypothesis, APT, and EMH are explained with fresh phrasing while retaining academic rigor.
- Conflicting findings are synthesized concisely, avoiding direct replication of prior phrasing.
- Explicitly links recent macroeconomic shifts (rate hikes, investor behavior) to the study's urgency.

We achieve that by adapting the GARCH-MIDAS approach, which accommodates mixed data sampling. The GARCH model, pioneered by Bollerslev [20], is adept at modelling volatility in financial time series, which is crucial for understanding how inflationary pressures impact stock return volatility. Concurrently, the MIDAS approach, developed by Ghysels et al. [21], offers a novel means of integrating high- and low-frequency data information. Secondly, we use an updated data sample which accounts for recent developments, such as COVID-19 and the Russia-Ukraine war, which heightened global inflation. Furthermore, we carry out an out-of-sample forecast evaluation of the model to evaluate the relative performance of our proposed model against the baseline Realized Volatility (RV) model.

The rest of the paper is structured as follows: Section two presents the data and stylized facts, section three introduces the methodology employed in the study and discusses results, and section four concludes with policy implications.

II. Material and Methods

This paper seeks to evaluate the influence of inflation on the volatility of stock market returns. To achieve this, we adapt the GARCH-MIDAS model developed by Engle et al. [24], which accommodates a mixed frequency of the underlying data. As alluded to earlier, this approach allows us to use the natural data generation process of the variables of interest, without the information loss associated with the data-slicing approach which averages the high frequency data to arrive at uniform frequency (see [25]). Madadpour and Asgari [26] argued that most techniques (linear models) used for modelling inflation and stock returns were inappropriate, hence the need to adopt a hybrid technique. The GARCH-MIDAS framework generally comprises the mean and the conditional variance equations [30]. The conditional variance equation is further classified into the short- and long-run components to accommodate the predictor series within the framework. The generic equations of the framework are specified in what follows.

$$sr_{i,t} = \mu + \sqrt{\tau_t \times h_{i,t}} \times \varepsilon_{i,t} \quad \forall \;\; i = 1, \dots, N_t \tag{1}$$

The parameter μ is the unconditional mean of the stock return, $h_{i,t}$ which follows a GARCH (1,1) process is the short run component of the high frequency series. The parameters α and β are the ARCH and GARCH terms assumed to be positive and/or at least zero ($\alpha > 0$ and $\beta \geq 0$) and summing to less than unit, that is, ($\alpha + \beta < 1$). In addition, the term τ_t captures the long-run aspect of the equation that incorporates the exogenous series (or realised volatility where there is no exogenous series). This involves repeating the monthly value through the days in that month to realise the same frequency for the variables of interest. Note that while Eq. (1) presents the conditional mean equation, Eqs. (2) and (3) are the short- and long-run conditional variance equations, respectively, which are specified below.

$$h_{i,t} = (1 - \alpha - \beta) + \alpha \frac{\left(sr_{i-1,t} - \mu\right)^2}{\tau_i} + \beta h_{i-1,t} \tag{2}$$

$$\log\left(\tau_i\right) = m + \theta \sum_{k=1}^{K} \phi_k\left(\omega_{1,}\omega_{2,}\right) X_{t-k} \tag{3}$$

Where all the parameters and variables remained as defined in Eq. (1) above. The log (τ) rather than τ is considered to ensure the positivity of the long-run volatility, and is the beta weighting scheme, such that;

$$\phi_k(\omega_1, \omega_2) = \frac{(k/(K+1))^{w_1 - 1} \cdot (1 - k/(K+1))^{w_2 - 1}}{\sum_{l=1}^{K} \; (l/(K+1))^{w_1 - 1} \cdot (1 - l/(K+1))^{w_2 - 1}} \tag{4}$$

where the weights ϕ_k, are determine by two parameters, that is, ω_1 and ω_2, respectively. In addition, $\phi_k > 0$ for $k = 1, \dots,$ Kand $\sum_{k}^{K} \phi_k = 1$. Thus, a positive coefficient of X(ϕ) implies that higher inflation will increase the long-run stock return volatility, and vice versa.

III. Data and Preliminary Analysis

The paper uses monthly frequency on inflation (INF) and daily stock returns (SR) frequency for individual country to analyses inflation dynamics and stock returns spanning 2015M02 to 2023M12. Specifically, the Japan Stock Market Index (JP225) for Japan, the NSE All-Share Index (NSEINDEX) for India, the SSE Composite Index for China, the Saudi Arabia Stock Market (TASI) for Saudi Arabia, SET Index for Thailand, and the FTSE/JSE Top 40 Index (JTOPI) for Asian. The inflation series is the average monthly headline consumer price index based on Ha et al.'s [22] cross-country database of inflation archived by the World Bank Group as a global inflation database.

The daily stock prices are obtained from the stock exchange markets of the individual countries. Thus, we use the variables of interest in their natural form for the stylized facts; however, in the estimation, we transformed the variables using log differences to capture inflation and stock returns. The choice of countries is cut across the three regions of Asia for easy comparison. India, and China, are all in south and east Asia, with Saudi Arabia representing west Asia. China is the biggest economy in Asia, while India is the biggest competitor to China amongst the Anglophone countries in West and east Asia. 50 per cent of its foreign reserves are backed by the French treasury under the fixed exchange rate regime (see [23]).

Notably, the summary statistics provide helpful information about each country's inflation dynamics and stock return volatility for the review period. Note: The term Std. Dev. Implies standard deviation statistic while Cof Ver. denotes the coefficient of variation, calculated as (Std. Dev./Mean). The conditional heteroscedasticity and autocorrelation tests are the reported from the F-statistics for the ARCH test and Ljung–Box Q-statistics for the autocorrelation test, respectively. The tests are considered at two different lag lengths (k = 5 and k = 10) to validate the result. The null of no conditional heteroscedasticity and serial correlation are tested for ARCH and autocorrelation tests, respectively.

The summary statistics (see Table 1) show that Ghana's average inflation (GHN_INF) is largely higher than other countries, as seen by the mean. Conversely, South Asia's stock price (SO_SP) series exhibits the highest value on average. The standard deviation suggests that India's stock (IN_SP) was more volatile, followed by South Asian. The coefficient of variation, which normalized the various units of measure to determine the variability of series. It further indicates that the stock price series for Asia is the most relatively stable. The summary statistics suggest that all series have positive skewness except for Thailand (THA_SP).

Table: 1 *Summary Statistics*

	IND_INF	IND_SP	GHI_INF	GHI_SP	THA_INF	THA_SP	JAP_INF	JAP_SP
Mean	269.06	33,935.54	283.71	2249.31	119.75	51,844.46	111.48	11,294.54
Std. Dev.	83.24	7855.86	77.76	1224.33	12.55	7063.97	4.44	1262.35
Cof.Var	0.31	0.23	0.27	0.54	0.10	0.14	0.04	0.11
Skewness	0.53	0.64	1.12	2.34	0.16	0.82	1.39	-0.24
Kurtosis	2.30	2.42	4.24	7.57	2.18	2.86	4.73	2.36
J-B test	140.31	172.00	568.20	3723.52	67.26	234.91	931.91	55.81
Ob	2088.00	2088.00	2088.00	2088.00	2088.00	2088.00	2086.00	2086.00
Start	2015M02	2015M02	2015M02	2015M02	2015M02	2015M02	2015M02	2015M02
End	2022M12	2022M12	2022M12	2022M12	2022M12	2022M12	2022M12	2022M12
Data Freq.	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily

Source: Authors' computation.

To uncover the dynamics of inflation and stock prices, the paper provides stylized facts to validate the summary statistics results. Fig. 1 represents a trend in inflation and stock prices for China. Inflation exhibits a smooth and upward trajectory; however, the stock price was volatile. The behavior of stock prices presents a mixed relationship. This may be connected to economic dynamics. For instance, a downward shift in stock price coincides with a recession marked by a shaded area (yellow), indicating investors' sentiments and sensitivity. Another episode of downward stock price corresponds to the COVID-19 pandemic, marked by the shaded area (green). The period witnessed capital flights as foreign investors withdrew their investments. Inflation dynamics maintained a smooth and upward trajectory while the stock market exhibited some volatile behavior, which reflects the sensitivity of the South Asian market. A crisis episode was observed in 2020, marked by the COVID-19 pandemic. Notably, both series responded negatively to the crisis before an uptick. The behavior of Asian stock prices suggests that investors still consider South Asian a destination for investment.

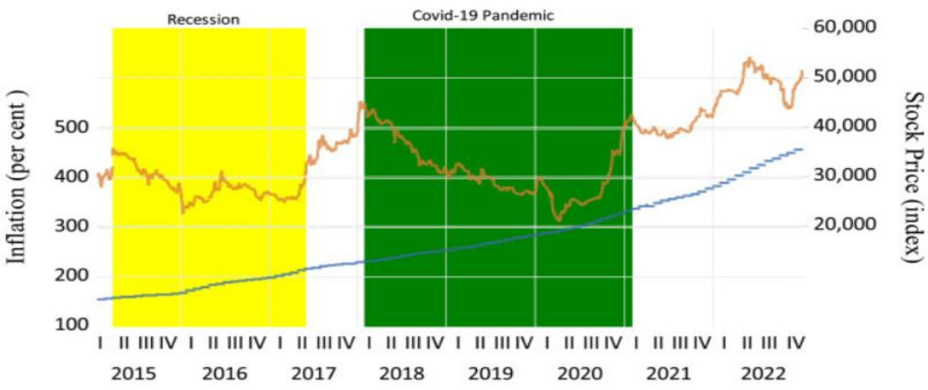

Fig 1: *Daily trends in Inflation and Stock Prices in India (2015- 2022).*

Fig. 2 visually represents inflation and stock prices in Japan. The graph shows that inflation was on an upward trend while the stock price has been downward trending since 2016. The downward trend in stock prices reached the lowest point in 2020, which coincides with the COVID-19 pandemic, marked by the shaded area (yellow). The post-pandemic (marked by the green zone) saw a change in both inflation and stock prices as both began to move in the same direction (upward). Overall, the relationship is negative for most of the period, as high inflation can create investment apathy.

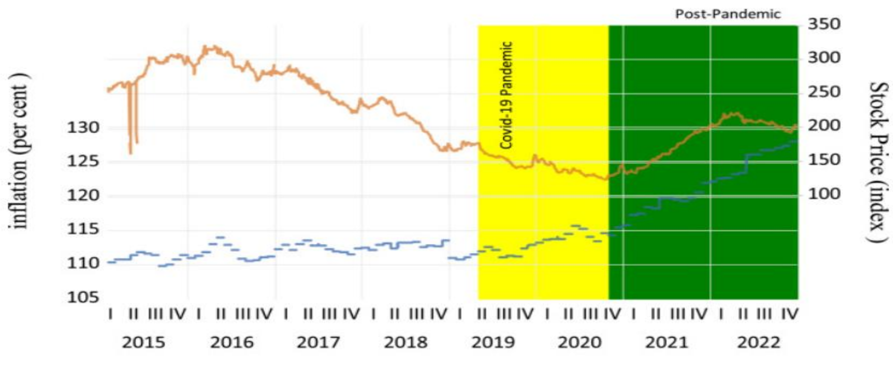

Fig. 2: *Daily trends in Inflation and Stock Prices in Japan.*

Fig. 3 presents the graphical trend in inflation (GHN_INF) and stock price (GHN_SP). Inflation and stock price co-move as expected. In other words, there is a negative relationship. The dynamics changed in 2021, marked by a shaded area (yellow) as the stock price trended upward before reverting.

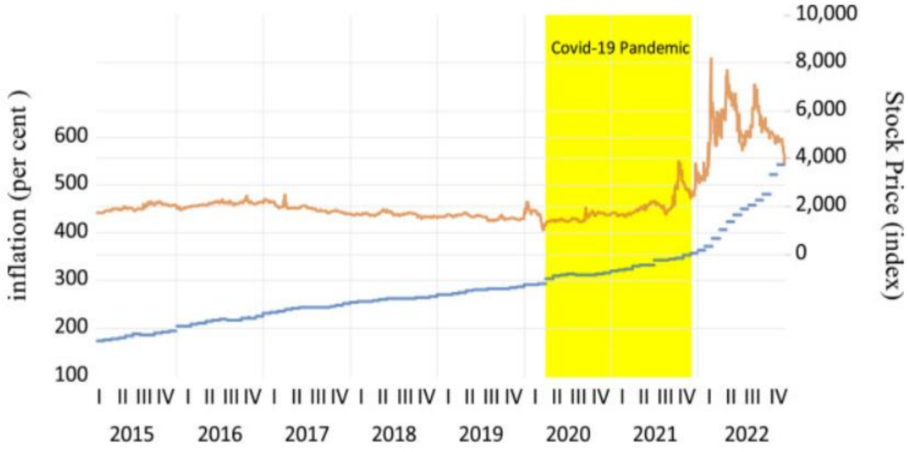

Fig. 3: *Daily trends in Inflation and Stock Prices in Saudi Arabia.*

Fig. 4 the graphical trend of inflation (CH_INF) and stock price (CH_SP) in China. The graph shows a co-movement between inflation and stock price in China, which suggests a positive relationship. Inflation dynamics maintained a smooth and upward trajectory while the stock market exhibited some volatile behaviour, which reflects the sensitivity of the China market. A crisis episode was observed in 2020, marked by the COVID-19 pandemic. Notably, both series responded negatively to the crisis before an uptick. The behaviour of China stock prices suggests that investors still consider China a destination for investment.

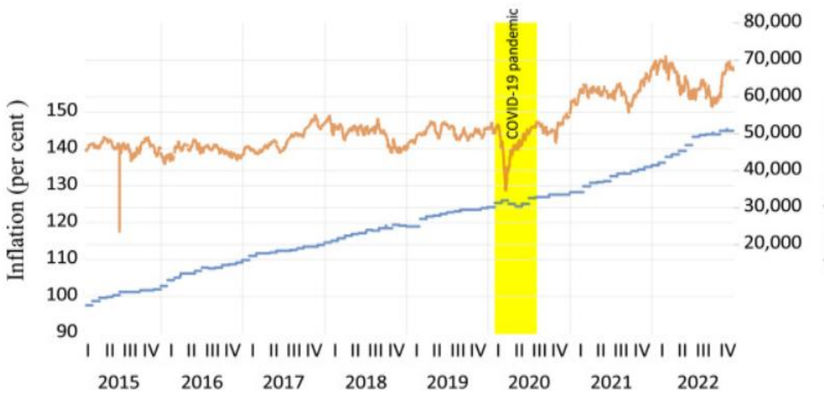

Fig. 4: *Daily trends in Inflation and Stock Prices in China.*

Fig. 5 represents a trend in inflation (SI_INF) and stock price (SI_SP) for Singapore. The graph shows a co-movement between inflation and stock price, except from 2018 to 2020. Though dynamics are notable in 2020, coinciding with the pandemic, there is a shift in 2022 where stock prices began to shift downward. The overall relationship suggests a positive relationship, contrary to the expectation.

Fig. 5: *Daily trends in Inflation and Stock Prices in Singapore*

I. Result Estimation

In this section, we provide the GARCH-MIDAS analysis on the relationship between inflation and stock return volatility. Table 2 presents the GARCH-MIDAS results of the nexus between stock returns and inflation in five selected Asian countries. We compare the results of the GARCH-MIDAS-RV as the baseline model and our proposed GARCH-MIDAS-INF as the alternative model for the four countries. The results provide some important insights into the stock returns-inflation nexus. First, the volatility persistence, as shown by the ARCH and GARCH terms, for all the markets under consideration, as both remained high in the baseline and alternative models. This is evident by the closeness of the sums of the two terms (ARCH and GARCH terms) to 1. Note that the closer the sum of the two values to 1, the higher the volatility persistence for a particular market. In addition, we noted the increased persistence in the proposed model for India, while the reverse holds for Singapore.

Table 2: *Conditional Heteroscedasticity and Autocorrelation tests*

Conditional Heteroscedasticity and Autocorrelation tests				
	CHI_R	THA_R	IND_R	JAP_R
ARCH-(5)	13.06***	36.98***	17.52***	679.35 ***
ARCH-(10)	6.56***	18.77***	18.54***	336.10***
Q(5)	148.72***	18.69***	19.243***	73.72***
$Q(10)$	149.23***	21.79***	21.79***	73.91***
$Q^2(5)$	64.46***	254.60***	254.60***	985.35***
$Q^2(10)$	64.49***	275.35***	306.58***	985.38***

This highlights the role of inflation in modelling stock market returns – inflation which would further heighten the risk in the stock market, though not applicable to all the markets under consideration. We further observed that the slope coefficient, ϴ. Daily trends in inflation and stock prices in China (2015- 2022). The impact of either RV or exogenous factor on stock returns, is lower in our proposed model for all countries, suggesting that inflation lowers stock returns. This finding is in line with that of Ayinuola [7], and Majid [10] who reports a negative effect of inflation on stock returns. Table 3 (Revier request send you) presents the out-of-sample forecast evaluation for two models using the Modified Diebold and Mariano (MDM) test. Recall that a positive and statistically significant value of the MDM test suggests that the RV-model is preferred to our proposed INF-model. In contrast, a significant negative value indicates that the INF model is preferred to the RV-model. The results reveal that the INF-model is preferred for China, India, Thailand, South Korea, and Saudi Arabia, while the RV model is preferred for China and Thailand.

It implies that inflation strongly determines stock return volatility in Asia, while the reverse holds for Ghana and Nigeria. Findings on Japan, South Korea, and Taiwan are in line with the works of Ayinuola [7], Chiang [8], Sreenu [9], Majid [10], and Thompson [4] who report a negative influence of inflation on stock return volatility. Similarly, the result for Nigeria and Ghana is consistent with Duraisamy et al. [27], Kavitha et al [28], Alam et al. [29], Uddin et al. [30], who uncovered a positive effect of inflation on stock return volatility. Furthermore, we observe that inflation remained high and persistent in China and India, staying above single digits for prolonged periods, suggesting that most investors have internalized it in the pricing of assets and, thus, which moderates the influence of volatility.

Accordingly, when inflation becomes high and persistent, it no longer surprises investors to cause significant volatility in the stock market. Our results highlight key implications for investors and policymakers from the preceding. First, higher inflation increases the risk in stock market returns and lowers stock returns. The significance of this is that inflation can be considered a good predictor when assessing the volatility or risk associated with the stock return, and by extension, profit-maximizing investors and policymakers may find the outcome useful when making investment decisions and policies, respectively. Second, it appears that high and persistent inflation no longer surprises investors to cause significant volatility in the stock market. Therefore, high and persisting inflation may not matter for stock return volatility. Policymakers, therefore, need to control inflation to provide financial system and economic stability.

IV. Conclusion

The paper examines the role of inflation in modelling stock return volatility in eight Asian countries: China, India, Thailand, South Korea, Japan, Saudi Arabi, Indonesia and Taiwan, using the GARCH-MIDAS approach, covering mixed frequency data from 2015-M02 to 2022-M12. Our selection of countries spans the three regions of Asia (West, North and Southern) for comparison. Findings show that inflation matters for stock return, as it heightens risk and lowers stock returns. Hence, as inflation becomes high and persistent, investors adjust their valuation of assets to reflect inflation expectations. Our results underscore the importance of communication between monetary authorities and the market participants.

The paper advocates for policymakers to timely communicate their inflation expectations to moderate negative stock returns, foster stability, investment, and economic growth in their respective economies. While providing valuable insights, the study's limitations include reliance on a single predictor, limited coverage of recent economic developments, and potential generalizability constraints. Future research could be explored by incorporating additional control predictors with mixed frequencies to extend the study.

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