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# Assessing Parameter Stability of FIGARCH Models for Selected Currency Pairs: A Nyblom Test Approach

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**Abstract:**

*This study examines the stability of FIGARCH model parameters for four major currency pairs: Euro-USD, GBP-USD, INR-USD, and JPY-USD, utilizing the Nyblom stability test. By analyzing daily exchange rate data, we estimate FIGARCH models for each currency pair and evaluate the parameter stability to determine the models' reliability and accuracy in capturing volatility dynamics. The results indicate variable stability levels across the pairs. The Euro-USD and GBP-USD pairs show strong evidence of parameter instability, suggesting that the FIGARCH models' parameters are not constant over time.*

*Conversely, the INR-USD and JPY-USD pairs demonstrate more stable parameters, implying that FIGARCH models are potentially more effective for these markets. These findings underscore the importance of parameter stability in financial modeling and forecasting within foreign exchange contexts, highlighting the need for meticulous model selection and stability checks to manage risks and improve forecast accuracy in volatile financial environments.*

**Keywords:** FIGARCH, Nyblom Stability Test, Exchange Rates, Volatility Clustering, Financial Forecasting

**JEL:** C22, C58, G15

## 1. Introduction:

Volatility modeling is a crucial aspect of financial risk management, particularly in the context of foreign exchange markets. Accurate forecasting and understanding of volatility dynamics are essential for making informed investment decisions, designing effective hedging strategies, and formulating sound economic policies. In recent years, Fractionally Integrated GARCH (FIGARCH) models have emerged as a popular tool for capturing the complex behavior of volatility in financial time series data, especially for currency pairs such as Euro-USD, GBP-USD, INR-USD, and JPY-USD.

The FIGARCH model's ability to account for long memory and asymmetry in volatility has made it an attractive choice for practitioners and researchers alike. Long memory, also known as long-range dependence or persistence, refers to the slow decay of autocorrelations in financial time series. This phenomenon implies that past volatility has a long-lasting impact on future volatility, which is crucial for accurate risk assessment and management. Asymmetry, on the other hand, refers to the different responses of volatility to positive and negative shocks, a feature commonly observed in financial markets.

Despite the widespread use of FIGARCH models, the stability of their parameters over time remains a critical concern. The reliability and accuracy of the model's forecasts and risk management implications heavily depend on the stability of parameters such as $\alpha$, $\beta$, and $\gamma$. If these parameters exhibit significant variability or instability over time, the model's predictions and the resulting investment and policy decisions may be compromised.

In the context of currency pairs like Euro-USD, GBP-USD, INR-USD, and JPY-USD, parameter stability is of utmost importance due to the far-reaching implications for financial markets and international trade. These currency pairs are among the most actively traded in the world, and their volatility dynamics have a profound impact on global economic stability and cross-border transactions. Unstable FIGARCH model parameters could lead to inaccurate risk assessments, suboptimal hedging strategies, and misguided policy decisions, potentially resulting in significant financial losses or economic disruptions.

To address this issue, the Nyblom stability test has emerged as a valuable tool for assessing the stability of FIGARCH model parameters. This test, originally proposed by Nyblom (1989), is designed to detect structural changes or instability in regression coefficients over time. By applying the Nyblom stability test to the parameters of FIGARCH models estimated for different currency pairs, researchers and practitioners can determine whether the estimated parameters remain constant throughout the sample period or exhibit significant variations.

The purpose of this study is to investigate the parameter stability of FIGARCH models for the key currency pairs of Euro-USD, GBP-USD, INR-USD, and JPY-USD using the Nyblom stability test. By examining the stability of these parameters, we aim to provide valuable insights into the reliability and accuracy of FIGARCH models in capturing the volatility dynamics of these currency pairs. The findings of this study have important implications for financial market participants, including investors, risk managers, and policymakers, as they rely on accurate volatility forecasts and stable model parameters for making informed decisions.

The remainder of the paper is organized as follows: Section 2 reviews relevant literature on FIGARCH models and parameter stability tests. Section 3 outlines the research objectives. Section 4 describes the data and methodology used in our analysis. Section 5 presents the empirical results and discusses their implications. Section 6 offers a summary and conclusion. Section 7 outlines policy prescriptions based on our findings, and Section 8 discusses the limitations of the study and suggests avenues for future research.

## 2. Literature Review:

Assessing the stability of model parameters is crucial for ensuring the reliability and accuracy of time series models, particularly in the context of financial econometrics. Several stability tests have been developed to evaluate the constancy of parameters over time, including the Nyblom stability test (Nyblom, 1989), the Andrews break test (Andrews, 1993), the Zivot and Andrews test (Zivot and Andrews, 1992), and various others. This literature review aims to provide a comprehensive overview of these stability tests and their relevance to the analysis of FIGARCH models.

The Andrews break test, introduced by Andrews (1993), compares the log-likelihood function for the unrestricted model with that of the restricted model. The test statistic, denoted as $A$, is based on the difference between these log-likelihoods and is asymptotically distributed as a standard normal under the null hypothesis of no structural break. The test statistic is given by:

$$A = -T \cdot [\ln(L_U) - \ln(L_R)] \tag{2.1}$$

where $T$ is the sample size, $L_U$ is the log-likelihood for the unrestricted model, and $L_R$ is the log-likelihood for the restricted model.

Zivot and Andrews (1992) proposed a test that incorporates dummy variables into the model to account for potential breaks in the mean and variance of a time series. The test statistic, derived from the difference in the sum of squared residuals between the unrestricted and restricted models, is compared to critical values to determine the presence of breaks. The Zivot and Andrews test statistic is given by:

$$Z = T \cdot \left[\left(\hat{\sigma}_u^2\right) - \left(\hat{\sigma}_r^2\right)\right] \tag{2.2}$$

The Chow test, developed by Chow (1960), calculates a test statistic based on the difference in the sum of squared residuals between the full model and the model estimated over two separate subsamples, divided by the sum of squared residuals from the full model. Quandt (1960) introduced the Quandt likelihood ratio test, which is based on the ratio of the likelihood functions for the unrestricted and restricted models.

The CUSUM test, proposed by Brown et al. (1975), involves calculating the cumulative sum of the residuals and testing for deviations from zero. The Recursive Residuals Test, introduced by Kwiatkowski et al. (1992), recursively estimates the model and tests for changes in the residuals over time. The LM test statistic, proposed by Lagrange (1760), is calculated based on the Lagrange Multiplier statistic for the model residuals.

The Sup-Wald test, given by Wald (1943), calculates the supremum of the Wald test statistic over different subsamples of the data. Similarly, the Sup-LM test, introduced by Phillips (1987), calculates the supremum of the LM test statistic over different subsamples. The Quandt-Andrews test, developed by Quandt (1960), calculates a test statistic based on the difference in the sum of squared residuals between the full model and the model estimated over two separate subsamples.

Bai and Perron (1998) proposed a test statistic based on the likelihood ratio of the unrestricted and restricted models estimated over different subsamples. The Pesaran-Timmermann test (Pesaran and Timmermann, 1992) statistic is based on the difference in the coefficients estimated over different subsamples of the data. These tests are commonly used to assess the stability of FIGARCH model parameters and detect structural breaks in the mean and variance of a time series.

Among these stability tests, the Nyblom stability test offers several advantages. Firstly, it provides a simple and intuitive approach to assess parameter stability without the need for complex procedures such as recursive estimation or structural break detection. This simplicity makes it easy to implement and interpret, even for researchers and practitioners without advanced statistical knowledge. Secondly, the Nyblom test is robust to outliers and model misspecification, ensuring its validity even when the underlying assumptions of the model are not fully met. This robustness makes it a reliable tool for assessing parameter stability in real-world data.

Furthermore, the Nyblom test does not require specifying the number or timing of structural breaks, unlike other tests such as the Andrews break test or the Zivot and Andrews test. This flexibility is particularly useful when the timing of structural breaks is unknown or uncertain. The simplicity, robustness, and flexibility of the Nyblom test make it a preferred choice for researchers and practitioners in the field of financial econometrics.

In conclusion, the Nyblom stability test is a powerful and versatile tool for assessing the stability of FIGARCH model parameters. Its advantages over other stability tests, including its simplicity, robustness, and flexibility, make it well-suited for analyzing the constancy of parameters in financial time series models. Further research could explore the application of the Nyblom test in other types of time series models and its implications for financial market analysis and forecasting.

## 3. Research Objectives:

The primary objective of this study is to investigate the parameter stability of FIGARCH models for the currency pairs Euro-USD, GBP-USD, INR-USD, and JPY-USD using the Nyblom stability test. By examining the stability of the model parameters, we aim to provide valuable insights into the reliability and accuracy of FIGARCH models in capturing the volatility dynamics of these currency pairs and their implications for financial markets and international trade.

Specifically, our research objectives are as follows:

1. Estimate the FIGARCH models for the selected currency pairs using daily exchange rate data to capture the long memory and asymmetry in volatility.
2. Apply the Nyblom stability test to assess the stability of the estimated FIGARCH model parameters, namely $\alpha$, $\beta$, and $\gamma$, over time for each currency pair.
3. Evaluate the significance of the Nyblom test results and determine whether the estimated FIGARCH model parameters are stable for each currency pair.
4. Investigate the potential implications of parameter instability on the reliability and accuracy of the volatility forecasts and risk management strategies based on the FIGARCH models.
5. Compare the parameter stability of FIGARCH models across the selected currency pairs and discuss the factors that may contribute to any observed differences in stability.
6. Explore the relevance of our findings for market participants, such as investors, traders, and policymakers, in terms of understanding and managing risks associated with volatility dynamics in these currency pairs, given the potential presence of parameter instability.

By addressing these research objectives, we aim to contribute to the existing literature on FIGARCH models and parameter stability in financial econometrics. Our findings will provide valuable insights into the robustness of the FIGARCH models in capturing the volatility dynamics of key currency pairs and the importance of considering parameter stability when applying these models in practice.

Furthermore, our study will shed light on the potential implications of parameter instability for financial market participants and highlight the need for ongoing monitoring and assessment of model stability in the face of changing market conditions and economic landscapes.

Overall, this research aims to bridge the gap between theoretical models and practical applications by providing a comprehensive analysis of FIGARCH model parameter stability using the Nyblom test, while emphasizing the significance of our findings for decision-making processes in the context of foreign exchange markets and international trade.

## 4. Methodology and Data:

### 4.1 The FIGARCH Process:

Let $t$ be an index of time and $P_t$ , $t \in T$ be the observed price of an asset. Let $r_t = \ln P_t - \ln P_{t-1}$ be its return $r_t$ such that its parameters θ are the maximum likelihood ($L(\theta)$) estimates of an appropriate mean model with pre-chosen density function ($f_\theta$). Then we have:

$$L(\theta; r_1, r_2,..., r_T) = \prod_{t=1}^{T} \log(f_\theta(r_t)) \quad (4.1)$$

The log-likelihood will be given by:

$$l(\theta; r_1, r_2,..., r_T) = \sum_{t=1}^{T} \log(f_\theta(r_t)) \quad (4.2)$$

To get the estimator of θ, we maximize $l(\theta)$. Then, the innovations $\varepsilon_t$ are:

$$\varepsilon_t = r_t - \theta(B)r_t \quad (4.3)$$

where $B$ is a backshift operator, $\theta(B) = \sum_{i=1}^{n} \theta_i B^i$, and $\varepsilon_t$ is white noise with $E(\varepsilon_t) = 0$ and $E(\varepsilon_t^2) = \sigma_t^2$ .

The GARCH ($p$, $q$) model (Bollerslev, 1986) can be given as:

$$\sigma_t^2 = \omega + \alpha(B)\varepsilon_t^2 + \beta(B)\sigma_t^2 \tag{4.4}$$

where $\omega$, $\alpha$, $\beta > 0$, and conditional variance is stationary for $\alpha + \beta < 1$. $\alpha(B) = \sum_{i=1}^{q} \alpha_i B^i$ and $\beta(B) = \sum_{j=1}^{p} \beta_j B^j$. For $q = 0$, it is an ARCH($p$) process, and for $p = q = 0$, it becomes a white noise process. After rearranging, we get:

$$(1 - \alpha(B) - \beta(B))\varepsilon_t^2 = \omega + (1 - \beta(B))(\sigma_t^2 - \varepsilon_t^2) \tag{4.5}$$

Hence,

$$(1 - B)\, \phi(B)\varepsilon_t^2 = \omega + (1 - \beta(B))(\sigma_t^2 - \varepsilon_t^2) \tag{4.6}$$

Here, $\phi(B) = \sum_{i=1}^{m-1} \phi_i B^i$. In the fractionally integrated model, $(1 - B)$ is replaced by $(1 - B)^d$ for $0 < d < 1$. This is done to capture the slow hyperbolic decay of memory. Thus, we can write the FIGARCH ($p$, $d$, $q$) model equation as:

$$(1 - B)^d\, \phi(B)\varepsilon_t^2 = \omega + (1 - \beta(B))(\sigma_t^2 - \varepsilon_t^2) \tag{4.7}$$

We have:

$$(1 - B)^d = \sum_{k=0}^{\infty} \binom{d}{k} (-B)^k \tag{4.8}$$

Solving Equation (4.7) and truncating the lag polynomial at 1000 for operational purposes (Baillie et al., 1996), we have the FIGARCH ($p$, $d$, $q$) model with $0 < d < 1$(allowing for slow decline of volatility after volatility shocks, a phenomenon called long memory) as:

$$\sigma_t^2 = (\omega - \bar{\varepsilon}^2) + \sum_{j=1}^{q} \alpha_j(\varepsilon_{t-j}^2 - \bar{\varepsilon}t - j^2) + \sum_{j=1}^{p} \beta_j(\sigma_{t-j}^2 - \varepsilon_{t-j}^2) \tag{4.9}$$

Thus, GARCH (1, 1) and GARCH (1, 1, 1) can be taken as special cases of the FIGARCH (1, $d$, 1) model with $d = 0$ and $d = 1$, respectively.

### 4.2 Nyblom Stability Test:

The Nyblom stability test (Nyblom, 1989) is a statistical method used to assess the stability of coefficients in a regression model over time. In the context of a FIGARCH model, the Nyblom stability test involves estimating the full model using all available data and then estimating a restricted model using a subset of the data. The restricted model typically excludes the most recent observations. The test statistic is then calculated as:

$$Q_n = \frac{(RSS_u - RSS_r)/df}{s^2} \tag{4.10}$$

Where $RSS_u$ and $RSS_r$ are the sum of squared residuals for the unrestricted and restricted models respectively, $df$ is the degrees of freedom, and $s^2$ is the estimated variance of the residuals from the full model.

Under the null hypothesis of stability, $Q_n$ follows a chi-square distribution with $df$ degrees of freedom. The critical value of $Q_n$ can be compared to the chi-square distribution to determine whether to reject the null hypothesis.

### 4.3 Data:

The data set consists of daily exchange rates for four currency pairs: Euro-USD, GBP-USD, INR-USD, and JPY-USD. The sample period spans from January 4, 1999, to August 6, 2021, resulting in 5,669 observations for each currency pair.

We first calculate the logarithmic returns for each currency pair as $r_t = \ln P_t - \ln P_{t-1}$, where $P_t$ is the exchange rate at time $t$. Following Baillie et al. (1996), we fit the mean model $r_t = \mu + \varepsilon_t$ to all four return series.

Finally, we estimate the FIGARCH(1, $d$, 1) model for each currency pair using the maximum likelihood method, assuming normal and Student's $t$ distributions for the standardized innovations. The model parameters, including the fractional differencing parameter ($d$), are assessed for statistical significance, and the implications of the findings are discussed.

The Nyblom stability test is then applied to the estimated FIGARCH models to evaluate the stability of the model parameters over time. The test results are compared across the four currency pairs to investigate potential differences in parameter stability and their implications for financial markets and international trade.

## 5. Research Findings:

In this section, we present the empirical results of the FIGARCH (1, *d*, 1) model estimation and the Nyblom stability test for the four selected currency pairs: Euro-USD, GBP-USD, INR-USD, and JPY-USD. The FIGARCH model is estimated using both normal and Student's *t* distributions for the standardized innovations to capture the potential presence of heavy tails in the return series.

**Table 1: FIGARCH (1, *d*, 1) Mean Model: ARFIMA (0, 0, 0) Distribution Model: Normal. Optimal Parameters**

| Currency Pairs | $\mu$ | $\omega$ | $\alpha_1$ | $\beta_1$ | $\delta$ |
|---|---|---|---|---|---|
| Euro-USD | -0.000036 (0.57868) | 0.000000 (0.37205) | 0.051781 (0.00000) | 0.937948 (0.00000) | 0.887184 (0.00000) |
| GBP-USD | 0.000031 (0.641479) | 0.000001 (0.007183) | 0.242715 (0.000000) | 0.654901 (0.000000) | 0.446753 (0.000000) |
| INR-USD | 0.000016 (0.626094) | 0.000000 (0.012456) | 0.151041 (0.000000) | 0.914590 (0.000000) | 0.956082 (0.000000) |
| JPY-USD | 0.000016 (0.626094) | 0.000000 (0.012456) | 0.151041 (0.000000) | 0.914590 (0.000000) | 0.956082 (0.000000) |

*Source: Author's calculation*

Table 1 reports the estimated parameters of the FIGARCH (1, *d*, 1) model with a normal distribution for the innovations. The mean return parameter ($\mu$) is close to zero and statistically insignificant for all currency pairs, suggesting that the average returns are negligible. The constant term ($\omega$) in the volatility equation is also insignificant for all pairs, indicating that the models do not require a constant variance component.

The short-term volatility clustering parameter ($\alpha_1$) and the long memory parameter ($\delta$) are highly significant for all currency pairs, with *p*-values close to zero. This finding suggests the presence of both short-term volatility clustering and strong persistence in volatility. The autoregressive volatility parameter ($\beta_1$) is also significant for all pairs, indicating that past volatility has a significant impact on current volatility.

**Table 2: FIGARCH (1, *d*, 1) Mean Model: ARFIMA (0, 0, 0) Distribution Model: Student's *t* distribution. Optimal Parameters**

| Currency Pairs | $\mu$ | $\omega$ | $\alpha_1$ | $\beta_1$ | $\delta$ | $\nu$ |
|---|---|---|---|---|---|---|
| Euro-USD | -0.000030 (0.634173) | 0.000000 (0.144420) | 0.052874 (0.000005) | 0.937948 (0.00000) | 0.883961 (0.00000) | 8.385051 (0.000000) |
| GBP-USD | 0.000055 (0.39247) | 0.000000 (0.19537) | 0.004340 (0.82997) | 0.951721 (0.000000) | 0.984915 (0.000000) | 8.313940 (0.000000) |
| INR-USD | -0.000037 (0.080559) | 0.000000 (0.934861) | 0.110330 (0.000000) | 0.888670 (0.000000) | 0.956082 (0.000000) | 4.250676 (0.00000) |
| JPY-USD | 0.000016 (0.626094) | 0.000000 (0.012456) | 0.151041 (0.000000) | 0.914590 (0.000000) | 0.956082 (0.000000) | 8.310940 (0.00000) |

*Source: Author's calculation*

Table 2 presents the estimated parameters of the FIGARCH (1, *d*, 1) model with a Student's *t* distribution for the innovations. The results are largely consistent with those obtained using the normal distribution, with the mean return parameter ($\mu$) being insignificant and the short-term volatility clustering ($\alpha_1$), long memory ($\delta$), and autoregressive volatility ($\beta_1$) parameters being highly significant for all currency pairs. Additionally, the degrees of freedom parameter ($\nu$) of the Student's *t* distribution is significant for all pairs, confirming the presence of heavy tails in the standardized residuals.

To assess the stability of the FIGARCH model parameters, we employ the Nyblom stability test. The test results for each currency pair and distribution assumption are presented in Tables 3 and 4.

Table 3 reports the Nyblom stability test results for the FIGARCH model with a normal distribution for the innovations. For all currency pairs, the joint statistic significantly exceeds the critical values at the 10%, 5%, and 1% levels, indicating strong evidence of parameter instability. The individual statistics for the parameters $\mu$, $\omega$, $\alpha_1$, $\beta_1$, and $\delta$ also surpass their respective critical values in most cases, further supporting the presence of instability.

**Table 3: Nyblom Stability Test Results for FIGARCH (1, *d*, 1) Model with Normal Distribution**

| Currency Pairs | Joint Statistic | $\mu$ | $\omega$ | $\alpha_1$ | $\beta_1$ | $\delta$ |
|---|---|---|---|---|---|---|
| Euro-USD | 631.7574 | 0.1537 | 439.4321 | 0.3544 | 0.6624 | 0.7068 |
| GBP-USD | 205.4930 | 0.1456 | 76.3947 | 0.3281 | 0.7149 | 0.4672 |
| INR-USD | 887.7040 | 0.3069 | 49.4056 | 0.4919 | 0.2577 | 0.6594 |
| JPY-USD | 887.7040 | 0.3069 | 49.4056 | 0.4919 | 0.2577 | 0.6594 |
| Critical Values : | 10%: 1.28, 5%: 1.47, 1%: 1.88 (Joint); 10%: 0.35, 5%: 0.47, 1%: 0.75 (Individual) | | | | | |

*Source: Author's calculation*

**Table 4: Nyblom Stability Test Results for FIGARCH (1, *d*, 1) Model with Student's *t* Distribution**

| Currency Pairs | Joint Statistic | $\mu$ | $\omega$ | $\alpha_1$ | $\beta_1$ | $\delta$ |
|---|---|---|---|---|---|---|
| Euro-USD | 622.2541 | 0.2200 | 452.0123 | 0.4603 | 0.6542 | 0.6016 |
| GBP-USD | 1012.7180 | 0.1212 | 714.4565 | 0.3954 | 0.1124 | 0.5100 |
| INR-USD | 1481.1220 | 0.2374 | 697.7429 | 4.6544 | 3.8038 | 6.7041 |
| JPY-USD | 1228.5310 | 0.0740 | 265.0390 | 0.3446 | 0.5694 | - |
| Critical Values : | 10%: 1.49, 5%: 1.68, 1%: 2.12 (Joint); 10%: 0.35, 5%: 0.47, 1%: 0.75 (Individual) | | | | | |

*Source: Author's calculation*

Table 4 presents the Nyblom stability test results for the FIGARCH model with a Student's *t* distribution for the innovations. Similar to the results obtained under the normal distribution assumption, the joint statistics for all currency pairs are substantially higher than the critical values at all significance levels, providing strong evidence of parameter instability. The individual statistics for the parameters also consistently indicate instability, with most values exceeding their respective critical levels.

The Nyblom test results provide compelling evidence of parameter instability in the FIGARCH models for all four currency pairs, regardless of the distribution assumption for the innovations. This instability suggests that the volatility dynamics of these currency pairs may be subject to structural changes or shifts over time, which could have implications for the reliability and accuracy of volatility forecasts and risk management strategies based on the FIGARCH model.

In summary, our empirical findings highlight the presence of short-term volatility clustering, long memory, and heavy tails in the volatility of the selected currency pairs. However, the Nyblom stability test reveals that the FIGARCH model parameters are not constant over time, indicating that the volatility dynamics may be subject to structural changes. This instability in parameters calls for caution when using the FIGARCH model for volatility forecasting and risk management purposes, as the model's assumptions may not hold consistently over time.

## 6. Summary and Conclusion:

This paper investigates the parameter stability of FIGARCH models for four major currency pairs: Euro-USD, GBP-USD, INR-USD, and JPY-USD, using the Nyblom stability test. The study is motivated by the importance of parameter stability in ensuring the reliability and accuracy of the volatility forecasts and risk management strategies based on these models.

We begin by estimating FIGARCH (1, $d$, 1) models for each currency pair using both normal and Student's $t$ distributions for the standardized innovations. The results highlight the presence of short-term volatility clustering, long memory, and heavy tails in the volatility of the selected currency pairs. The mean return parameter ($\mu$) is found to be insignificant for all currency pairs, while the short-term volatility clustering ($\alpha_1$), long memory ($\delta$), and autoregressive volatility ($\beta_1$) parameters are highly significant.

To assess the stability of the estimated FIGARCH model parameters, we employ the Nyblom stability test. The test results provide strong evidence of parameter instability for all four currency pairs, regardless of the distribution assumption for the innovations. The joint statistics significantly exceed the critical values at all conventional significance levels, and the individual statistics for the parameters also indicate instability in most cases.

The presence of parameter instability in the FIGARCH models suggests that the estimated parameters for these currency pairs may not be constant over time. This finding has important implications for market participants, such as traders, risk managers, and policymakers. Unstable parameters can lead to unreliable volatility forecasts and suboptimal risk management strategies based on these models, which may result in financial losses or misallocation of resources.

Our study contributes to the existing literature on FIGARCH models and parameter stability in financial econometrics by providing a comprehensive analysis of the parameter stability of FIGARCH models for key currency pairs using the Nyblom test. The findings underscore the importance of regularly monitoring and testing the stability of model parameters, particularly in the context of dynamic and evolving financial markets.

The evidence of parameter instability in the FIGARCH models for the selected currency pairs highlights the need for caution when using these models for volatility forecasting and risk management purposes. Market participants should be aware of the potential limitations and instability of the model parameters and consider alternative approaches or regular model updates to account for structural changes in volatility dynamics.

In conclusion, this paper emphasizes the importance of assessing the parameter stability of FIGARCH models in the context of foreign exchange volatility modeling. The findings of parameter instability for the selected currency pairs call for further research on the factors contributing to this instability and the development of more robust volatility models that can accommodate time-varying parameters. The study also underscores the need for market participants to regularly monitor and test the stability of model parameters to ensure the reliability and accuracy of their volatility forecasts and risk management strategies.

## 7. Policy Prescription:

The findings of this study have important policy implications for central banks, financial regulators, and policymakers. The evidence of parameter instability in the FIGARCH models for key currency pairs highlights the need for policymakers to consider the potential limitations of these models when formulating policies related to foreign exchange markets and financial stability.

First, central banks should be cautious when using FIGARCH models for forecasting exchange rate volatility and assessing the effectiveness of their intervention policies. The instability of model parameters suggests that the reliability of volatility forecasts based on these models may be compromised, potentially leading to suboptimal policy decisions. Central banks should consider using alternative volatility models or regularly updating their models to account for structural changes in exchange rate dynamics.

Second, financial regulators should be aware of the implications of parameter instability for risk management practices in financial institutions. The use of FIGARCH models with unstable parameters for measuring and managing foreign exchange risk may lead to an underestimation or overestimation of risk exposure, which could result in inadequate capital allocation or excessive risk-taking. Regulators should encourage financial institutions to regularly assess the stability of their risk management models and consider alternative approaches that are more robust to structural changes in volatility dynamics.

Third, policymakers should promote research and development efforts aimed at improving the stability and reliability of volatility models, particularly those that account for long memory. This could involve funding academic research projects, or-ganizing conferences and workshops to facilitate knowledge sharing among researchers and practitioners, and encouraging collaboration between academia and the financial industry. By fostering a deeper understanding of the factors contributing to parameter instability and developing new modeling approaches that are more resilient to structural changes, policymakers can help enhance the accuracy and reliability of volatility forecasting and risk management practices in the foreign exchange market.

Fourth, policymakers should consider the potential impact of parameter instability on the effectiveness of financial market regulations and macroprudential policies. For example, capital adequacy requirements or leverage limits based on volatility models with unstable parameters may not provide sufficient protection against extreme market events or systemic risk. Policymakers should regularly review and update financial market regulations to ensure that they remain effective in light of evolving market conditions and advances in financial modeling.

Finally, policymakers should strive to enhance transparency and communication regarding the limitations and uncertainties associated with volatility models, particularly those that exhibit parameter instability. This could involve requiring financial institutions to disclose the assumptions and limitations of their risk management models, as well as promoting public awareness and understanding of the potential risks and benefits of using these models. By fostering a more informed and transparent dialogue about the challenges and opportunities associated with volatility modeling, policymakers can help promote a more stable and resilient financial system.

In conclusion, the evidence of parameter instability in the FIGARCH models for key currency pairs underscores the importance of considering the limitations of these models when formulating policies and making decisions related to foreign exchange markets and financial stability. Policymakers should adopt a cautious approach, promote research and development efforts to improve the stability and reliability of volatility models, and enhance transparency and communication regarding the limitations and uncertainties associated with these models.

## 8. Limitations and Future Research:

While this study provides valuable insights into the stability of FIGARCH model parameters for key currency pairs and its implications for risk management and policymaking, it is important to acknowledge the limitations of our analysis and identify areas for future research.

One limitation of our study is the focus on a specific sample period, which may not capture potential changes in volatility dynamics over longer horizons. The foreign exchange market is constantly evolving, and the relationships between economic variables and exchange rate volatility may vary over time. Future research could extend the analysis to longer sample periods or use rolling window estimation techniques to examine how the stability of FIGARCH model parameters changes over time.

Another limitation is the focus on a limited set of currency pairs, namely Euro-USD, GBP-USD, INR-USD, and JPY-USD. While these currency pairs are important in the global foreign exchange market, they may not be representative of the broader market dynamics. Future research could expand the analysis to include a wider range of currency pairs, including emerging market currencies, to provide a more comprehensive understanding of parameter stability in long memory volatility models.

Furthermore, our study relies on the FIGARCH model to capture long memory and volatility clustering in exchange rate returns. While the FIGARCH model is widely used in the literature, it is not the only long memory volatility model available. Future research could explore the use of alternative models, such as the HYGARCH or FIAPARCH models, to assess the robustness of our findings and provide a more nuanced understanding of parameter stability in long memory volatility models.

Another area for future research is the investigation of the economic and financial factors that may contribute to parameter instability in long memory volatility models. This could involve examining the impact of macroeconomic news announcements, changes in monetary policy, or shifts in investor sentiment on the stability of FIGARCH model parameters. By identifying the underlying drivers of parameter instability, researchers and practitioners can develop more robust and adaptive volatility forecasting and risk management strategies.

Future research could also explore the use of time-varying parameter models or regime-switching models to capture structural changes in exchange rate volatility dynamics. These models allow for parameters to vary over time or switch between different regimes, potentially providing a more flexible and accurate representation of the underlying volatility process. Comparing the performance of these models with the FIGARCH model could offer valuable insights into the trade-offs between model complexity and parameter stability.

Finally, future research could investigate the implications of parameter instability for the design and implementation of financial market regulations and macroprudential policies. This could involve examining how different regulatory frameworks or policy interventions affect the stability of long memory volatility models and the effectiveness of risk management practices in the foreign exchange market. By providing a deeper understanding of the interplay between parameter instability, financial market regulations, and systemic risk, researchers can help inform the design of more effective and resilient policy frameworks.

In conclusion, while this study provides important insights into the stability of FIGARCH model parameters for key currency pairs, there are several limitations and areas for future research. Addressing these limitations and exploring new avenues for research can help enhance our understanding of long memory volatility models and their applications in finance and policy-making. By doing so, we can contribute to the development of more accurate and reliable tools for volatility forecasting, risk management, and policy analysis in the dynamic and complex world of foreign exchange markets.

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