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TIME-VARYING INEFFICIENCY IN EXCHANGE RATE RETURNS: THE CASE OF EURO AGAINST MAJOR CURRENCIES

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Abstract

This paper examines the efficiency of the euro's exchange market against the USD, GBP, and CNY, which are generally considered highly efficient. We used two robust tests on a fixed-length rolling window to identify periods of inefficiency. A classification problem was then formulated to link these periods to specific market conditions. The data sample spanned from 1999 to 2025 for EUR/USD and EUR/GBP, and from 2005 to 2025 for EUR/CNY. Our findings show that market efficiency fluctuates over time. EUR/CNY returns were the most inefficient, followed by EUR/USD, with EUR/GBP returns being the most efficient. The detected periods of inefficiency appear to be linked to periods of crisis and high uncertainty. Logistic regression results also suggested that periods of lower

volatility are more likely to be predictable or inefficient. These empirical findings align with market microstructure theory.

Keywords: EMH, market microstructure, euro, uncertainty, variance ratio test

1. INTRODUCTION

According to Fama (1970), financial literature categorizes market efficiency as weak, semi-strong, and strong forms. Weak-form efficiency states that asset prices fully reflect all past publicly available market data. Therefore, historical prices and returns cannot be used to predict future prices or earn abnormal returns. Semi-strong form efficiency is a stronger version, stating that prices reflect all publicly available information, including financial statements, news announcements, and economic data. Under this form, neither technical analysis nor fundamental analysis can provide an advantage. Strong-form efficiency is the most stringent form, asserting that prices reflect all information, both public and private (insider information). In a strong-form efficient market, no one, not even corporate insiders, could consistently achieve abnormal returns. Lo (2004) suggested the Adaptive Market Hypothesis (AMH), and Lo (2005) reconciled this hypothesis with behavioural finance. While the traditional efficient market hypothesis offers three distinct forms, Lo's AMH argues that market efficiency is a dynamic process shaped by evolutionary forces and human behaviour, with periods of efficiency and inefficiency. However, little is known about specific market conditions related to market inefficiency. Consequently, this research aims to identify periods of inefficiency and link the detected periods to a specific market condition. This paper used publicly available data. Therefore, it focuses specifically on the weak form of exchange market efficiency. A key assumption of efficient financial markets is that transaction costs and information asymmetry are absent, and exchange rate returns follow a true random walk. Consequently, some studies explore how violations of these assumptions, among other factors, drive exchange rate movements. The existing findings commonly stem from regression-based estimations. Another strand of literature aims to identify autocorrelation among exchange rate returns while relying on rather complex algorithms and methods, often leading to a loss of interpretability. This research begins by testing foreign exchange market efficiency under the assumption that exchange rate returns behave as a pure random walk. The study then shifts from previous approaches, formulating the problem as a classification of market conditions associated with predictable exchange rate returns. The empirical findings were later contextualized within contemporary literature development. Following the introductory part, the remainder of this paper is organized as follows: Section 2 briefly summarizes existing literature related to the topic under consideration. Section 3 presents research methods, while Section 4 discusses the research data and empirical results. The final section provides an overview of the main findings of the research.

2. LITERATURE OVERVIEW

Exchange rate market efficiency is an evergreen topic in empirical literature. While generally efficient, the foreign exchange rate market experiences occasional periods of inefficiency, as consistently shown in existing research. The literature demonstrates the inherent difficulty in ascertaining forex market efficiency (Meese and Rogoff, 1983, Katusiime et al., 2015; Rehman et al., 2022) which exhibits temporal variation (Mensi et al., 2020), particularly in contexts of high uncertainty. While taking into account various anomalies the contemporary literature struggles to identify methods or combinations of methods to improve the forecasting accuracy of exchange rate returns. Some research (Galeshchuk and Mukherjee, 2017; Rivas et al., 2017) employed neural networks to address the issue of linearity in predicting exchange rate returns since the poor performance of linear models to predict exchange rate returns is well known and frequently documented (Meese and Rogoff, 1983). Plakandaras et al. (2015) used the data for EUR/USD, USD/JPY, AUD/NOK, NZD/BRL and ZAR/PHP currency pairs between January 4, 1999 and October 30, 2011 and support vector regression after ensemble empirical mode decomposition and multivariate adaptive regression splines for a variable selection. The findings revealed that models employed outperformed the random walk model as a benchmark in out-of-sample forecasting for all of the considered currency pairs. Parot et al. (2019) highlighted the importance and complexity of EUR/USD exchange rate returns and suggested combining of linear (vector autoregression and vector error correction models) and nonlinear models (artificial neural networks) as an approach to forecast EUR/USD exchange rate returns. Using the proposed approach and daily data sample for the period between 4 January 1999 and 30 December 2015 for EUR/USD, GBP/USD, and JPY/USD parities the approach illustrated improved performance in predicting EUR/USD returns. Bošnjak et al. (2021) employed quantile autoregression approach to consider market efficiency for returns on the euro against fifteen currencies. While findings for many of the considered currency pairs were found to be predictable, depending on the sign and magnitude of endogenous shocks, the findings for EUR/USD, EUR/GBP and EUR/CNY were fully in line with the assumption of the efficient market hypothesis. The findings from Bošnjak et al. (2021) rely on autoregressive process of order one (AR(1) process). Lee et al. (2021) pointed out a need for longer formation and test periods to support the hypothesis of foreign exchange market inefficiency. Starting with the goal of explaining deviations from market efficiency, the literature has evolved in various directions. Numerous studies have supported the adaptive market hypothesis suggested by Lo (2004), which is rooted in an interdisciplinary approach combining complex systems, bounded rationality, evolutionary psychology and evolutionary biology. Asif and Frömmel (2022) investigated the efficiency of various foreign exchange markets relative to the USD by applying detrended fluctuation analysis. The resulting Hurst exponents suggested that market efficiency changed over time, consistent with the adaptive market hypothesis. In line with the adaptive market hypothesis, Kumar (2018) demonstrated that the efficiency of Indian exchange rates against the US dollar, British pound, Euro, and Japanese yen fluctuates over time in response to

changing market conditions. Several studies incorporated ideas from behavioural finance. Drawing on behavioural finance, Lavoie and Daigle (2011) explained how exchange rate expectations influence exchange rate dynamics. In line with behavioural finance approaches, Maghyereh and Abdoh (2022) found sentiment to be a significant driver and predictor of volatility. The observed limitations in the predictive capacity of macroeconomic exchange rate models resulted in the emergence of literature that seeks to understand exchange rate dynamics through the framework of market microstructure (Lo, 2022). The findings of Sasaki and Yokouchi (2025), derived from an artificial market model of the forex market, lend support to the potential role of microstructure market factors in explaining exchange rate dynamics. Drawing on the market microstructure approach, Said et al. (2024) found that the time-varying efficiency of the stock market is determined by key factors such as volatility, liquidity, trading costs, and thin trading. Notwithstanding the inherent differences between the stock market and the foreign exchange market, some findings pertinent to stock market predictability may warrant consideration in the context of foreign exchange return predictability.

3. RESEARCH METHODS

The non-normality and heteroscedasticity commonly observed in financial time series pose significant challenges for the empirical evaluation of market efficiency. To overcome these issues when testing for autocorrelation in returns and assessing foreign exchange market efficiency, we utilized the automatic portmanteau test (Escanciano and Lobato, 2009) and the wild bootstrap automatic variance ratio test (Kim, 2009). As noted by Charles et al. (2011), these tests are particularly advantageous for small samples with non-normal and heteroscedastic data. The automatic portmanteau test, a refinement of the Ljung-Box Q statistic, improves upon conventional methods by addressing the assumption of independent and identically distributed returns and the subjective choice of autocorrelation lags. The optimal lag for this test is automatically selected based on either the Bayesian information criterion (BIC) or the Akaike information criterion (AIC). The test statistic for the automatic portmanteau test is presented in equation (1):

$$AQ_k^* = T \cdot \sum_{i=1}^{k} \rho_i^2 \quad (1)$$

In this context, T denotes the total number of observations, m represents the order of autocorrelation, and k is the optimal lag length. The AQ statistics follows chi-square distribution with one degree of freedom. The null hypothesis for the automatic portmanteau test is that there is no autocorrelation($\rho_i = 0,$ for all $i \leq k$). To ensure the robustness of our empirical findings, we also employed an advanced version of the variance ratio test (Choi, 1999). Kim (2009) highlighted the limitations of Choi's (1999) variance ratio test in small samples with heteroscedasticity and proposed a wild bootstrap procedure to address these issues. The test statistic for the wild bootstrap automatic variance ratio test is presented in equation (2):

$$AVR(k) = \sqrt{\frac{T}{k}} \cdot \frac{[VR(K)-1]}{\sqrt{2}} \xrightarrow{d} N(0,1) \quad (2)$$

The wild bootstrap automatic variance ratio test procedure consists of three steps:

1) Formation of bootstrap sample of size $T, Y_t^* = \eta_t Y_t$ for $t = 1, \cdots$,T, where η_t represents a rendom sequence with zero mean and unit variance;
2) Calculate $AVR^*(K)$ obtained from $\{Y_t^*\}_{t=1}^T$;
3) Repeat steps 1) and 2) BS times in order to generate bootstrap distribution of the AVR statistics$\{AVR^*(k,j)\}_{j=1}^{BS}$.

For this research, T was selected as a trade-off between the sample size needed for test power and the test's sensitivity in capturing a switch between efficient and inefficient markets. T was set to 500. The two-tailed p-value for this test was calculated as the proportion of absolute values of $\{AVR^*(k,j)\}_{j=1}^{BS}$ greater than absolute values of $AVR(K)$.

The described procedure identified periods of inefficiency. The subsequent analysis seeks to elucidate periods of inefficiency. Firstly, some events and economic conditions corresponding to periods of inefficiency we recalled. Afterwards, the classification problem was formulated. A common limitation in the exchange rate market efficiency literature is its reliance on regression analysis, which primarily generates correlations and offers limited insight into causal effects. We formulated a classification problem to gain insight into market conditions across predictable and unpredictable periods. While relying on public data, we aim to discriminate between periods of efficiency and inefficiency based on the mean and variance of exchange rate returns. Methodological literature offers many different approaches to deal with the problem of classification. The preferred method depends on the goal: estimation or forecasting accuracy. Given the need for interpretable estimates in our classification problem, we selected logistic regression as our approach. To assess the relationship between 500-day mean returns, 500-day return variance, and inefficiency within the same 500-day window, a logistic regression model, as shown in equation (3), was estimated.

$$ME_t\left(r_{[t-499,\cdots,t]}\right) = \alpha + \beta_1 \cdot \mu_t\left(r_{[t-499,\cdots,t]}\right) + \beta_2 \cdot {\sigma^2}_t\left(r_{[t-499,\cdots,t]}\right) + \varepsilon_t \quad (3)$$

Where $ME_t\left(r_{[t-499,\cdots,t]}\right)$ is a binary categorical variable taking the value 1 in the case of market inefficiency and 0 in the case of market efficiency, $\mu_t\left(r_{[t-499,\cdots,t]}\right)$ represents the average return over the last 500 days, and ${\sigma^2}_t\left(r_{[t-499,\cdots,t]}\right)$ represents the variance of returns over the last 500 days. To provide robustness of the results, we estimated two regression models with different dependent variables for each currency pair. The dependent variables were determined by the Escanciano and Lobato (2009) test as well as by the Kim (2009) test. To check for multicollinearity in a logistic regression model, a common method is to use the Variance Inflation Factor (VIF). High VIF values suggest that the predictor variables are highly correlated with each other, which can make the model's coefficients unstable and difficult to interpret. Consequently, in line with

the coefficient estimates, we provided the VIF for each independent variable. To evaluate the performance of the logistic regression models, we obtained and reported the Area Under the Receiver Operating Characteristic curve (AUC-ROC). The AUC-ROC measures the model's ability to discriminate between the positive and negative classes. An AUC of 1.0 indicates a perfect model, while an AUC of 0.5 is no better than random guessing. AUC-ROC values are interpreted as follows: 0.90-1.00 (excellent discrimination), 0.80-0.90 (good discrimination), 0.70-0.80 (acceptable discrimination), 0.60-0.70 (poor discrimination) and AUC < 0.60 (no discrimination power). Statistical analysis was performed using R statistical software.

4. RESEARCH DATA AND EMPIRICAL FINDINGS

Data on mid-exchange rates for the specified currency pairs were sourced from the European Central Bank (ECB). The time series cover the period from January 4, 1999, to March 26, 2025, for EUR/USD and EUR/GBP, and a shorter period from April 1, 2005, to March 26, 2025, for EUR/CNY. For analysis, daily exchange rates were converted natural logarithms. In this logarithmic representation, a rising value corresponds to euro appreciation, and a falling value to euro depreciation. Exchange rate returns (r_t) of EUR against USD, GBP and CNY at day (t) was calculated as given in equation (4):

$$r_t = log\left(\frac{y_t}{y_{t-1}}\right) \cdot 100 \quad (4)$$

Using the methodology detailed in the section 3 Research methods, we first identified periods of (in)efficiency for EUR/USD based on the p-values obtained from the Escanciano and Lobato (2009) and Kim (2009) tests. These results are presented in Figure 1.

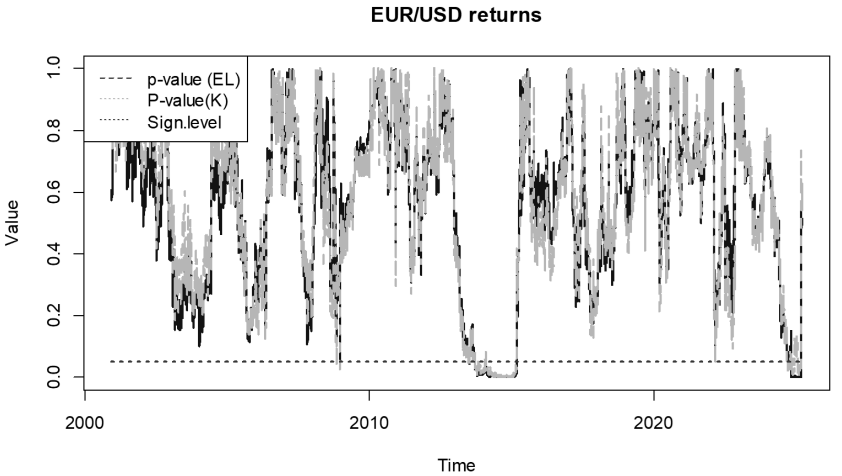

Figure 1 P-values for the EUR/USD returns from the Escanciano and Lobato (2009) (EL) and Kim (2009) (K) tests

Source: Author.

Figure 1 presents the evolution of the p-values resulting from the application of the Escanciano and Lobato (2009) (EL) test and the Kim (2009) (K) test. The initial inefficiency, calculated using a 500-day window as outlined under section 3 Research methods of this paper, was detected on October 31, 2008, based on the previous 500 observations (two years). The observed inefficiency in EUR/USD exchange rate returns can be attributed to the 2007 US sub-prime financial crisis. A subsequent period of inefficiency in the EUR/USD exchange rate returns was identified beginning on June 27, 2013 and persisting until March 6, 2015. The second period of inefficiency seems to have been caused by the Eurozone debt crisis. Specifically, the increase in bond yields (Samarakoon, 2017) and the European Central Bank's monetary policy adjustments likely affected the efficiency of EUR/USD exchange rate returns. The third, short-lived period of inefficiency (March 1, 2022), detected only by the Kim (2009) test, may have been triggered by the COVID-19 pandemic crises. Furthermore, the most recent period of inefficiency in EUR/USD exchange rate returns, lasting from September 10, 2024, to March 6, 2025, could be a result of the Russian invasion of Ukraine and the subsequent inflationary pressures. Following the same procedure p-values for the EUR/GBP returns were obtained and are illustrated in Figure 2.

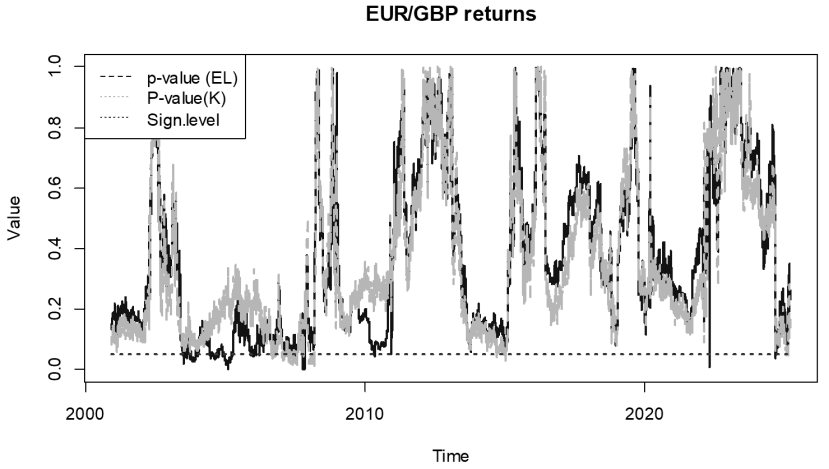

Figure 2 P-values for the EUR/GBP returns from the Escanciano and Lobato (2009) (EL) and Kim (2009) (K) tests

Source: Author.

Figure 2 illustrates a period of inefficiencies from March 26, 2003, to November 13, 2007. However, these inefficiencies did not seem to be clearly associated with economic or market conditions during that time. Additionally, inefficiencies were observed in May 2022 and September 2024, possibly due to the COVID-19 crises and the Russian invasion of Ukraine, respectively. The same

methodology was used to derive p-values for the EUR/CNY returns, and these results are presented in Figure 3.

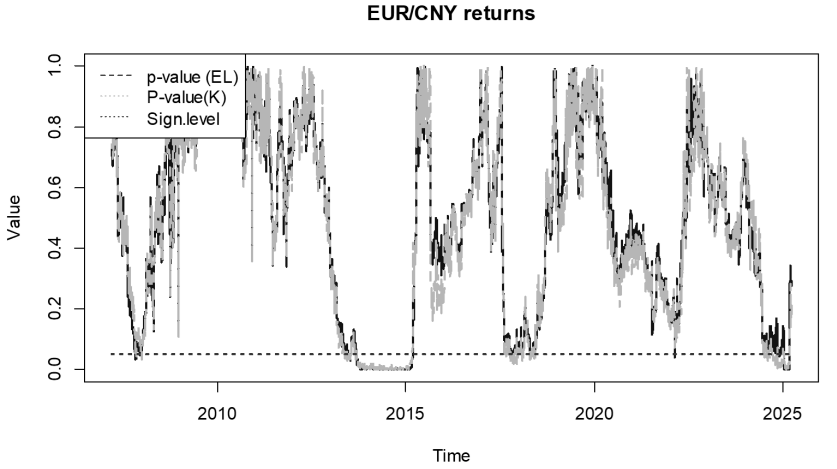

Figure 3 P-values for the EUR/CNY returns from the Escanciano and Lobato (2009) (EL) and Kim (2009) (K) tests.

Source: Author.

Figure 3 illustrates a period of inefficiencies in EUR/CNY returns detected in May 2013. China experienced an economic growth slowdown in 2010, prompting a large stimulus package that subsequently led to inflationary pressures. The People's Bank of China (PBC) took measures to tighten monetary policy to combat these inflationary pressures (Burdekin and Weidenmier, 2015). Some lagged effects were captured by the sample and inefficiency was detected in May 2013, based on the previous 500 observations. Subsequently, inefficiencies were detected from September 2017 to June 2018, and later from July 2024 to March 2025. The degree of (in)efficiency for each considered currency pair is illustrated in Table 1 by reporting the percentage of the total observation period characterized by efficiency and inefficiency.

Table 1 Degree of (in)efficiency for each considered currency pair.

Currency	**Test**	**Efficient 500-day periods (%)**	**Inefficient 500-day periods (%)**
EUR/USD	Escanciano and Lobato (2009)	92,41%	7,59%
	Kim (2009)	92,62%	7,38%
EUR/GBP	Escanciano and Lobato (2009)	95,66%	4,34%
	Kim (2009)	97,28%	2,72%
EUR/CNY	Escanciano and Lobato (2009)	89,87%	10,13%
	Kim (2009)	87,06%	12,94%

Source: Author.

Table 1 shows that EUR/GBP exhibited the highest market efficiency, followed by EUR/USD, while EUR/CNY was the most inefficient among the analysed pairs. Following equation (3), we used a logistic regression model to estimate market inefficiency, with the 500-day mean and variance of returns as the independent variables. The estimates were summarized in Table2.

Table 2 Logistic regression model estimates for market inefficiency with 500-day mean and variance of returns as regressors

Currency	**Test**	**Coeff.**	**Estimate (Std. Error)**	**(Odds-1)*100**	**t value**	**VIF**	**AUC-ROC Value:**
EUR/USD	(Escanciano and Lobato, 2009)	α	0.220*** (0.007)	24.639	27.741	-	0.805
		β_1	-0.489*** (0.131)	-38.726	-3.735	1.031	
		β_2	-0.410*** (0.020)	-33.677	-19.935	1.031	
	(Kim, 2009)	α	0.210*** (0.007)	23.389	26.746	-	0.785
		β_1	-0.289** (0.129)	-25.120	-2.229	1.031	
		β_2	-0.388*** (0.020)	-32.196	-19.059	1.031	
EUR/GBP	(Escanciano and Lobato, 2009)	α	0.114*** (0.005)	12.094	20.81	-	0.832
		β_1	1.654*** (0.151)	423.127	10.92	1.225	
		β_2	-0.323*** (0.021)	-27.662	-15.32	1.225	
	(Kim, 2009)	α	0.090*** (0.004)	9.417	20.59	-	0.931
		β_1	0.634*** (0.120)	88.603	5.25	1.225	
		β_2	-0.271*** (0.016)	-23.766	-16.10	1.225	
EUR/CNY	(Escanciano and Lobato, 2009)	α	0.195*** (0.009)	21.606	20.966	-	0.622
		β_1	-0.385 (0.275)	-32.012	-1.403	1.293	
		β_2	-0.331*** (0.030)	-28.179	-10.894	1.293	
	(Kim, 2009)	α	0.240 (0.010)	27.134	23.30	-	0.644
		β_1	1.030*** (0.303)	180.298	3.394	1.293	
		β_2	-0.360*** (0.033)	-30.252	-10.738	1.293	

Note: *** and ** represent statistical significance at 1% and 5%, respectively.

Source: Author.

Based on the estimates in Table 2, an increase in the 500-day mean and variance of returns are associated with a lower likelihood of inefficiency in the EUR/USD exchange rate market. This finding holds true regardless of whether inefficiency was estimated using the Escanciano and Lobato (2009) or the Kim (2009) test. Similarly, an increase in variance in EUR/GBP returns is linked to a lower likelihood of inefficiency. However, an increase in the 500-day mean for EUR/GBP returns is associated with a greater likelihood of inefficiency. Both tests employed support these findings. While the findings for EUR/CNY returns were generally consistent with those for EUR/GBP, the mean return was not a statistically significant determinant of inefficiency when assessed using the Escanciano and Lobato (2009) test. Findings in Table 2 suggest no multicollinearity between mean returns and its volatility. The logistic regression model achieved the best discrimination (excellent discrimination) between efficient and inefficient periods in the case of EUR/GBP, specifically when inefficiency was detected using the Kim (2009) test. Good discrimination was obtained in the case of EUR/GBP when Escanciano and Lobato (2009) were employed to detect periods of inefficiency. Good or acceptable discrimination was obtained in the case of EUR/USD returns. This epended on which test was employed, either the Escanciano and Lobato (2009) or the Kim (2009) test. For EUR/CNY, model discrimination was found poor, though slightly better results were achieved when using the Kim (2009) test to detect inefficiency. Generally, the inefficient periods were characterized by low volatility, which suggests that potential earnings might be limited.

Foreign exchange rate fluctuation arises as a consequence of various factors (Benić, 2004). Its role has appeared to be of wider importance in an economy, for example, to absorb external shocks (Derado and Mlikota, 2007) or to maintain foreign exchange reserves (Bošnjak et al., 2019). Therefore, an understanding of foreign exchange overreaction is of paramount importance. Examining 30 years of foreign exchange overreaction, Lee et al. (2021) found that reversal was significant over longer periods, while there was no persistent momentum or reversal overall pointing out sample-period sensitivity. Wu et al. (2022) found that increased risk aversion significantly reduces long-run Renminbi exchange rate volatility. Analysis of Figures 1, 2, and 3 indicates certain overlapping periods of inefficiency among the three currency pairs. Existing literature (Hung, 2020; Jeon and Lee, 2002) suggested that foreign exchange markets were strongly linked. This interconnectedness meant that high volatility in one geographical area typically spilled over to the next as global trading hours shifted, a pattern described as the "meteor shower" effect (Engle et al., 1990). Consistent with the concept of volatility spillover, the transmission of inefficiency or predictability in return dynamics may also occur, thereby strengthening the established relationship between market volatility and deviations from efficiency. King et al. (2013) provided a survey of research on the foreign exchange rate market microstructure, including the theoretical underpinnings of the empirical results. Following King et al. (2013) and the literature therein, volatility arises as a consequence of private information arrival, and trading volume is higher when private information arrives more frequently. Consistent with market microstructure

theory, the empirical findings herein suggest that higher return volatility and variance coincide with greater market efficiency. Findings from Brennan and Xia (2006) point out that exchange rate volatility moves closely with the predicted volatility of pricing kernels. Notably, foreign exchange risk premiums are significantly influenced by both this estimated volatility of pricing kernels and the inherent volatility of exchange rates. According to Osler's (2012) argument and supporting empirical findings, there is a link between aggressive interbank buying of major currencies (euro, yen, or pound) versus the US dollar and their appreciation. Specifically, a net daily purchase of $1 billion is associated with an approximate 0.5% gain in the currency's value. Evidence highlights order flow's crucial role in returns, as it drives as much as two-thirds of the market's reaction to news (Rime et al., 2010). The findings presented in Table 2 indicate a higher likelihood of inefficiency when the euro appreciates against the US dollar and when it depreciates against the British pound. However, the analysis for the EUR/CNY pair yields inconclusive results that vary depending on the test applied. Further research might be directed towards including private information and consider its effects on foreign exchange market inefficiency.

5. CONCLUSIONS

This paper's findings clearly illustrate a departure from the weak form of market efficiency in the euro's exchange market against the USD, GBP, and CNY, as well as the time-varying nature of market efficiency. The results further suggested that EUR/GBP exhibited the highest market efficiency, followed by EUR/USD, while EUR/CNY was the most inefficient among the analysed pairs. Substantial efficiency is a common feature of the exchange rate market for major currencies, with inefficiencies being temporary in nature. The complexities of foreign exchange market inefficiency can only be understood by taking into account not just macroeconomic and market conditions, but also the links between them. Unlike other studies, this paper advocates a classification problem approach to understand the conditions related to foreign exchange market inefficiency. Considering macroeconomic conditions as a fundamental driver of currency value, observed inefficiencies tend to occur during crises and the resulting uncertainties. Existing literature highlights the market microstructure approach as a well-established framework for understanding market conditions. However, literature developed on behavioural finance should not be neglected. Mean value of returns appeared significant in determining market inefficiency. Eventually, the more volatile periods with higher variance of returns appeared more efficient. Therefore, the inefficient periods were characterized by low volatility, which suggests that potential earnings might be limited. Market microstructure theory accurately reflects the relationship between foreign exchange market inefficiencies and underlying conditions like volatility and mean returns. Empirical findings from this paper suggest that during times of calm, when volatility is low, market participants may have opportunities to predict price movements and earn profits. Policymakers and regulators should be aware of this dynamic, as it could have implications for market integrity and the need for a framework to monitor or respond to such conditions.

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VREMENSKI PROMJENJIVA NEUČINKOVITOST U PRINOSIMA DEVIZNOG TEČAJA: SLUČAJ EURA U ODNOSU NA GLAVNE VALUTE

Sažetak

U radu se ispituje učinkovitost deviznog tržišta eura u odnosu na USD, GBP i CNY, valute koje se općenito smatraju vrlo učinkovitima. Koristili smo se dvama robusnim testovima na pomičnom prozoru fiksne duljine kako bismo identificirali razdoblja neučinkovitosti. Zatim je formuliran problem klasifikacije kako bi se ta razdoblja povezala sa specifičnim tržišnim uvjetima. Uzorak podataka obuhvaćao je razdoblje od 1999. do 2025. za EUR/USD i EUR/GBP te od 2005. do 2025. za EUR/CNY. Naši nalazi pokazuju da učinkovitost tržišta varira tijekom vremena. Najizraženija neučinkovitost uočena je pri prinosu EUR/CNY, zatim EUR/USD, dok su prinosi EUR/GBP pokazali najveću razinu učinkovitosti. Čini se da su otkrivena razdoblja neučinkovitosti povezana s razdobljima krize i visoke neizvjesnosti. Rezultati logističke regresije također upućuju na to da su razdoblja niže volatilnosti sklonija predvidljivosti ili neučinkovitosti. Ovi empirijski nalazi u skladu su s teorijom tržišne mikrostrukture.

Ključne riječi: EMH, mikrostruktura tržišta, euro, neizvjesnost, test omjera varijance.

JEL klasifikacija: M15, M41, K24, G32, D83.