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Exchange Rate Volatility: Does Microeconomic Policy Uncertainty Impact Exchange Rate Volatility?

Kelly Oniha
Texas A&M International University, USA

Abstract: ***This paper analyzes the impact of macroeconomic policy uncertainty on the exchange rate volatility in United States. Using newly developed measure of monetary policy uncertainty, and macroeconomic variables, I find that higher monetary policy uncertainty increases the exchange rate volatility.***

I. INTRODUCTION

Exchange rate volatility is an issue that has been extensively discussed in the literature (Fama, 1984; Hodrick, 1987; Kinkyo, 2020). In the literature, the exchange rate volatility has been attributed to various macroeconomic and non-macroeconomic indicators. Specifically, the exchange rate has been documented to react to events ranging from the announcement of macroeconomic news (Mueller, Tahbaz-Salehi, & Vedolin, 2017) to financial crisis. One event that is recently receiving much attention is the impact of macroeconomic policy uncertainty on the volatility of the exchange rate (Chen, Du, & Hu, 2020; Hutchison & Sushko, 2013; Park, Qureshi, Tian, & Villaruel, 2020; Plíhal & Lyócsa, 2021; Zhou, Fu, Jiang, Zeng, & Lin, 2020). This study has become necessary following the financial crisis of 2007-2009.

The macroeconomic policy uncertainty (hereafter, MPU) can be seen as a situation that makes it difficult to form probability distribution over the future outcome of macroeconomic policies (Park et al., 2020). Both theoretical and empirical research have established several links between the macroeconomic policy and the exchange rate. One important tool of the macroeconomic policy that has been found to influence exchange rate is the interest rate. Capital inflows and outflows are dependent on the interest rates. These inflows also determine the exchange rate position of a country. Therefore, uncertainty that arises with respect to the interest rate also influence the exchange rate. The volatility of the exchange rate is the persistent changes of the exchange rate over time. These persistent changes generate exchange rate risks. The effect of the risk caused by the exchange rate volatility includes the reduction in investment, consumption, productivity and economic growth (Park et al., 2020).

The purpose of this study is to investigate the relationship between the MPU and exchange rate volatility using United States of America dataset from the federal reserve. The extant literature (Chen et al., 2020; Hutchison & Sushko, 2013; Park et al., 2020; Plíhal & Lyócsa, 2021; Zhou et al., 2020) have studied the effect of various policy uncertainty, like, monetary policy uncertainty, economic policy uncertainty, and interest rate uncertainty on exchange rate volatility. However, these studies have not specifically investigated the relationship in the United States (US). Some of these researches only studied how the monetary policy uncertainty in the US affect the volatility of the exchange rate in other countries (Krol, 2014; Park et al., 2020). Also, this study employed the newly developed MPU data by (Husted, Rogers, & Sun, 2020). In the existing literature of MPU, the dominant proxies used are the implied and realized volatility models, and in recent times, one developed by (Baker, Bloom, & Davis, 2016). I adopted the MPU developed by (Baker et al., 2016) to serve as a robustness check.

To analyze the relationship between MPU and the volatility of the stock market, I employ US monthly time series data of exchange rate and other macroeconomic indicators from January 1985 to August 2020. The study finds that the higher the monetary policy uncertainty the higher the exchange rate volatility. The results are similar when I use both measures of MPU. That is, the MPU developed by (Baker et al., 2016) increases the exchange rate volatility by 5%. Also, the MPU developed by (Husted et al., 2020) increases the exchange rate volatility by 6%. In addition, I find that inflation, money supply, and effective federal funds rate also increase the exchange rate volatility. This suggests that any instability in any of these variables are likely to cause instability in the exchange rate. The rest of the paper is organized as follows. In section two, I review the relevant literature for the study including both the theoretical and empirical literature. In section three, I describe the hypothesis and the methodology of the study. In section 4, I describe my data and the variables for the study. In section five, I analyze the results and show its consistency in the literature. Lastly, in section six, I draw my conclusion of the study and the findings.

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II. LITERATURE REVIEW

In this section, I review the theories that link monetary policy uncertainty to exchange rate volatility and the empirical evidence concerning this relationship.

A. Theoretical Review

Theories have established a link between interest rate and exchange. In the Mundell Fleming model, for instance, expansionary monetary policy reduces interest rate and makes assets denominated in dollars to be less attractive compared to assets denominated in other foreign denominated. There is thus capital outflow from the US to foreign countries and this depreciates the dollar relative to other currencies. As predicted by the uncovered interest rate parity, a country with low interest rates is expected to experience depreciation in its currency relative to the currency of the country with high interest rates (Kinkyo, 2020). Also, (Mueller et al., 2017), in a theoretical research, finds that when the interest rate differential is higher between two countries, there is a larger excess return on the foreign currency position.

In contractionary monetary policy, the interest rate increases, and the dollar denominated assets become attractive relative to the foreign denominated assets. There are more capital inflows as a result and the exchange rate appreciates relative to foreign currencies. Again, the uncovered interest rate parity predicts that the country with high interest is likely to experience appreciation of its currency relative to the currency of the country with low interest rate.

The link established between the interest rate and the exchange rate suggests that uncertainty in the monetary policy increases the volatility of the exchange rate (Kinkyo, 2020). This is in line with (Mueller et al., 2017). They proposed that the expected excess return of the foreign currency increases with an increase in monetary policy uncertainty in the United States.

B. Macroeconomic Policy Uncertainty

Policy uncertainty occurs when the outcome of the policy is unknown. There is a growing literature in this area. Following the interest in this area and the onset of the financial crisis, (Baker et al., 2016) and (Husted et al., 2020) have developed data for MPU using a textual based analysis. Specifically, they both conducted a number of newspapers searches to find certain key terms that relates to economic and macroeconomic policy uncertainty. Common key terms among these two papers are “uncertainty” or “uncertain”. This computer based search were also audited by humans as a robustness test. Prior to these MPU indexes, researchers used proxies like the realized volatility models **(**Anderson, 1998). Both measures are developed from the interest rate. Studies have found high correlation between the MPU and these models (Baker et al., 2016) (Antonakakis, Chatziantoniou, & Filis, 2013). Also, the inclusion of the economic policy uncertainty to these models has been shown to increase their forecasting abilities (Kaminska & Roberts-Sklar, 2018; Liu & Zhang, 2015)

C. Macroeconomic Policy Uncertainty and Exchange Rate Volatility

(Park et al., 2020) investigated the impact of US monetary policy uncertainty on the dollar exchange rates of ten Asian countries. The data sample covers from February 2006 and January 2019. Using an EGARCH model, their result indicates that the monetary policy uncertainty in the US increases the volatility of the exchange rate in some of the countries.

(Chen et al., 2020) investigate the effect of economic policy uncertainty on the China’s exchange rate. They source data from China Stock Market and Accounting Research Database (CSMAR) and World Trade Organization, and the sample runs from December 2001 to November 2018. Using quantile regression, they find that the effect of economic policy uncertainty on the exchange rate is asymmetric, with the highest correlation at the 75%. They also observed the impact of the uncertainty in other countries, like Hong Kong, United States, United Kingdom and Japan on China’s exchange rate. They find heterogenous effect, in that, all the different markets significantly influenced exchange rate volatility in China, except Hong Kong.

By employing GARCH-MIDAS model, (Zhou et al., 2020) investigate whether the relative economic policy uncertainty between China and the United States of America can impact China’s exchange rate. They source daily data that runs from January 1, 2003 to September 28, 2018 from DataStream. They find that the ratio of the China and the United States of America economic policy uncertainty has a long term impact on the instability of China’s exchange rate.

(Krol, 2014) investigate the economic and the general economic policy uncertainty on the exchange rate volatility of ten industrial and emerging countries. Except Mexico and Brazil, the sample of data spans June 1990 to February 2012. Using either instrumental variable estimators or ordinary least squares, they find that economic policy uncertainty increases the volatility of the exchange rate for most of the countries in the sample. Also, they find that the impact of the economic policy is higher than the impact of the general economic uncertainty

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III. HYPOTHESES AND METHODOLOGY

The main purpose of this study is to hypothesize and estimate the relationship between monetary policy uncertainty and exchange rate volatility. This section focuses on the hypotheses for the study. I draw insight from theories and empirical findings in finance and economics to aid with the hypothesis formulation. As mentioned in the theoretical literature review, the uncovered interest rate parity and the Mundell Fleming model establish a relationship between the macroeconomic policy, interest rate and the exchange rate. Thus, any macroeconomic policy easing by a country is likely to reduce the interest rate. By the proposition of the uncovered interest rate parity and the Mundell Fleming model, that country is likely to experience depreciation in its currency relative to foreign currencies. The opposite is also documented to be true. That is, tightening macroeconomic policy is likely to increase the interest rate and further appreciate the country's exchange rate relative to foreign exchange rate.

Given the link between the macroeconomic policy and the exchange rate volatility, it is expected that any uncertainty with the macroeconomic policy should have an effect on the exchange rate volatility. Empirical and theoretical researches, alike, have established that higher monetary policy uncertainty increases the exchange rate volatility. Specifically, (Krol, 2014) and (Zhou et al., 2020), empirically confirmed that macroeconomic policy uncertainty increases the exchange rate volatility. Also, (Mueller et al., 2017) proposed the expected excess return of the foreign currency increases with an increase in monetary policy uncertainty in the United States. Following these empirical and theoretical evidence, I hypothesize that:

Hypothesis: An increase in monetary policy uncertainty increases the exchange rate volatility and a lower monetary policy uncertainty reduces exchange rate volatility.

A. Methodology

Based on the hypothesis and the objective of the research, which is to examine the effect of the macroeconomic policy uncertainty on the exchange rate volatility, I employ the variables and the estimation technique explained below. I specify the empirical model as:

$$EXCH_{i,t} = \beta_0 + \beta_1 MPU_{i,t} + \beta_2 CPI_{i,t} + \beta_3 MS_{i,t} + \beta_4 FedFund_{i,t} + \beta_5 IndProd_{i,t} + e_{i,t}$$

Where $EXCH_{i,t}$ is the real effective exchange rate. The real effective exchange rates are calculated as weighted averages of bilateral exchange rates adjusted by relative consumer prices. $MPU_{i,t}$ represent both measures of MPU (Baker et al., 2016; Husted et al., 2020). To obtain the volatility of the exchange rate, I find the first difference of the log real effective exchange rate. This approach is largely adopted in the literature (Chen et al., 2020; Park et al., 2020). The $CPI_{i,t}$ is the consumer price index using 2015 base year and $MS_{i,t}$ is the real money supply. The $FedFund_{i,t}$ is the effective federal fund rate and the $IndProd_{i,t}$ is the industrial production index which is used as a proxy for gross domestic product. Lastly, the $\beta's$ represent the coefficients of the variables.

The estimation technique that is appropriate for the empirical model above is that the ordinary least squares. I employed robust standard errors to solve any problem of heteroscedasticity. This approach is extensively used in the extant literature (Krol, 2014).

IV. DATA AND SUMMARY STATISTICS

This section describes the data and the summary statistics of the variables used for the study.

As noted in the methodology and the introduction, the dependent variable of this study is the exchange rate volatility. Also, because the study is on the macroeconomic policy, I employ as my control variables, the effective federal funds rate, the industrial production, the CPI and money supply. The primary independent variable for my study is the MPU.

As mentioned in the introduction, I employ two forms of the MPU, one developed by (Baker et al., 2016) (hereafter, MPU_{BBD}) and another developed by (Husted et al., 2020) (hereafter, MPU_{HRS}). Both measures use a textual based analysis, that is, they conducted a number of newspapers searches to find certain key terms that relates to economic policy uncertainty. Even though the measures are highly correlated, there is substantial differences in how they derived their measures. (Baker et al., 2016), for instance, used 10 US newspapers while (Husted et al., 2020) tracked the frequency of newspaper articles like the Wall Street Journal, Washington Post and New York Times, on issues related to MPU. Some of the key searches of (Baker et al., 2016), include the trio of the terms, 'uncertainty' or 'uncertain' and 'economic' or 'economy'. Also, (Husted et al., 2020) included "interest rate" or "monetary policy" and "the Fed" or "Federal Reserves". They both did a monthly summation of the frequency of the terms and the data is available from January 1985. I obtain the data of the control variables from Federal Reserves' website. I took the natural log of all the macroeconomic variables. Both MPU are sourced from Baker, Bloom and Davis website, policyuncertainty.com. The data run from January 1985 to October 2020. I begin the analysis by looking at the correlation among the variables with main emphasis on the MPU and the dependent variables. Table 1 displays the result of the correlation among the variables. Both measures of macroeconomic policy uncertainty, MPU_{BBD} and MPU_{HRS} correlate positively with the real effective exchange rate. All other variables show positive relationship with the real effective exchange rate.

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Table 1: Correlation matrix of all the variables

This table displays the correlation among the variables. MPU_{BBD} is the measurement of MPU by (Baker et al., 2016). MPU_{HRS} is the measurement of MPU by (Husted et al., 2020). Exch Rate is the real effective exchange rate, Fed is the effective exchange rate, Indus Prod is the industrial production index, Money SS is the real money supply and CPI is the Consumer Price Index.

	MPU_{HRS}	MPU_{BBD}	Exch	Fed	Indus Prod	Money SS	CPI
MPU_{HRS}	1						
MPU_{BBD}	0.6929	1					
Exch	0.3329	0.3154	1				
Fed	-0.1787	-0.3381	0.0136	1			
Indus Prod	0.2801	0.3313	0.1274	-0.7226	1		
Money SS	0.3525	0.4929	0.3169	-0.7363	0.7731	1	
CPI	0.2974	0.4181	0.1186	-0.8337	0.9315	0.9189	1

Next, I consider the descriptive statistics displayed in Table 2. It is evident that MPU_{BBD} and MPU_{HRS} have similar means, medians, and standard deviations. The standard deviation of the variables can be described as the volatility of the variables. The average real effective exchange rate over the periods is 109 with the standard deviation of 11. It is evident that the volatility of the real effective exchange rate is high. Also, the average CPI over the period under consideration is 78 with standard deviation of 19. The effective federal fund rate averages 3.5 with a standard deviation of 2.8. The industrial production averages 87 with standard deviation of 17. Finally, the real money supply averages 3475 with standard deviation of 1201.

Table 2: Summary Statistics

This table shows the descriptive statistics of all the variables used for the study. The table shows the mean, median and the standard deviation.

Variables	Mean	Median	Standard Deviation
MPU_{HRS}	93.438	77.15	59.330
MPU_{BBD}	115.560	100.405	63.132
Real Exchange Rate	108.936	105.285	11.122
CPI	77.575	76.49	19.209
Effective Fed fund	3.5119	3.16	2.794
Industrial Production	87.127	93.245	16.956
Real Money Supply	3474.9	3164.95	1201.336

V. RESULTS AND ANALYSES

Table 3 displays the OLS regression results with percentage change in real exchange rate (exchange rate volatility) as the dependent variable. The control variables are also in percentage changes to solve the problem of non-stationarity. In this table, my primary objective is to examine the impact of MPU_{HRS} on exchange rate volatility. The result indicates that monetary policy uncertainty is positively related with the exchange rate volatility. The coefficient of the MPU is 0.0559 and significant at 1 percent. The result means that higher monetary policy uncertainty significantly increases exchange rate volatility. Conversely, a lower monetary policy uncertainty lowers exchange rate volatility. The result is consistent with theories and empirical results in the literature. For instance, (Mueller et al., 2017) show theoretically that monetary policy uncertainty causes exchange rate volatility. Similarly, (Krol, 2014) and (Zhou et al., 2020), empirically, show that the monetary policy uncertainty drives exchange rate volatility in the countries they considered. In the second row, consumer price index is positively related with the volatility of the exchange rate. The coefficient of the consumer price index is 0.017 and significant at 10 percent. This means that an increase in the growth rate of the CPI increases the volatility of the real effective exchange rate. Also, a decrease in the growth rate of CPI decreases the volatility of the real effective exchange rate. This result is consistent with the power purchasing parity which suggests that the currency of a country with a relatively higher inflation depreciates, comparatively. In the third row, the change in real effective exchange rate is positively related with the effective federal funds rate. The coefficient of the effective federal funds rate is 0.0734 and significant at 1 percent. The result indicates that the increase in the effective federal funds rate increases the volatility of the exchange rate and the decrease in the effective federal funds rate decreases the volatility of the exchange rate.

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In the fourth row, the change in industrial production is positively related to the real effective exchange rate. The coefficient of the industrial production is -1.6 and significant at 1 percent. The result indicates that the increase in the industrial production reduces the volatility of the real effective exchange rate and the decrease in the industrial production increases the volatility of the real effective exchange rate. This result is consistent with theory as the increase in production increases export relative to import. The net export increases as a result, and the exchange rate appreciates, thus reducing the volatility of the real effective exchange rate.
In the fifth row, the change in the real money supply is positively related to the real effective exchange rate. The coefficient is 0.9477 and significant at 1%. The result indicates that positive change in the real money supply increases the volatility of real effective exchange rate and the negative change in the real money supply reduces the volatility of the real effective exchange rate. The intuition is that a lower money supply reduces CPI which lowers volatility of the real effective exchange rate.

Table 3: OLS Regression

This table presents the Ordinary least squares regression results with real effective exchange rate as the dependent variable. The primary independent variable used is the $MPU_{HRS.}$ The control variables are explained in Table 1. The sample spans from the period January 1985- October 2020. Standard deviations are robust and are in parentheses below coefficients. ***, **, * represents significance at the 0.01 level, significance at the 0.05 level and significant at the 0.10 level, respectively.

	Δ Real Exchange Rate
MPU_{HRS}	0.0559***
	(0.0075)
Δ CPI	0.0173*
	(0.0118)
Δ Effective Fed fund	0.0734***
	(0.0227)
Δ Industrial Production	-1.555***
	(0.3394)
Δ Money Supply	0.9477***
	(0.2432)
constant	4.4330***
	(0.0338)
Adj R^2	0.15

Table 4 also displays the result of the OLS regression results with percentage change in real effective exchange rate (exchange rate volatility) as the dependent variable. The control variables are also in percentage changes to solve the problem of non-stationarity. In this table, my primary objective is to examine the impact of MPU_{BBD} on exchange rate volatility.
The result in this table is similar to the result in Table 4.
The result indicates that monetary policy uncertainty is positively related with the exchange rate volatility. The coefficient of the MPU is 0.0599 and significant at 1 percent. The coefficient of MPU_{HRS} and MPU_{BBD} are similar. The result means that higher monetary policy uncertainty significantly increases exchange rate volatility. Conversely, a lower monetary policy uncertainty lowers exchange rate volatility. Again, the result is consistent with theories and empirical results in the literature.
In the second row, consumer price index is positively related with the volatility of the exchange rate. The coefficient of the consumer price index is 0.0049 and significant at 10 percent. Again, this means that an increase in the growth rate of the CPI increases the volatility of the real effective exchange rate. Also, a decrease in the growth rate of CPI decreases the volatility of the real effective exchange rate. This result is consistent with the power purchasing parity which suggests that the currency of a country with a relatively higher inflation depreciates, comparatively.
In the third row, the change in real effective exchange rate is positively related with the effective federal funds rate. The coefficient of the effective federal funds rate is 0.0859 and significant at 1 percent. Again, the result indicates that the increase in the effective federal funds rate increases the volatility of the exchange rate and the decrease in the effective federal funds rate decreases the volatility of the exchange rate.

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In the fourth row, the change in industrial production is positively related to the real effective exchange rate. The coefficient of the industrial production is -1.40 and significant at 1 percent. The result indicates that the increase in the industrial production reduces the volatility of the real effective exchange rate and the decrease in the industrial production increases the volatility of the real effective exchange rate. Again, this result is consistent with theory as the increase in production increases export relative to import. The net export increases as a result, and the exchange rate appreciates, thus reducing the volatility of the real effective exchange rate.

In the fifth row, the change in the real money supply is positively related to the real effective exchange rate. The coefficient is 0.906 and significant at 1%. Again, this result indicates that positive change in the real money supply increases the volatility of real effective exchange rate and the negative change in the real money supply reduces the volatility of the real effective exchange rate. The intuition is that a lower money supply reduces CPI which lowers volatility of the real effective exchange rate.

Table 4: OLS Regression

This table presents the Ordinary least squares regression results with real effective exchange rate as the dependent variable. The primary independent variable used is the $MPU_{BBD.}$ The control variables are explained in Table 1. The sample spans from the period January 1985- October 2020. Standard deviations are robust and are in parentheses below coefficients. ***, **, * represents significance at the 0.01 level, significance at the 0.05 level and significant at the 0.10 level, respectively.

	Δ Real Exchange Rate
MPU_{HRS}	0.0599***
	(0.0091)
Δ CPI	0.0049*
	(0.0127)
Δ Effective Fed fund	0.0859***
	(0.0233)
Δ Industrial Production	-1.4013***
	(0.3442)
Δ Money Supply	0.9060***
	(0.2466)
constant	4.4090***
	(0.0414)
Adj R^2	0.15

VI. CONCLUSION

The advent of the financial crisis spurred the interest in forecasting the future crisis. Also, following the construction of data on economic and macroeconomic policy uncertainty by (Baker et al., 2016), researchers in recent times have studied the impact of the policy uncertainty on many variables, both macroeconomic and financial variables.

In this study I examine the effect of monetary policy uncertainty on the volatility of the real effective exchange rate in the United States.

I employed monetary policy uncertainty proxies like that developed by (Baker et al., 2016) and (Husted et al., 2020). This paper to my best of knowledge is first to employ the newly developed monetary policy uncertainty proxy by (Husted et al., 2020) to study the exchange rate volatility.

I employ macroeconomic data from the federal reserves' website and the monetary policy uncertainty measures from Baker, Bloom and Davis website. The data spans from January 1985 to October 2020.

The result indicates that monetary policy uncertainty influences exchange rate volatility. That is, higher monetary policy uncertainty increases the exchange rate volatility, and the lower monetary policy uncertainty reduces the exchange rate volatility. This is consistent with theories and previous empirical findings (Krol, 2014; Zhou et al., 2020) .

During periods of crisis, the situation that has been documented in the literature reflects my findings. The results are also robust.

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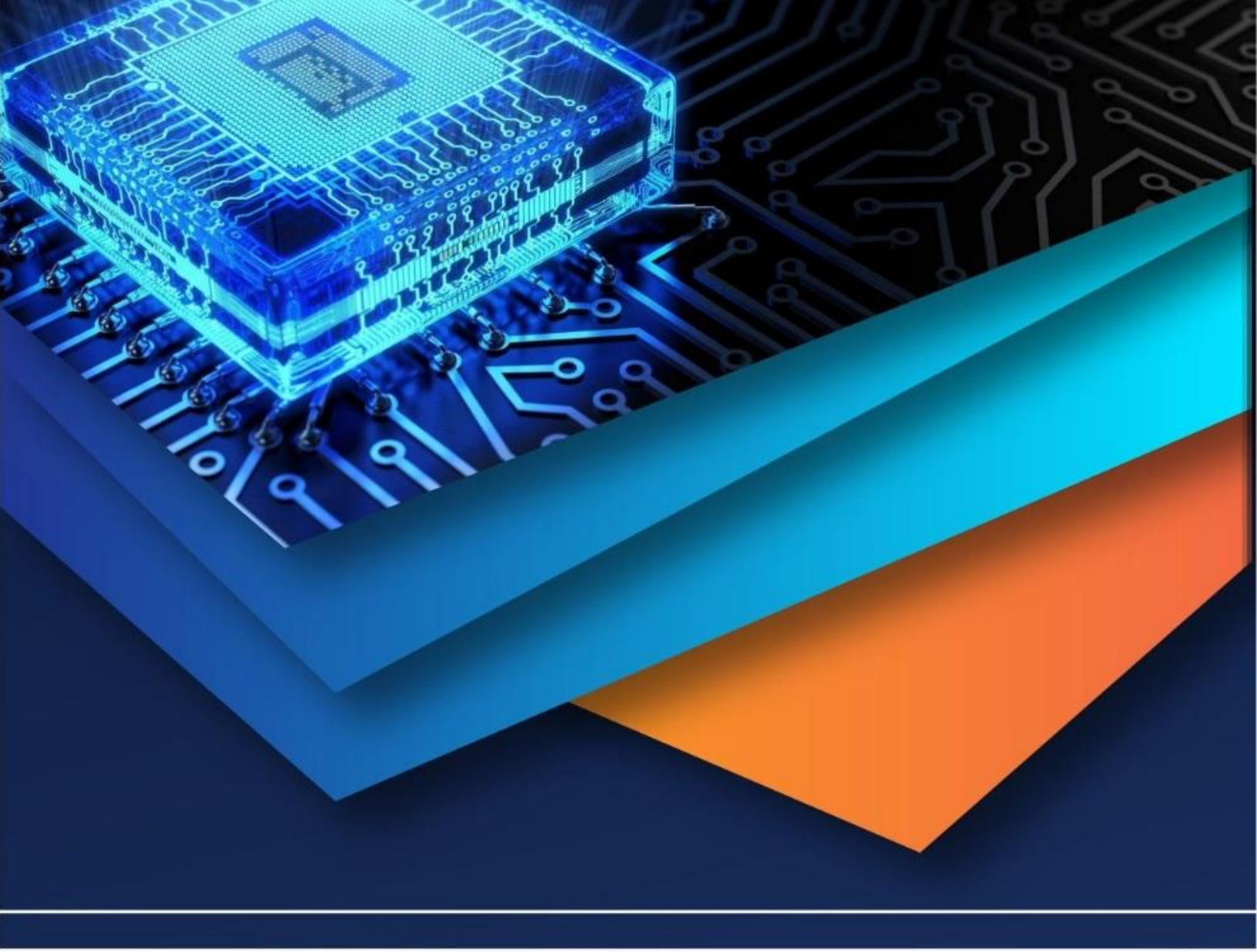

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