Acta Univ. Sapientiae, Economics and Business, **10** (2022) 161–184

DOI 10.2478/auseb-2022-0010

Global Economic Uncertainties and Exchange Rate Management in Africa: A Panel Study

Adeniyi J. ADEDOKUN, Olabusuyi R. FALAYI,*
Francis O. ADEYEMI, Terver T. KUMEKA
Department of Economics, Dominican University, Ibadan, Oyo State – Nigeria
e-mail: jimmyade2005@yahoo.com, franceadeyemi@yahoo.com, terverkumeka@yahoo.com
* Corresponding author: busuyifalayi@gmail.com

Abstract. This study investigates the effects of global economic uncertainties on exchange rate management in Africa from 1990 to 2021. Employing the quantile regression technique, findings show that both global and domestic economic uncertainties have significant influence on exchange rate management in Africa. The intensity of global economic uncertainty rises during the bearish and transitional markets, but dependence declines during the bullish markets. Moreover, the relationship between domestic uncertainty and African exchange rate management shows that the structure of dependence improves around the upper tails but declines around the lower tails. African countries should pay attention to global economy in order to combat any impending negative effects of global economic uncertainties. Also, attention should be paid to other uncertainties such as political, social, or other factors that may aggravate domestic economic uncertainties.

Keywords: global economic uncertainties, exchange rate management, Africa, panel study

JEL Classification: C21, D81, F31

1. Introduction

Globalization has exposed the world, Africa in particular, to rising and varying degrees of economic uncertainty, thus raising concerns among scholars and policy makers about its possible spillover effects on African countries. For instance, the occurrence of the 2007–2009 global financial crisis and the recent outbreak of COVID-19 have drawn the attention of scholars and policy makers towards the issues surrounding economic uncertainty because of its severe impact on global economies, including Africa. This position is also supported by economic

theory, which posited that economic uncertainty inhibits an accurate prediction of monetary policy outcomes (Kydland and Prescott, 1977).

Uncertainty is inextricably linked to issues of news shocks to both financial and macroeconomic variables, and it is an important factor to be considered with regard to the transmission and efficacy of monetary policy (Central Bank of Nigeria, 2015), though central banks often set specific monetary and macroeconomic objectives with target outcomes, such as exchange rate stability, and thus develop policy measures to enhance their success. Furthermore, their expectations take into account the uncertainty surrounding the dynamic behaviour of interest factors, which has an impact on monetary policy outcomes. Put succinctly, global economic uncertainty can trigger economic policy uncertainty (EPU), which can exert direct and indirect effects on exchange rate, hence influencing the exchange rate management policies (Beckmann and Czudaj, 2017; Olanipekun, Olasehinde-Williams, and Güngör, 2019; Olanipekun, Güngör, and Olasehinde-Williams, 2019; Leming, Ziqing, and Zhihao, 2020).

Despite the fact that African economies have been steadily improving for decades in terms of growth, the International Monetary Fund (IMF) upgraded some African countries to emerging market status, including South Africa, Ghana, Kenya, and Nigeria, to name but a few (IMF, 2013).

However, for economic progress, many African countries continue to rely heavily on advantageous economic links with developed countries, especially through increased international trade and economic cooperation (Olasehinde-Williams and Olanipekun, 2020). This high level of economic openness effects exchange rate management policies as well as the international transmission of uncertainty shocks into their exchange rate markets. The sensitivity of African economies to external variables helps to explain why uncertainty from adverse economic policy spillover from other countries can often shape their exchange rate management policies. As a result, the degree of fluctuations experienced by African currencies in recent years is exemplified by the dramatic decline in the nominal values of many of these currencies against the US dollar, as seen in appendix A1. Furthermore, substantial devaluations of African currencies occurred in the late 1980s and the early 1990s as countries sought to reduce or eliminate the impact of parallel foreign exchange markets that had emerged in many of these countries, which prompted many countries to implement these devaluations in the hope of improving their export competitiveness and boosting non-traditional exports, but the terms of trade in many African countries remain unstable, as seen in *Appendix A2*.

As a result, exchange rate management in Africa has been diverse and varied, with many countries employing various exchange rate arrangements, such as a peg to a single currency, managed floating, and an autonomously floating exchange rate system, as well as monetary zone agreements in an attempt to find an optimal and long-term exchange rate arrangement (IMF, 2013). Exchange rate regimes

in sub-Saharan African countries shifted from pegs to floats between the mid-1990s and the mid-2000s. Between 1995 and 2008, around 45 and 35 percent of the countries were classed as pegs or floats, respectively, with the remaining 20 percent classified as intermediates. Following the global financial crisis of 2008, this tendency was reversed, and the number of nations in sub-Saharan Africa, having an independently floating currency, decreased over time. Eight nations in sub-Saharan Africa (Burundi, Democratic Republic of Congo, Ghana, Guinea, Liberia, Mozambique, Rwanda, and Zambia) shifted away from de jure floats to embrace less flexible currency rate regimes in the aftermath of the global financial crisis. In 1996, 16 countries in the region had de jure independent floating exchange rate regimes, while eight others had de facto independent floats. By 2014, no country in sub-Saharan Africa had been designated as a de facto independent floater, which allows for exceptional actions to address market instability. African countries' transition to a regulated floating exchange rate regime has not been without challenges and difficulties. As a result, several monetary authorities in African countries have encountered policy challenges (IMF, 2017).

Another source of policy issues for African monetary authorities is when decision makers lack appropriate knowledge about the present economic situation or are in a dilemma about the model that best matches the dynamics and have a poor understanding of the prevailing external variables (Abid, 2020). As a result, policy makers continue to face uncertainty regarding the transmission mechanism and an insufficient knowledge of the system (Uchendu, 2009). In spite of efforts to achieve sustainable exchange rate management by adopting various types of exchange rate arrangements in the last few decades, available data shows that most African countries are still bedevilled by a high degree of exchange rate volatility. While studies in this area have concentrated on the advanced economies of Europe, America, and Asia, the attraction of most studies on Africa have been the effects of economic uncertainty on exchange rate volatility and stock markets, rather than the potential impact of economic uncertainty on exchange rate management (see, for example: Jingshan, 2020; Olanipekun, Olasehinde-Williams, and Güngör, 2019; Dai, Yu, and Li, 2017; Mehmet, Rangan, Clement, and Wohar 2016; Rober, 2014). This study aims to fill this gap by looking into the effects of economic policy uncertainty on African exchange rate management.

Specifically, this study uses the quantile regression approach to evaluate the effects of global and domestic economic uncertainty on exchange rate management in Africa on different quantiles. This method enables us to more accurately examine the effects of global and domestic economic uncertainty on the management of exchange rates in selected African countries. Our findings reveal a strong link between global economic uncertainty and exchange rate management in the African nations we studied. Furthermore, we discover a strong correlation between exchange rate management and domestic economic uncertainty. Other findings

in the empirical literature on relevant research corroborate our findings in this study (see: Krol, 2014; Aizenman and Binici, 2016; Kido, 2016; Das and Kumar, 2018; Olanipekun et al., 2019).

The remainder of the work is organized as follows. Section 2 focuses on literature review, Section 3 presents the methodology and data, Section 4 presents the results and discussion, and Section 5 concludes the paper.

2. Literature Review

Conceptual Issues

The concept of macro uncertainty has remained an area that gained relevance in the literature. Several authors have evidently viewed economic uncertainty from various perspectives. This term in traditional economic phrasing simply means variability in financial condition and economic variables. According to Kydland and Prescott (1977), predicting the outcome of monetary policy has remained problematic due to the uncertainty of the macroeconomic variable. Observation of different scenarios has made it possible for central banks to anchor their expectations on the probability of future occurrence. In the literature, the term of uncertainty, its meaning and impacts on the conduct of monetary policy have been conceptualized by many schools of thought. Some economists also understand macroeconomic uncertainty from inflation and output volatility and variability position (Bredin and Fountas, 2009), while some others have a countercyclical conceptualization behaviour of the economic/business cycle (Bloom, 2009).

From the methodological front, different methods of analysis and measurements of variables have been adopted by various authors and studies. Notable among these methods is the quartile regression analysis. This is a method of least-square estimates being used when the conditions of linear regression are not met. One major strength of this method is that the quantile regression estimate is more robust against outliers in response measurement. It is also useful when conditional functions are of interest. Studies that have adopted this method include: Mehmet, Rangan, Clement, and Wohar (2016); Dai, Yu, and Li (2017); Chen, Du, and Hu (2019).

Another method is the Generalized Method of Moments (GMM). GMM is a generic way of estimating parameters in statistical models. This method gives an estimator that can be computed after assigning proper weights to the various cost function products (Hansen 1982). This method has minimum variance among all estimates for the novel parameters and was adopted by Abid and Rault (2020).

We also have the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model, which was introduced by Engel (1982). This model allows for past

conditional variances in the current conditional variances and has been adopted in studies to measure exchange rate, volatility, exchange rate variability, and also stock volatility. Some of the studies that have adopted GARCH are Kazutaka (2016) and Noria and Bush (2019). Some studies also employed the Ordinary Least Square (OLS) and the Two-Stage Least Squares (2SLS) regression analysis. OLS estimates the parameters in a regression model by minimizing the sum of square residuals, while the Two-Stage Least Squares (2SLS) regression analysis is a statistical technique that is used for structural equation analysis. This method is an extension of the OLS analysis. It is employed when the regressands' error terms are correlated with the explanatory variables, and it has been employed by Lance and Don (1977) and Weymark (1995). Other methods of analysis include: the latent threshold time-varying parameter VAR (LT-TVP-VAR) econometric approach, ordinary least squares and instrumental variable estimators, and cross-sectional augmented IPS (CIPS) unit root test (Jingshan, 2020; Robert, 2014) Further similar studies also used binary probit model / probit regression. This is often employed when we intend to perform regression for binary outcome variables, which are regressands with two outcomes such as yes/no, male/female, etc. This technique was employed by Barry et al. (1996).

In terms of measurement of variables, the subject of global uncertainty cannot be exhausted due to the influence of nature, which cannot be predicted. However, empirical studies have recently used the EPU index as a proxy for the measurement of economic policy uncertainty. Although this is entirely bias-free, it establishes a high correlation with other quantitative uncertainty measures, such as stock volatility and exchange rate variability (Baker et al., 2016). Other measurements of uncertainty include domestic political uncertainty and domestic economic uncertainty (Noria and Bush, 2019).

Empirically, many authors have estimated the economic uncertainty and economic variables nexus. Some of the findings show conflicting while some others similar results. For instance, Liu (2020) and Chen et al. (2019) show that the responses of exchange rate volatility to economic policy uncertainty is asymmetric (EPU). The study also showed that EPU is positive and significant at all instabilities of exchange rates. According to them, it implies that governments are more likely to change economic policies with increases in volatility. Similarly, findings from Robert (2014) and Dai et al. (2017) show that economic policy uncertainty results in high level of exchange rate volatility. Results from Mehmet, Rangan, Clement, and Wohar (2016) show that EPU disparities have predictive ability for both exchange rate returns and the return variance over the entire conditional distribution for four exchange rates. The result further shows that there is no causality of EPU differentials to either exchange rate returns or return volatility.

Kurasawa (2016) worked on "policy uncertainty and foreign exchange rates: the DCC-GARCH model of the US/Japanese foreign exchange rate". The study's

findings reveal that dynamic conditional correlations between EPU indices and the exchange rate are not time-invariant. The sign of the connection changes in the sample period, especially for the level of exchange rate. The study also reveals that policy uncertainty in the US and exchange rate are negatively connected, suggesting that if policy uncertainty in the US increases, the value of the US dollar vis-à-vis the Japanese yen will decrease. Furthermore, Olanipekun, (2019) investigated the Impact of Economic Policy Uncertainty on Exchange Market Pressure. His finding shows that exchange market pressure responds positively to financial and trade openness. It also demonstrates that the foreign exchange market is influenced by strong capital mobility and unfettered portfolio flows. The study goes on to show that each of the four categories of Exchange Market Pressure (EMP) and Economic Policy Uncertainty, as well as GDP growth, the Consumer Price Index, domestic credit, trade openness, financial openness, and Foreign Direct Investment (FDI) inflow have a long-run link.

From our review, although there have been studies on the relationship between economic uncertainty and macroeconomic variables such as exchange rate, exchange rate volatility, exchange rate variability, and exchange market pressure, among others (see e.g. Mehmet, Rangan, Clement & Wohar 2016, Dai, et al., 2017, Wensheng, Ronald, Joaquin, 2017, Olanipekun et al., 2019), none of these studies alluded to the topics under consideration. To this end, we contribute to a recent but growing literature that has originated in the wake of the global uncertainty by investigating the effects of global economic uncertainty and exchange rate management in Africa.

3. Methodology and Data

Traditional econometric models of the effect of exchange rate management mostly offer the conditional mean of the variability in exchange rate but do not provide complete information about the conditional distribution. Nevertheless, owing to different economic uncertainty and heterogeneous market activities globally, it is probable that exchange rate dynamics and EPU's interactions may produce discriminate outcomes at different quantiles. Due to this fact, the coefficients in the quantile regression (QR) model have the capacity to differ at different quantiles. The QR also provides better estimates by identifying the fluctuation in the impact of economic uncertainty on the variation in exchange rate distribution, and it thereby informs the adoption of the QR method.

Therefore, our current study will employ the quantile regression (QR) model in evaluating the dependence between exchange rate management and economic uncertainty in Africa. The QR model as a modification of the ordinary regression provides a detailed representation of the conditional distribution. Given the nature

of our work, this consists of the complex impact of global policy uncertainty, which served as a proxy for economic uncertainty all through the conditional distribution. The QR technique has the following relevant benefits: it accounts for changes in parameters across diverse quantiles that enable us to detect what happens in the extreme values of our samples; the QR is robust; there exists outlier and heavy tails in data distribution and when the dependent variables are heterogeneous (Koenker and Hallock, 2001). Thus, the QR model is more suitable in our analysis since it captures the conditional mean distribution when the foreign exchange market is bearish, intermediate, or bullish, which also determines policy responses. The seminal work of Koenker and Bassett (1978) introduced the QR framework, with the assumption that the significance of the disturbance term conditional on the explanatory variables is zero in the τ^{th} percentile.

In general, given any (τ) level across the response variable g and given a number of exogenous variables w, the conditional quantile indicates:

$$Q_g(\tau \mid w) = \inf\{k : F(k \mid w) \geq \tau\},$$

where $F(\bullet \mid w)$ is the conditional distribution function. Hence, we present the conditional quantile in the model as follows:

$$Q_t(EMP \mid EPU_i) = \delta_0^{\tau} + \rho^{\tau} EPU_i + \varphi^{\tau} \mathbf{W} + \xi^{\tau} \tag{1}$$

From (1), $Q_{\tau}(EMP \mid \bullet)$ represents the estimated exchange market pressure (EMP), that proxy exchange rate management, conditional quantile function at the τ^{th} quantile, given $\tau \in (0,1)$. EMP denotes the periodic exchange market pressure. EPU_i stands for both the global and individual market economic uncertainty in our sample. These include Algeria, Congo DR, Cote d'Ivoire, Ghana, Kenya, Mauritius, Morocco, Nigeria, South Africa, and Zambia. ρ^{τ} stands for the coefficients measuring the magnitude of dependence of the exchange market pressure at the τ^{th} quantile to EPU_i. $\mathbf{W}$ denotes a group of covariate control variables, while φ^{τ} varies according to the specific estimated quantile. Equation (1) evaluates the impact of the variations in economic uncertainty on exchange rate management. This model is implemented using eight quantiles (5^{th}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 80^{th}, 90^{th}, 95^{th}), which are divided into three market conditions – lower quantiles (5^{th}, 10^{th}, 25^{th}), or bearish market, a currency pair where there is decline in the exchange rate value. The second market condition is the high or upper quantiles (75^{th}, 80^{th}, 90^{th}, 95^{th}), or bullish market, which is a market where market actors expect the value of exchange rate to rise. Lastly, the intermediate or medium quantile (50^{th}), or "neutral" market condition is when the currency pair (exchange rate) is between the bullish and bearish markets. The value of exchange rate is sideways with insignificant vertical fluctuations to the foreign exchange market. Intermediate market situations are generally referred to as sideways drift or lateral trends.

To determine the impact of both global and domestic uncertainty on exchange rate management for the African economies, monthly data was obtained for the period from 1997 to 2019. We employ data for EPU index that Baker et al. (2016) developed (available on: http://www.policyuncertainty.com/), and world uncertainty data is provided by Ahir, Bloom, and Furceri (2018): World Uncertainty Index, Stanford mimeo. Exchange rate data was sourced from IMF, International Financial Statistics, and www.investing.com. The construction of each country's EPU index follows the searching for related terms on historical daily newspaper documentations, including "economy", "policy", and "uncertain". Global EPU index is made up of the EPU indices of 20 economies, based on the comparative portions of their weighted nominal gross domestic product (GDP). These indices have been used by prior studies (see, for example, Olanipekun et al., 2020). Our measure of exchange rate management is captured by the EMP, which is constructed as foreign exchange rate and international reserves minus gold.

Following Olanipekun et al. (2020) and Aizenman and Pasricha (2012), we constructed the EMP using the formula: $EMP_t = 100 \times (\Delta exr_t - \Delta fer_t)$, where exr_t and fer_t represent a country's currency exchange rate to the US dollar and foreign reserves excluding gold in US dollar respectively. Δ signifies change, and t is time. This data was obtained from IMF, International Financial Statistics database.

The concept of EMP was primarily documented in Girton and Roper's (1977) pioneering paper. They argued that fluctuations in foreign exchange can be described by the movements in the official exchange rate and the intervention in foreign reserves. This concept was further applied by Weymark (1995), who states that the fluctuations in exchange rate produced by the surplus of demand over supply for foreign currency can be eliminated without interference in the foreign exchange market. Furthermore, Eichengreen et al. (1996) weighted and standardized the EMP model by adding the interest rate variations to foreign reserves and exchange rate. Therefore, the EMP denotes how the additional demand or supply of the home currency give rise to money gap, thereby drawing the intervention of central banks in moderating the unfavourable depreciation or appreciation of the exchange rate. Lastly, the components required in computing the EMP are relevant in the sense that for economies with fixed exchange rate systems, exchange rate market pressures adjust over the movements in foreign reserves, whereas for economies of flexible exchange rate systems, the pressures in the exchange rate market are through volatilities in exchange rate.

Further, the discussion on how exchange rate management interrelates with economic uncertainty must control for certain relevant macroeconomic factors, such as terms of trade (TOT) that reveals the rise in export prices and decreases foreign export demand (Chen, Zu, and Hu, 2020; Raza and Afshan, 2017) or foreign reserves minus gold (FER) that may have negative effect on exchange rate dynamics (Abid, 2020; Leming et al., 2020; Eichler and Littke, 2018). Other

control variables include the interest rate (IR), the money supply (MS) – it reflects the concern of central bank with regard to money market dynamics (Abid, 2020) –, and the consumer price index (CPI) (see Abid, 2020). *Table 1* presents detailed characteristics of variables, including symbols, measurements, and sources.

Table 1. *Characteristics of data*

S/N	Symbols	Variables	Measurements	Sources
1.	**GEPU**	**Global Economic Policy Uncertainty**	The construction of each country's EPU index follows a search of daily newspaper archives on articles containing related terms, including "economy", "policy", and "uncertain"	http://www.policyuncertainty.com/
2.	**DEPU**	**Domestic Economic Policy Uncertainty**	The 3-quarter weighted moving average is computed as follows: 1996Q4 = (1996Q4*0.6) + (1996Q3*0.3) + (1996Q2*0.1)/3	http://www.policyuncertainty.com/
3.	**EMP**	**Exchange Market Pressure**	The change in a country's currency exchange rate to the US dollar MINUS foreign reserves excluding gold in US dollar	Authors' computation with underlying data from IMF, International Financial Statistics, and www.investing.com.
4.	**TOT**	**Terms of Trade**	This is computed as the percentage of price of Exports to price of Imports; export prices divided by Import prices multiplied by 100	Authors' computation with underlying data from IMF International Financial Statistics
5.	**FER**	**International Reserves**	Foreign Reserves excluding Gold, US Dollars	IMF, International Financial Statistics
6.	**IR**	**Interest Rates**	Interest Rates, Central Bank Policy Rate, Percent per Annum	IMF, International Financial Statistics
7.	**MS**	**Money Supply**	Broad Money, National Currency	IMF, International Financial Statistics
8.	**CPI**	**Consumer Price Index**	Consumer Price Index, All Items, Index	IMF, International Financial Statistics

Source: authors' compilation

Note: We take the natural logarithms of international reserves and money supply, while other variables are in their level form.

4. Results and Discussion

Some Stylized Facts

Summary statistics and tests for the order of integration for the global economic uncertainty, each country's domestic uncertainty and exchange market pressure are displayed in *Table 2*. Starting with the domestic economic policy uncertainty (DEPU), *Table 2* reveals that South Africa has the largest market uncertainty with an average value of about 0.1380, followed by Zambia with a mean value of around 0.1028, whereas Algeria and Morocco have the least policy uncertainty in this group of countries, with averages of 0.0475 and 0.0251 respectively. The standard deviation measured the unconditional market variation. This value reveals that again South Africa has the maximum amount of variation in policy uncertainty with an average value of 0.1248, followed by Zambia with an average of 0.0903, while Morocco has the lowest variability in policy uncertainty with 0.0274 as standard deviation. Considering the skewness and kurtosis, *Table 2* shows that market uncertainty for all countries is skewed to the right with high peak and heavy tail recorded for Algeria, Congo DR, Kenya, Morocco, South Africa, and Zambia. Further, considering exchange market pressure, *Table 2* shows that all markets have negative average values with the exception of Cote d'Ivoire and Ghana. Cote d'Ivoire has the largest positive mean value of 68.2244, while Ghana has an average value of 1.0713. On the other side, Congo DR has the highest negative EMP mean value of -2.0163, while Mauritius displayed the lowest EMP mean value of -0.2946. Further, Cote d'Ivoire presents the highest variation in exchange market pressure with a standard deviation of 1,127.807 followed by Congo DR with a variation of about 28.3971, whereas Mauritius has the lowest variability in EMP with 4.6215 as standard deviation. The outcomes for the EMP further show that the markets for Algeria, Congo DR, Morocco, and Zambia are negatively skewed to the left, while the other market are right-skewed, with very high peakedness in Cote d'Ivoire. Further, the EMP revealed heavy tails and outliers, where all the series for each market have large kurtosis. Furthermore, we have tested for the normality, autocorrelation, and heteroskedasticity of our variables. The results indicate rejection of H0 at 1% level of significance for each of the tests. Therefore, conventional regressions with the assumption of disturbance terms being *i.i.d.* no longer suit our study – this may produce spurious results. Hence, the QR approach presents a superior argument in solving such regression challenges and provides all information with analytical flexibility.

Table 2. *Summary statistics*

	Mean	Median	Std.	Skew.	Kurt.	ADF	PP	Bai–Perron multiple breaks
Global Economic Policy Uncertainty								
	126.562	107.643	66.915	1.650	5.908	-13.409***f	-27.230***f	
Domestic Economic Policy Uncertainty								
Algeria	0.048	0.028	0.065	2.807	11.868	-4.918***l	-5.556***f	2000M11
Congo DR	0.0838	0.0458	0.090	1.190	3.199	-5.197***f	-6.247***f	2001M07; 2005M02; 2009M02
Cote d'Ivoire	0.072	0.061	0.054	0.720	2.777	-5.152***l	-2.610*l	2002M01
Ghana	0.072	0.059	0.045	0.894	3.083	-3.451***l	-3.148**l	2000M09; 2004M04; 2009M03
Kenya	0.097	0.094	0.064	0.672	3.278	-3.067***l	-2.847*l	2008M11
Mauritius	-	-	-	-	-	-	-	2000M12; 2007M02; 2010M11
Morocco	0.025	0.018	0.027	1.774	6.306	-3.381**l	-3.484***l	2001M03
Nigeria	0.098	0.089	0.062	0.653	2.605	-3.064**/	-5.858***f	2002M08; M10; 2006M05; 2016M06
South Africa	0.138	0.095	0.125	1.009	3.142	-3.717***f	-6.089***f	1999M12
Zambia	0.103	0.071	0.090	1.431	4.222	-3.010**l	-6.599***f	2000M03; M10; 2004M04
Exchange Market Pressure								
Algeria	-1.653	-0.803	9.348	-8.347	89.528	-7.259***l	-22.95***l	
Congo DR	-2.016	-0.142	28.397	-0.830	23.912	-14.920***l	-14.866***l	
Cote d'Ivoire	68.224	0.010	1127.807	16.871	285.765	-16.958***l	-16.958***l	
Ghana	1.071	0.739	11.606	1.672	11.688	-8.126***l	-17.077***l	
Kenya	-0.798	-0.629	5.877	0.590	10.029	-13.729***l	-13.723***l	
Mauritius	-0.295	-0.260	4.622	0.021	8.387	-14.163***l	-14.528***l	
Morocco	-0.590	-0.427	5.326	-0.316	7.281	-16.006***l	-16.006***l	
Nigeria	-0.406	-0.375	6.727	0.584	6.460	-13.993***l	-14.969***l	
South Africa	-0.360	-0.133	9.266	2.259	27.365	-14.067***/	-14.709***l	
Zambia	-1.469	-1.390E-05	17.260	-1.951	19.367	-20.721***l	-20.767***l	

Notes: Preliminary summary statistics for global and domestic uncertainties for ten African economies are presented in this table. Std., Skew. Kurt., ADF, and PP denote standard deviation, skewness, kurtosis, Augmented Dickey–Fuller test, and Phillips–Perron respectively. To ascertain the timing and number of breaks, we also provide Bai–Perron multiple test results, implemented following L + 1

vs. L sequential, with a trimming option of 0.15, five maximum breaks, and 5% level of significance. l and f represent stationarity stages at level and first difference respectively. ***, **, and * denote 1%, 5%, and 10% level of significance respectively.

Next, we present the results of unit root tests for the Augmented Dickey–Fuller (ADF) and Phillip–Perron (PP). In *Table 2*, both tests of unit roots showed the rejection of the presence of unit root at the 1%, 5%, and 10% significance levels. Therefore, the variables for EMP in each country are stationary at 1% level, i.e. integrated of order I(0), while in the case of policy uncertainty, Congo DR and South Africa are stationary at first difference – integrated of order I(1) while other countries are of order I(0).

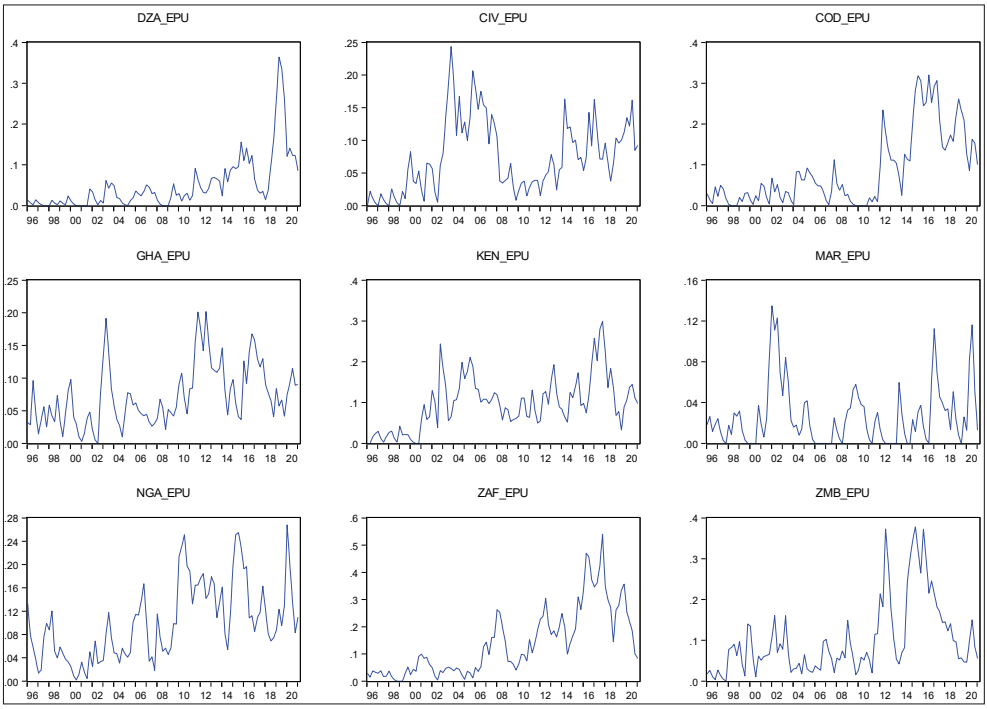

Figure 1. *Domestic Uncertainty Indices for individual countries*

Note: DZA, CIV, COD, GHA, KEN, MAR, NGA, ZAF, and ZMB represent Algeria, Cote d'Ivoire, Congo DR, Ghana, Kenya, Morocco, Nigeria, South Africa, and Zambia respectively. Vertical axes display the values for uncertainty, while horizontal axes denote the time periods.

Moreover, given the duration of our study, there may be structural adjustments in the relationship between EPU and EMP over the years. It is therefore recommended to evaluate the existence of structural breaks in the link between exchange market pressures and economic policy uncertainty. In this study, we followed Bai and Perron's (1998, 2003) test approach for multiple structural breaks. The outcomes

are displayed in *Table 2*, and it can be observed that the economies have at least between one and four breaks. Algeria, Cote d'Ivoire, Kenya, Morocco, and South Africa experienced one break each in 2000M11, 2002M01, 2008M11, 2001M03, and 1999M12 respectively. Congo DR (2001M07, 2005M02, 2009M02), Ghana (2000M09, 2004M04, 2009M03), Mauritius (2000M12, 2007M02, 2010M11), and Zambia have three breaks each (2000M03, M10, 2004M04), and Nigeria has four breaks (2002M08, M10, 2006M05, 2016M06). The outcomes from the structural break tests showed evidence of the spillover effects of major global events to developing markets economies; these include the dot-com bubble of 2001, the global financial crisis of 2007–2009, and the 2010 debt crisis in Europe.

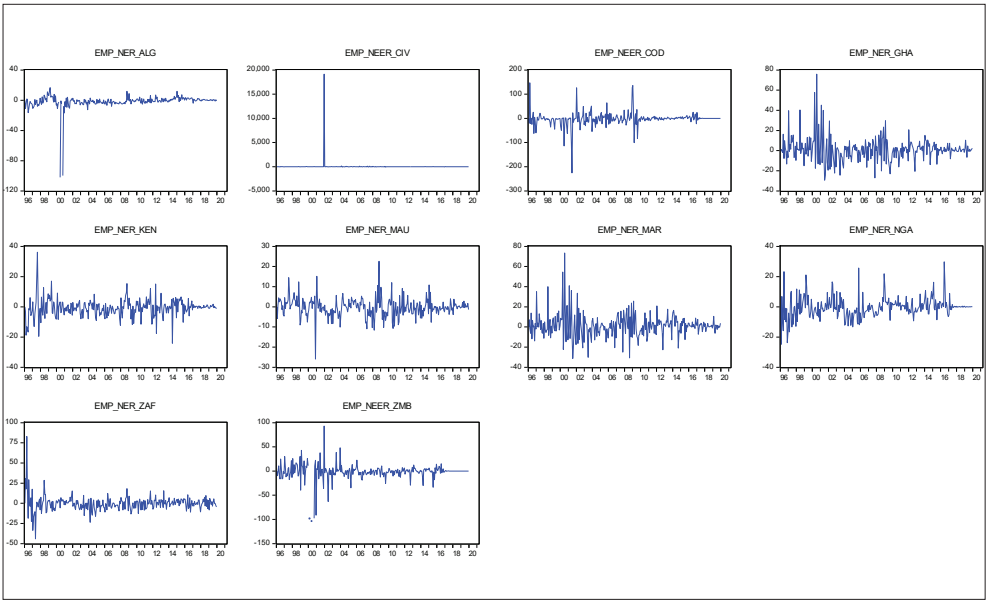

Figure 2. *Exchange market pressures for individual countries*

Note: EMP denotes exchange market pressure. The graphs are for Algeria, Cote d'Ivoire, Congo DR, Ghana, Kenya, Mauritius, Morocco, Nigeria, South Africa, and Zambia. Vertical axes display the values for EMP, while horizontal axes denote the time periods.

In addition, we present a graphical analysis of the key variables in *figures 1–2* (i.e. economic uncertainties and exchange market pressures). *Figure 1* reveals that each country experiences different levels of uncertainty at different periods. For instance, Algeria had high spikes between 2015 and 2017 and in 2019; Cote d'Ivoire experienced high uncertainties between 2003 and 2008 and from 2014 to 2019; Congo DR had high spikes in 2012–2013 and from 2015 to 2019; Ghana showed uncertainties in the periods of 2003, 2011–2014, and 2015–2018; in the case of Kenya, irregular spikes could be observed in 2003, 2004–2008, 2013, and 2016–

2018. Furthermore, Morocco had high uncertainties in the periods of 2001–2003, 2008–2010, 2013, and 2016–2019; Nigeria displays various levels of uncertainty at different periods such as 1997, 2003, 2006, 2008, 2009–2013, 2015, and 2019; South Africa had spikes between 2007 and 2008, 2011 and 2013, and 2015 and 2019; and, lastly, Zambia had high levels of domestic uncertainties in 2011–2012 and from 2014 to 2018. Moreover, *Figure 2* for exchange market pressure indicates that all the countries experienced significant and intensive pressure in their exchange rate management around the period from 2000 to 2003. However, the intensities appear to be more pronounced in Ghana, Kenya, Mauritius, Morocco, Nigeria, and Zambia.

Empirical Analysis

Structure and Degree of Dependence

The QR framework is employed to evaluate the dependence between EPU (global and domestic) and exchange rate management in Africa. We present and discuss the estimation results for both the OLS and QR models. However, the OLS model computes the average consequences of the explanatory variables of the response variable (Cade and Noon, 2003). It has the disadvantage of generating under- or overestimate impacts in diverse conditional distributions. And the OLS estimations do not provide the whole picture about the impact of EPU on EMP. Our analyses have two parts: first, we present the OLS and QR results for each of the markets in our sample, and, second, we present the panel OLS and QR results. Based on the literature on QR, we present estimated results for eight quantiles running from the 5^{th} to the 95^{th} quantile, considering both global and domestic uncertainty. A pair of bootstrapping standard errors are also included following the procedure proposed by Buchinsky (1995).

Panel Results

To evaluate the influence of both global and domestic economic uncertainty on foreign exchange management in Africa, we employ a panel of ten African countries based on monthly data for the period from 1997M01 to 2019M12. To achieve our objectives in this study, we use the penalized panel quantile regression to examine how African economies manage their foreign exchange markets in the face of global and domestic economic uncertainties. *Table 4* presents the seven selected quantiles (0.05, 0.10, 0.25, 0.50, 0.75, 0.90, 0.95) of the estimated coefficients of the panel quantile regression for the sampled African economies. As a form of robustness to our panel QR results, we also presented the estimates of a pooled ordinary least-square (pooled OLS) regression in *Table 3*.

Table 3: *Exchange Rate Management and Economic Uncertainty*

	(1)	(2)
	Model 1	Model 2
VARIABLES	Pooled OLS	Pooled OLS
GLOBAL_EPU	-0.4335	
	(0.6198)	
TERMS_OF_TRADE	0.0003	0.0028
	(0.0067)	(0.0074)
INTEREST_RATE	0.1552***	0.1573***
	(0.0348)	(0.0382)
COMSUMER_PRICE_INDEX	0.0114*	0.0040
	(0.0065)	(0.0061)
FOREIGN_RESERVE	-0.0299	-0.0655
	(0.2783)	(0.3322)
MONEY_SUPPLY	0.1517	0.1671
	(0.1746)	(0.1926)
DOMESTIC_EPU		5.4989*
		(3.1637)
Constant	-4.3511	-6.2168
	(4.9520)	(5.3522)
Observations	2,878	2,878
R-squared	0.0212	0.0242

Notes: Model 1 captures Global Economic Uncertainty, while Model 2 captures Domestic Uncertainty Index. Standard errors are in parentheses. ***, **, and * represent significance levels at 1%, 5%, and 10% respectively.

Starting from the pooled OLS results in *Table 3*, our analyses are provided in two models – Model 1 captures the global economic uncertainty, while Model 2 contains the individual countries' domestic policy uncertainty. Thus, Model 1 in *Table 3* reveals that global economic uncertainty is negatively related to the foreign exchange market of these African economies, but the impact is statistically insignificant at all conventional levels. On the other hand, in Model 2, contrary to the global uncertainty index, we find that domestic uncertainties have a positive and a 10% significance impact on the African foreign exchange market. From the pooled OLS results, we can conclude that the pressure in exchange rate management in Africa intensifies as the level of domestic uncertainty becomes more prominent. Further, we present results for the other macroeconomic variables, and the results indicate that all the regressors positively influenced exchange rate management in Africa, except for FER, which shows a negative effect. These relationships are significant only at 1% and 10% in the cases of IR and CPI, respectively. However,

it should be noted that the pooled OLS model results, as reported in *Table 3* and *Table A1*, are poorly fit, as the low values for the R-squared indicators suggest.

Results for the panel QR regression are displayed in *Table 4* as panels A & B – Panel A captures the effects of global economic uncertainty, while Panel B captures domestic policy uncertainty. From Panel A, it can be concluded that the effect of global policy uncertainty on the African foreign exchange market is positive and significant for the 0.05, 0.10, 0.50, and 0.95 quantiles but negative and significant for the 0.75 and 0.90 quantiles of this region. It is obvious from the results that the intensity of the co-movement between the African foreign exchange rates and the global uncertainty index declines from the 0.05 quantile to the 0.10 quantile and then improves again in the intermediate quantile. It turns negative in the 0.75 and 0.90 quantiles before returning to positive in the extreme upper quantile (i.e. 0.95). These outcomes suggest that the degree and structure of dependence declines from the bearish to the harshly declining markets, recovers during the tranquillity or transitional market conditions, then dampens in the bullish market (0.75 and 0.90), whereafter it increases in the extreme bullish (0.95) markets. Thus, it can be submitted that the African foreign exchange market and global economic uncertainty exhibit a heterogeneous or asymmetric co-movement as the dependence structure varies across the different quantiles. Intensity rises during the bearish and transitional markets, but dependence declines during the bullish markets.

Further, in Panel B, our results show that the domestic uncertainty effect on exchange rate management in Africa is also highly significant for all the quantiles. Specifically, it is positively significant for all the quantiles except for the harshly declining market (0.10), which is negative and significant. This relationship is positive for the bearish market (0.05), the intermediate market (0.50), and the bullish markets. The correlation between domestic uncertainty and African exchange rate market strengthens from the lower to the upper percentiles, which signifies that the structure of dependence improves around the upper tails but declines during the lower tails. Actually, there is evidence of non-linear co-movement among exchange rate markets when we investigate the different percentiles across time. Thus, the African foreign exchange market and their domestic uncertainties exhibit asymmetric correlation as the magnitude of dependence rises during high markets pressures, but the degree of dependence drops when there is less pressure in the market.

Overall, when considering African economies as a group, in a panel analysis, the results between economic uncertainty and foreign exchange market show that there is a significant co-movement between global economic uncertainty and foreign exchange market in Africa. Also, we have found significant co-movement between these countries' foreign exchange markets and their domestic policy uncertainty. Several inferences can be drawn from these results. First, in general, the exchange rate management of these African markets is collectively susceptible to the spillover

effects occasioned by the global economic uncertainty. Secondly, we also agree that African foreign exchange markets are also influenced by locally induced policy uncertainties. This suggests that there is evidence of detrimental and unfavourable policy summersault, which may lead to chains of reactions, thereby worsening the general economy. Our findings in this study are consistent with extent studies on the relationship between economic uncertainty and exchange rates (see Krol, 2014; Aizenman and Binici, 2016; Kido, 2016; Das and Kumar, 2018; Olanipekun et al., 2019).

Table 4. *QR Exchange Rate Management and Economic Uncertainty*

Panel A:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
VARIABLES/ QUANTILES	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
GLOBAL_EPU	0.20***	0.16***	0.27	0.33***	-0.61***	-0.56***	0.07***
	(0.00)	(0.00)	(0.00)	(0.05)	(0.01)	(0.00)	(0.01)
TERMS_OF_ TRADE	0.01***	0.00***	0.00	-0.00***	-0.01***	-0.02***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
INTEREST_ RATE	0.17***	0.16***	0.08	0.06***	0.13***	0.19***	0.38***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
COMSUMER_ PRICE_INDEX	0.05***	0.04***	0.02	0.00	-0.00***	-0.01***	-0.05***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FOREIGN_ RESERVE	0.73***	0.07***	-0.26	0.25***	0.71***	0.54***	-0.52***
	(0.00)	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)	(0.00)
MONEY_ SUPPLY	0.96***	1.03***	0.49	-0.12***	-0.40***	-0.50***	0.06***
	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
Observations	2,878	2,878	2,878	2,878	2,878	2,878	2,878
Number of groups	10	10	10	10	10	10	10
Panel B:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
VARIABLES/ QUANTILES	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
DOMESTIC_ EPU	2.01***	-3.94***	1.88***	3.06***	5.25***	4.36***	8.22***
	(0.06)	(0.03)	(0.00)	(0.01)	(0.06)	(0.00)	(0.03)
TERMS_OF_ TRADE	0.00***	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Panel B:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
VARIABLES/ QUANTILES	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
INTEREST_ RATE	0.21***	0.15***	0.12***	0.09***	0.12***	0.17***	0.37***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
COMSUMER_ PRICE_INDEX	0.02***	0.05***	0.02***	0.01***	-0.01***	-0.02***	-0.07***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FOREIGN_ RESERVE	1.46***	1.66***	0.52***	0.42***	0.55***	-0.18***	-1.79***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
MONEY_ SUPPLY	0.96***	0.37***	0.38***	-0.10***	-0.37***	-0.42***	0.33***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	2,878	2,878	2,878	2,878	2,878	2,878	2,878
Number of groups	10	10	10	10	10	10	10

Notes: The table contains the estimated coefficients for the quantile regression. Panel A captures Global Economic Uncertainty, and Panel B captures Domestic Uncertainty Index. Bootstrapped standard errors are reported in parentheses. ***, **, and * represent significance levels at 1%, 5%, and 10% respectively.

5. Conclusions

The main objective of this paper was to investigate the effects of global economic uncertainties on exchange rate management in Africa from 1996 to 2019 employing the quantile regression approach. The first specific investigation centred on the effect of global economic uncertainties on exchange rate management in Africa, and the second one looked into the effect of domestic economic uncertainties on exchange rate management in Africa. Results showed that both global and domestic economic uncertainties have significant implications for exchange rate management in Africa.

Based on the findings of this study and the fact that African countries, being highly dependent on developed economies, are vulnerable to external shocks, global economic uncertainties become a major concern. Thus, African countries must do all within their capacities to improve their economic status in order to reduce the level of dependence on global economies, especially on the developed countries of the world. In the meantime, African countries should pay keen attention to what goes on in global economy in order to combat any impending negative effect of the global economic uncertainties. In the same vein, African economies should pay attention to other uncertainties, such as political and social, or other factors that may aggravate domestic economic uncertainties.

References

Abid, A. (2020). Economic policy uncertainty and exchange rates in emerging markets: Short and long runs evidence. *Finance Research Letters* 37. 101378.

Abid, A.; Rault, C. (2020). On the exchange rate and economic policy uncertainty nexus: A panel VAR approach for emerging markets. *CESifo Working Paper* No. 8189. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3570291#.

Ahir, H.; Bloom, N.; Furceri, D. (2022). The world uncertainty index (No. w29763). *National Bureau of Economic Research Working Paper* 29763. DOI: 10.3386/w29763.

Aizenman, J.; Binici, M. (2016). Exchange market pressure in OECD and emerging economies: Domestic vs. factors and capital flows in the old and new normal. *Journal of International Money and Finance* 66: 65–87.

Aizenman, J.; Pasricha, G. K. (2012). Determinants of financial stress and recovery during the great recession. *International Journal of Finance & Economics* 17: 347–372.

Baker, S. R.; Bloom, N.; Davis, S. J. (2016). Measuring economic policy uncertainty. *The Quarterly Journal of Economics* 131: 1593–1636.

Beckmann, J.; Czudaj, R. (2017). Exchange rate expectations and economic policy uncertainty. *European Journal of Political Economy* 47: 148–162.

Bloom N. (2009). The Impact of Uncertainty Shocks. *Econometrica* 77: 623–685.

Bredin D.; Fountas S., (2009). Macroeconomic uncertainty and performance in the European Union. *Journal of International Money and Finance* 28: 927–986.

Buchinsky, M. (1995). Estimating the asymptotic covariance matrix for quantile regression models. A Monte Carlo study. *Journal of Econometrics* 68: 303–338.

Bush, G. R.; Noria, L. G. (2019). Uncertainty and exchange rate volatility: The case of Mexico. *Banco de México Working Papers* No 2019-12. Available at SSRN: https://ssrn.com/abstract=3283374 or http://dx.doi.org/10.2139/ssrn.3283374.

Central Bank of Nigeria. (2015). *Modeling the impact of macroeconomic uncertainty on the conduct of monetary policy*. Research Department Publication.

Chen, L.; Du, Z.; Hu, Z. (2020). Impact of economic policy uncertainty on exchange rate volatility of China. *Finance Research Letters* 32: 101266. https://www.sciencedirect.com/science/article/pii/S1544612319306038.

Dai, Y.; Zhang, J-w.; Yu, X-z; Li, X. (2017). Causality between economic policy uncertainty and exchange rate in China with considering quantile differences. *Theoretical and Applied Economics* XXIV, No. 3(612), Autumn: 29–38.

Das, D.; Kumar, S. B. (2018). International economic policy uncertainty and stock prices revisited: Multiple and partial wavelet approach. *Economics Letters* 164: 100–108.

Eichengreen, B.; Rose, A. K.; Wyplosz, C. (1996). *Contagious currency crises* (No. W5681). Cambridge, MA: National Bureau of Economic Research.

Eichler, S.; Littke, H. C. N. (2018). Central bank transparency and the volatility of exchange rates. *Journal of International Money Finance* 89: 23–49.

Girton, L.; Roper, D. (1977). A monetary model of exchange market pressure applied to the postwar Canadian experience. *The American Economic Review* 67(4): 537–548.

Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica* 50(4): 1029–54.

International Monetary Fund. (2013). *World economic outlook: Hopes, realities risks*. Washington, D. C.: IMF Press. Retrieved from: http://www.imf.org/external/pubs/ft/weo/2013/01.

(2017). *Regional economic outlook: Exchange rate regimes in sub-Saharan Africa: Experiences and lessons*. Retrieved from: https://www.imf.org//media/Files/Publications/REO/AFR/2017/ October/pdf/ sreo1017.ashx.

Jingshan, Liu. (2020). Impact of uncertainty on foreign exchange market stability: Based on the LT-TVP-VAR model. The current issue and the full-text archive of this journal are available on *Emerald Insight* at: https://www.emerald.com/insight/2044-1398.htm.

Kazutaka, K. (2014). Policy uncertainty and foreign exchange rates: The Dcc-Garch model of the US/Japanese foreign exchange rate. *International Journal of Economic Sciences* V(4). DOI: 10.20472/ES.2016.5.4.001.

Kido, Y. (2016). On the link between the US economic policy uncertainty and exchange rates. *Economic Letters* 144: 49–52.

Koenker, R.; Bassett Jr., G. (1978). Regression quantiles. *Econometrica* 46: 33–50.

Koenker, R.; Hallock, K. (2001). Quantile regression: An introduction. *Journal of Economic Perspectives* 15: 143–156.

Krol, R. (2014). Economic policy uncertainty and exchange rate volatility. *International Finance* 17(2): 241–255. DOI: 10.1111/infi.12049.s

Kydland F. E.; Prescott E. C. (1977). Rules rather than discretion: The inconsistency of optimal plans. *Journal of Political Economy* 85(3): 473–492.

Mehmet B.; Rangan G.; Clement K.; Wohar E. W. (2016). Does economic policy uncertainty predict exchange rate returns and volatility? Evidence from a nonparametric causality-in-quantiles test. *Open Economies Review* 27: 229–250. DOI: 10.1007/s1109-016-9388-x.

Olanipekun, I. O.; Güngör, H.; Olasehinde-Williams, G. (2019). Unraveling the causal relationship between economic policy uncertainty and exchange market pressure in BRIC countries: Evidence from bootstrap panel granger causality. *SAGE Open* 9(2): 2158244019853903.

Olanipekun, I. O.; Olasehinde-Williams, G.; Güngör, H. (2019). Impact of economic policy uncertainty on exchange market Pressure. *SAGE Open* 9(3): 2158244019876275.

Olasehinde-Williams G.; Olanipekun I. (2020). Unveiling the causal impact of US economic policy uncertainty on exchange market pressure of African economies. *Journal of Public Affairs*. https://doi.org/10.1002/pa.2278.

Raza, S. A.; Afshan, S. (2017). Determinants of exchange rate in Pakistan: Revisited with structural break testing. *Global Business Review* 18: 825–848.

Uchendu, O. A. (2009). Monetary policy management in Nigeria in the context of uncertainty. *Bullion* [publ. of the Central Bank of Nigeria] 33(3): 1–6.

Wensheng K.; Ronald A. R.; Joaquin V. (2017). The impact of global uncertainty on the global economy, and large developed and developing economies. *Federal Reserve Bank of Dallas Globalization and Monetary Policy Institute Working Paper* No. 303. https://www.dallasfed.org/~/media/documents/institute/wpapers/2017/0303.pdf.

Weymark, D. N. (1995). Estimating exchange market pressure and the degree of exchange market intervention for Canada. *Journal of International Economics* 39: 273–295.

Appendices

Table A1. *Exchange rate management and economic uncertainty*

	(1)	(2)	(3)	(4)
	Model 1	**Model 1**	**Model 2**	**Model 2**
VARIABLES	**OLS with global_ EPU**	**OLS with global_ EPU**	**OLS with domestic EPU**	**OLS with domestic EPU**
global_epu	1.9201	22.0506		
	(14.5123)	(21.4975)		
terms_of_trade		0.2869		0.2640
		(0.1992)		(0.1981)
interest_rate		-0.6138		-0.5325
		(0.8609)		(0.8574)
comsumer_ price_index		0.1419		0.2194
		(0.2540)		(0.2436)
foreign_reserve		-12.6734***		-12.6754***
		(3.4506)		(3.4520)
money_supply		4.9751		5.0463
		(3.5302)		(3.5307)
dummy_GFC		-39.9118*		-29.7896
		(23.5978)		(21.4428)
domestic_epu			3.8767	0.8642

	(1)	(2)	(3)	(4)
	Model 1	Model 1	Model 2	Model 2
VARIABLES	OLS with global_ EPU	OLS with global_ EPU	OLS with domestic EPU	OLS with domestic EPU
			(31.7922)	(32.1717)
Constant	-3.0950	20.9986	5.7102	113.1451
	(68.9411)	(139.4699)	(7.0202)	(106.7164)
Observations	2,880	2,880	2,880	2,880
R-squared	0.0000	0.0061	0.0000	0.0058

Notes: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. Model 1 captures Global Economic Uncertainty, while Model 2 captures Domestic Uncertainty Index.

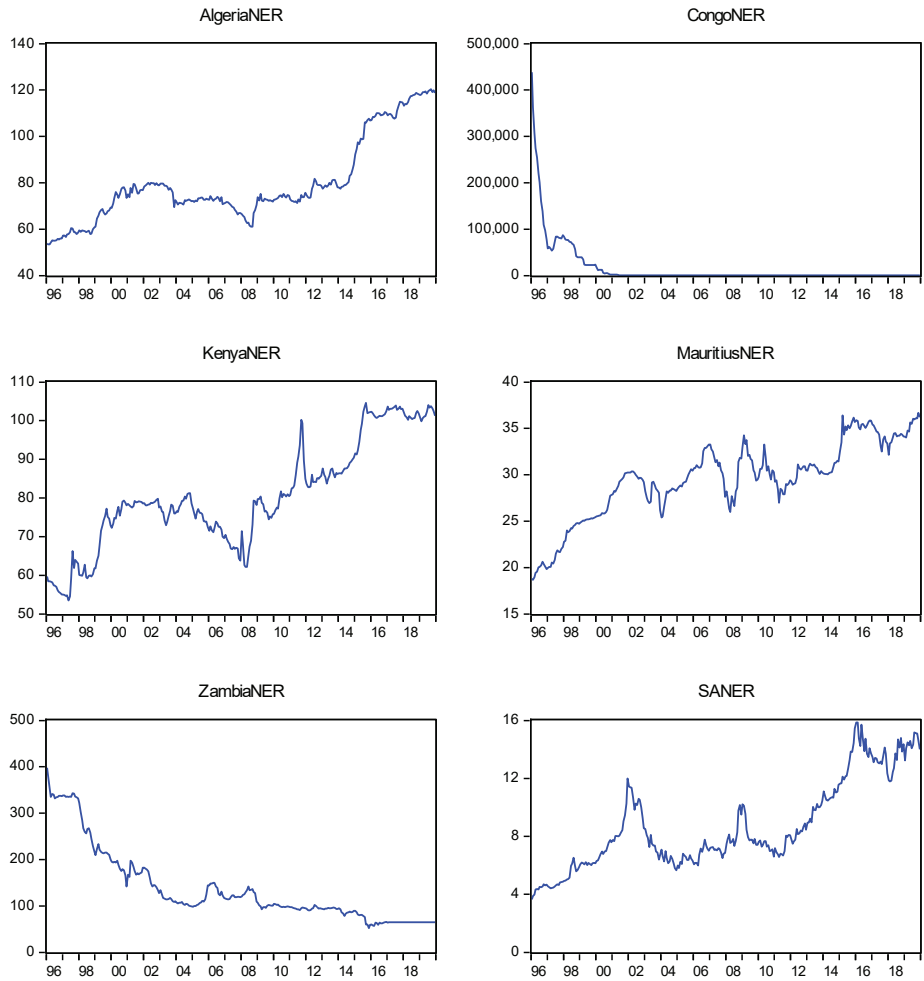

Figure A1-a. *Trend analysis of nominal exchange rates (1996–2019)*

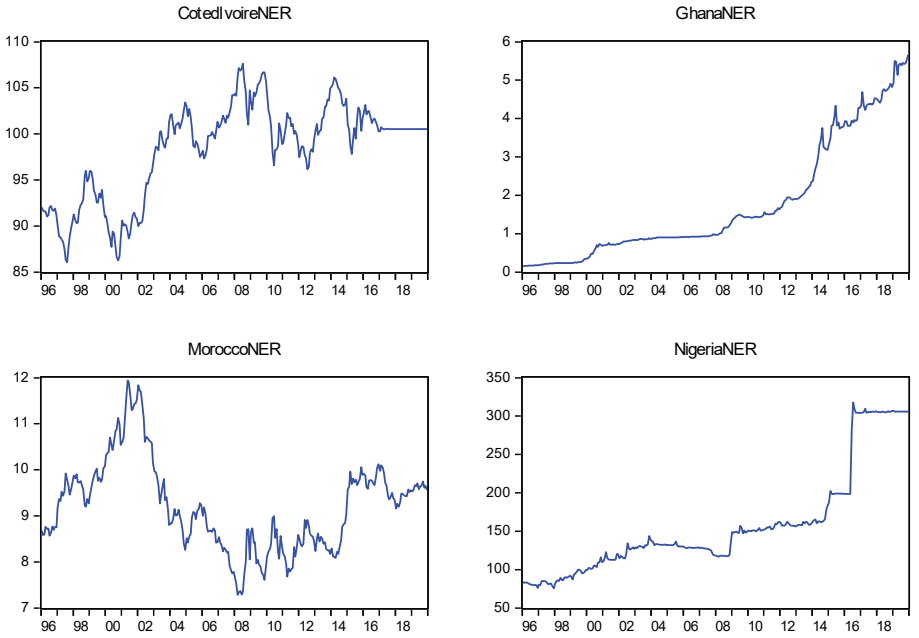

Figure A1-b. *Trend analysis of nominal exchange rates (1996–2019)*

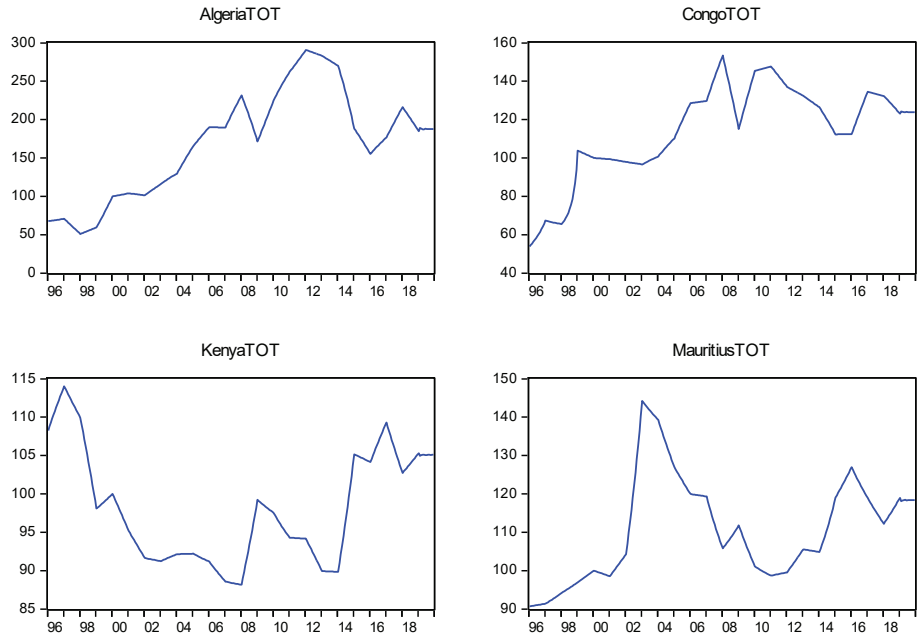

Figure A2-a. *Trend analysis of terms of trade (1996–2019)*

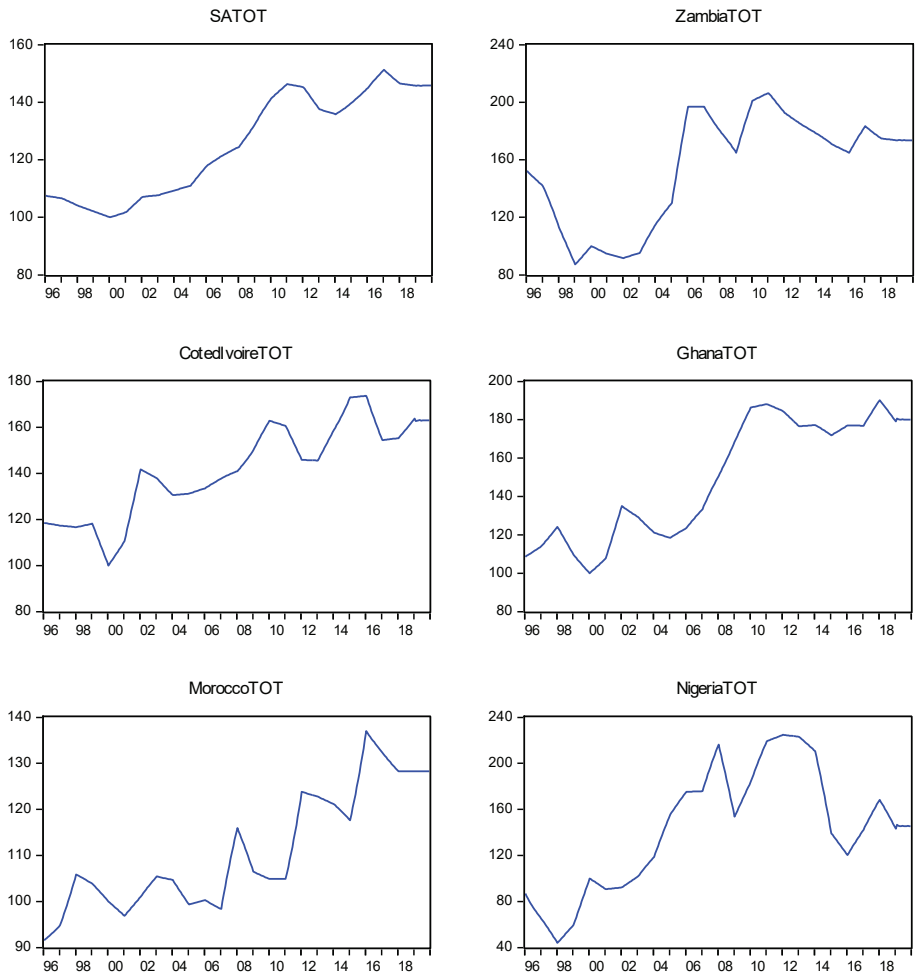

Figure A2-b. *Trend analysis of terms of trade (1996–2019)*