DETERMINANTS OF CONSUMER PRICE INDEX IN THE NIGER REPUBLIC: SOME EVIDENCE FROM NONLINEAR COINTEGRATION AND ERROR CORRECTION MODEL

Nijer Cumhuriyetinde Tüketici Fiyat Endeksinin Belirleyicileri: Doğrusal Olmayan Eşbütünleşme ve Hata Düzeltme Modelinden Bazı Bulgula

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Abstract

This study investigates the causal relationships between Gross Domestic Product (GDP) per capita, Exchange Rate (ER), Globalization (GI), Urbanization (UP), Carbon Dioxide emissions (CO_2), and consumer price index (CPI). The nonlinear cointegration and error correction model (ECM) of Kapetanios, Shin, and Snell (2006) was used to investigate the short-run and long run relationships between inflation and the above-mentioned variables during the 1990-2019s in the Republic of Niger. The results of nonlinear cointegration showed the existence of a cointegration relationship between CPI, GDP, GI, UP and CO_2 and those of the error correction model revealed the existence of a relationship between UP and CPI. In addition, the results of Linear Granger causality tests showed bidirectional causal linkages running from CPI to CO_2 and from CO_2 to CPI, causal linkage running from CPI to GI, and a unidirectional causal linkage running from GDP to CPI. Consequently, the study ends up with some recommendations for the policy and decision-makers to increase the welfare of the country.

Keywords: Consumer Price Index, Globalization, KSS (2006) nonlinear cointegration analysis, Error Correction Model, Niger Republic

Özet

Bu çalışmada, kişi başına Gayri Safi Yurtiçi Hasıla (GSYİH), Döviz Kuru (ER), Küreselleşme (GI), Kentleşme (UP) ve Karbon Dioksit emisyonu (CO_2) ile tüketici fiyat endeksi (TÜFE) arasındaki nedensellik ilişkisi incelenmektedir. Bu çerçevede Nijer Cumhuriyeti için 1990-2019 tarih aralığındaki yıllık verilerden yararlanarak Kapetanios, Shin ve Snell'in (2006) doğrusal olmayan eş bütünleşme ve hata düzeltme modeli (ECM) temelinde enflasyou etkileyen faktörler araştrılmaktadır. Doğrusal olmayan eş bütünleşme sonuçları, TÜFE, GSYİH, GI, UP ve CO_2 arasında bir eş bütünleşme ilişkisinin varlığını gösterirken, hata düzeltme modeli sonuçları, UP ile TÜFE arasında bir ilişkinin varlığını ortaya koymaktadır. Ayrıca, doğrusal Granger nedensellik testi sonuçları, TÜFE'den CO2'ye ve CO2'den TÜFE'ye çift yönlü nedensellik ilişkisinin varlığını yansıtırken, TÜFE'den GI'ya ve GSYİH'dan TÜFE'ye doğru tek yönlü nedensellik ilişkisinin varlığını göstermektedir. Sonuç olarak çalışma, ülke refahını artırmak için politika yapıcılara ve ekonomik karar vericilere bazı öneriler sunarak son bulmaktadır.

Anahtar Kelimeler: Tüketici Fiyat Endeksi, Küreselleşme, KSS (2006) Doğrusal Olmayan Eşbütünleşme Analizi, Hata Düzeltme Modeli, Nijer Cumhuriyeti

Introduction

The Niger Republic is a West African Sahel ranked as one of the poorest ones in the globe (World Bank, 2022). With a fertility rate of 7.6 children per woman, the country has the highest population growth of 3.9% over the globe while agriculture and livestock are key sectors employing about 87% of the rural population (Institut National de la Statistique, 2019). Accordingly, Raballand et al. (2017) note that the economy of the Niger Republic is agrarian and depends mainly on informal sectors such as agriculture and livestock. World Bank (2020) indicates that agricultural exports contribute to about 40% of the national GDP of the country. Furthermore, CIA (2020) indicates that the per capita GDP in the Niger Republic accounts for $1,200 and World Bank (2020) reported that approximately 41.4% of the population of the country lives in extreme poverty.

As a landlocked country located about 1040 km from the nearest port of Cotonou (Benin), Pitigala and Lopez-Calix (2021) mention that this geographical location of the country isolates its population from both external and internal markets. This would depreciate the purchasing power of the consumers as the price in the country's domestic market might fluctuate according to the variation of the prices on the regional and international markets. During the last decades, the price of the domestic market of Niger Republic experienced a series of variations. According to the World Bank (2022a), the Niger Republic recorded the highest consumer price indexes of 36% in 1994, 78% in 2005 and 11.3%. The same source reported that the country has recorded other variations in consumer price indexes during the same period. Such variations of the consumer price index reveal the instability of the domestic as it strongly depends on the regional and international markets, which poses serious challenges for the authority and the populations.

Many numerous factors determine the functions of the domestic market and the occurrence of price variations. These factors include the models of a functioning market, (Swedberg, 1993), the functioning of the institutions and the conditions of the infrastructure, especially in rural (Ribot, 1998). Huchet-Bourdon (2011) indicates that numerous macroeconomic and financial factors, such as changes in oil prices, global money supply, and the value of the dollar affect the dynamic of the prices, especially those of agricultural products. Daviron et al. (2008) highlight that the inflation is attributable to the country's agro ecological conditions, macroeconomic stability,

implemented policies, landlocked or coastal features of the country and its connectivity to external markets. WTO (2003) indicates that export structure of the Niger Republic focuses mainly on cash agricultural products such as cowpeas and onions, which explains the low export capacity of the sector.

World Bank (2022) mentions that the Niger Republic's economy experienced a decline in 2021 because rainfall variability adversely affected its key sectors (agriculture and livestock). Although the inflation of the country declined from 4.4% in 2020 to 3.1% in 2021, it remained higher than the threshold of the West African Economic and Monetary Union countries (3%).

In the context of West African region, some scholars examined the determinants of inflation from different perspectives. Some authors focused on the effects and numerous macroeconomic variables on inflation at the regional scale. In this context, Jelilov et al. (2016) analyzed the effects of inflation on unemployment in 10 Economic Community of West African (ECOWAS) States by exploring the relationship between economic growth, inflation and unemployment. Keho (2016) studied the effect of the budget deficit and money supply on inflation and found a positive relationship between money supply and price in Burkina Faso, Cote d'Ivoire and Senegal and the nonexistence of causality relationship from money supply to inflation in the short-run. Moreover, Ayodeji (2020) investigated the potential risk factor of corruption towards inflation in ECOWAS countries and found that inflation was significantly affected by past inflation shocks, level of corruption, real GDP and exchange rates.

Other scholars focused on the causes of inflation at countries' scales. Accordingly, Adenuga et al. (2012) studied the causes of inflation in the Federal Republic of Nigeria and found that inflation was not a purely monetary phenomenon to be monitored by the monetary authority. In addition, Gyebi and Boafo (2013) investigated the macroeconomic factors affecting inflation in Ghana for the period 1990 to 2009 and indicated that real output and money supply exerted strong pressure on the price, which moved up the exchange rate depreciation.

From the above-mentioned studies, there is evidence that some macroeconomic variables affect inflation. Yet, it still lacks significant academic studies that investigated the effects of economic, political, ecological and demographic variables on inflation, especially in

the Niger Republic. Hence, carrying out a study that investigates the effect of both macroeconomic and ecological variables on inflation could reveal the different relationships between these variables and help in a better understanding of the causes of the transmission of shocks. Moreover, such a study would guide the policy and decision-makers to design and implement earlier measures to prevent inflation and reduce the underlined negative effect of inflation on the country's economy. Accordingly, the current study aims to investigate the short-run and long run impacts of the determinants of the consumer price index during the 1990-2019s in the Niger Republic. Especially, it examines the short and long run effects of the GDP per capita, CO_2 emission, ER, GI and UP on CPI) by:

a)Analyzing the stationarity of the consumer price index and some selected macroeconomic, political, ecological, and demographic variables

b)Analyzing the cointegration vector and error correction model of the consumer price index and those variables;

c)Analyzing the linear and non-linear Granger causality relationships of the consumer price index and those macroeconomic, political, ecological, and demographic variables.

d)In this study, the exponential smooth transition autoregressive model (ESTAR) was used to investigate the short-run impact and long-run impact of each factor on inflation.

1. Literature Review

Inflation is one of the economic concepts acknowledged as a key determinant of monetary policy. Çelik (2021) notes that inflation refers to the occurrence of an increase in prices prevailing in the economy. Equally, Kumar (2017) indicate that inflation is an economic concept that refers to a continuous increase in the price of goods and services for a certain period. The same authors also highlight that the increase in inflation depreciates the value of currency unit and therefore affects the quantity of products affordable by a given amount of currency. Ferguson (2005) stresses that inflation has key implications for the economic stability and affects the overall growth of some sectors such as the financial sector and the living standard of the populations. The same author mentions that a moderate level of inflation triggers economic growth whilst a high rate of inflation negatively affects the performance of the economy and living standards in the economy.

For instance, Joshi (2022) indicates that low inflation together with rapid and sustainable economic growth are two of the main goals of macroeconomic policy design in developing nations.

On the other hand, Mohamed (2020) indicates that two key indicators used in the public economy policy to compute the inflation rate and the purchasing power of the currencies are the consumer index price. Gülşen & Kara (2019) notes that any shift in inflation rates indicate the impracticality of policy decisions and makes it difficult to compute and inappropriately the monitoring of the monetary policy. Szafranek (2019) stresses that accurate predictions of the inflation rate are crucial for monetary policy.

Worldwide, consumer index price has been a research topic of numerous scholars. Ratnasiri (2011) explored the main determinants of inflation in Sri Lanka by using Vector Autoregressive analysis and found that money supply was a key determinant of inflation in the country. Some authors studied the effect of various macroeconomic variables on inflation. Hence, Lim et al. (2015) explored the determinants of inflation in high-inflation and low-inflation countries from 1970 to 2011s by using an Error Correction Model based on the Autoregressive Distributed Lag (ARDL) model. They uncovered GDP growth, national expenditure and money supply affected inflation with a long-run impact in high-inflation countries. However, the same study reveals that GDP growth, money supply, imports of goods and services significantly affected inflation in low inflation countries.

On the other hand, Khan (2010) evaluated the impact of economic openness on the inflation trend in Pakistan and uncovered that the process of globalization had key implications for inflation and its dynamics in the country. Greenidge and Da Costa (2009) conducted a study to examine the determinants for inflation in the Caribbean by using Cointegration, Error-correction model and found both cost-push and demand-pull affected inflation. Bandara (2011) used Vector auto-regressive (VAR) models to examine the factors affecting inflation in Sri Lanka during 1993–2008. He found that the money supply, exchange rate and the GDP determine the dynamic of inflation in the country. Adu and Marbuah (2011) used the bounds test and other econometric approaches to explore the factors affecting inflation dynamics in Ghana and found that fiscal deficit, nominal interest rate, real output, money supply and nominal exchange rate determine the inflationary process in the country.

Beyond evaluating the effects of macroeconomic variables on inflation, some studies studied the effects of demographic factors on inflation. Hence, Liu and Westelius (2017) studied the impact of demographics on productivity and inflation in Japan though regression analysis. He found that inflation affected the region with high population growth. Equally, Bobeica et al. (2017) investigated the relationship between demographic change and inflation by using cointegrated VAR model. They pointed out that a positive long-run relationship between inflation and growth rate of the working-age population in the euro area countries as a whole and in the US and Germany. Andrews et al. (2018) used panel analysis to explore the relationship between inflation and the evolution of the demographic structure. They found that a significant relationship between the share of the elders and deflation. Then, Yoon et. al. (2018) used multivariate regression model to analyze the long run effect of demographic variables on fiscal balances, economic growth, investment, inflation and savings.

However, other authors indicate there was not any relationship between some macroeconomic variables and inflation. Menji (2008) studied the determinants of inflation in Ethiopia by using Co-integration regression. He found that money supply growth positively and significantly affects inflation whereas domestic output negatively and significantly inflation. A few authors conducted studies on the effects of both macroeconomic, demographic and environmental variables in the current context of global warming, especially in the least developed regions. Some scholars emphasized that studying such relationships would be of much important (Gonzalez and Holt, 2002; Islam et al., 2021).

In fact, scholars use a variety of methodologies in determining the factors affecting inflation. Joshi (2022) highlights that economists raised several views on inflation according to the theoretical explanations and the set of variables of the macroeconomic environment of an economy. For instance, Aise and Vegia (2006) used panel data econometrics to determine the effect of political instability on inflation for 100 countries, Telatar et al. (2010) conducted a dynamic panel analysis in studying the relationship between political instability, political freedom and inflation in developed and low-inflation countries. Fenira (2014) used cross-national time-series data to examine the causes of macroeconomic pathologies and illustrated the effect of democracy in reducing inflation.

The current study aims at investigating using both macroeconomic and environmental variables on the consumer price index (CPI). Nonlinear cointegration and error correction model (ECM) of Kapetanios, Shin, and Snell (2006).

2. Methodology

2.1. Study Data

This study used secondary data consisting of consumer index price (CPI), Gross Domestic Product (GDP) per capita, CO2 emission, Exchange Rate (ER), Globalization Index (GI) and Urbanization (UP) obtained from the World Bank during the1990-2019s. Table 1 shows the characteristics of the study data.

Table 1: Description of The Data

Variables	Unit of measurement	Sources
CPI	Consumer price index (2010 = 100)	WB
GDP	Gross Domestic Product (current LCU)	WB
ER	Official exchange rate (LCU per US$, period average)	WB
GI	Globalization index (not applicable)	WB
UP	Urban population growth (annual %)	WB
CO2	Annual production-based emissions of carbon dioxide (CO2) (million tons per year).	Global Carbon Project

Source: WB denotes World Bank.

In this study, the dependent variable consists of the consumer price index and the independent variables include all other variables considered in the study. Table 2 shows the descriptive statistics of the variables.

Table 2: Descriptive Statistics of The Variables

Statistical variables	LNCPI	LNGDP	LNER	LNUP	LNCO2
Mean	4.41	28.52	6.22	1.36	-0.06
Median	4.45	28.39	6.26	1.36	-0.34
Maximum	4.72	29.65	6.60	1.47	0.76
Minimum	3.82	27.49	5.58	1.29	-0.64
Std. Dev.	0.27	0.70	0.27	0.05	0.50
Skewness	-0.95	0.12	-1.28	0.29	0.69
Kurtosis	2.95	1.70	4.00	2.13	1.78
Jarque-Bera	4.48	2.17	9.46	1.37	4.22
Probability	0.11	0.34	0.01	0.50	0.12
Sum	132.33	855.47	186.52	40.91	-1.93
Sum Sq. Dev.	2.05	14.08	2.07	0.07	7.39
Observations	30	30	30	30	30

Note: The natural logarithm of all series was taken.

Figure 1: Presentation of Raw Series
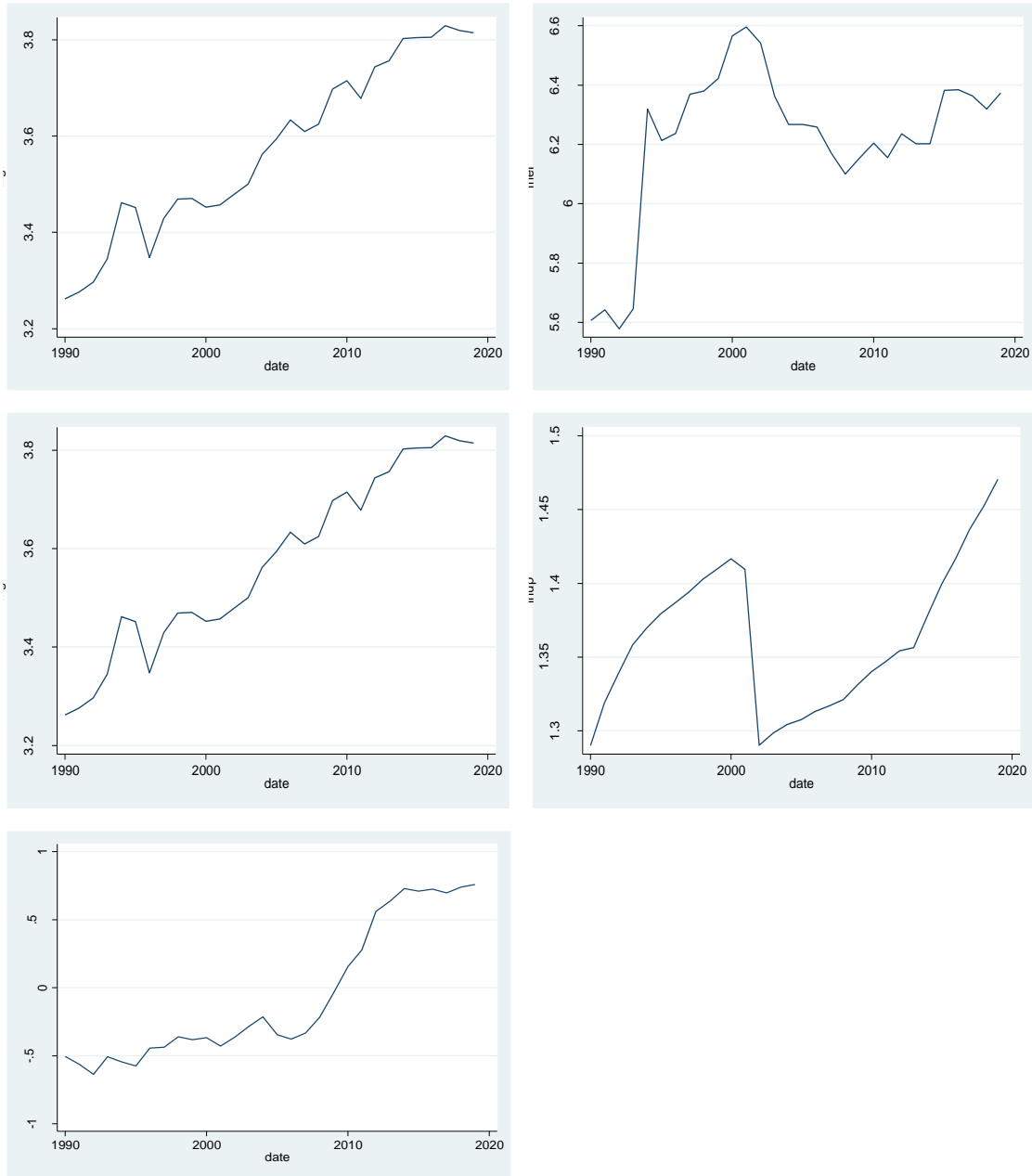
2.2. Data analysis

The natural logarithms of the values of the study's variables were used to eliminate the scaling differences of the series and allow the interpretation of the estimated coefficients as the coefficients of elasticity. The model for the first aforementioned approach is as follows:

CPI= f (GDP, ER, GI, UP, CO2)   (1)

By transforming all the variables in logarithmic value, the econometrics model as follows (Equation 2):

$$lnCPI_t=\beta_0+\beta_1 lnGDP_t+\beta_2 lnER_t+\beta_3 lnGI_t+\beta_4 lnUP_t+\beta_5 lnCO2+\varepsilon_t \qquad (2)$$

Where ε_t refers to the error term at t = 1990, ..., 2019, β_0 states the intercept of the model, and β_1 to β_5 represent the coefficient quantifying the magnitude of nexus between lnCPI and the explanatory variables

3. Results

3.1. Unit Root Test

The stationarity of the series was examined by conducting the Augmented Dickey-Fuller (ADF) (1979), Phillips-Perron (PP) (1988) and DF-GLS unit root tests. Table 3 shows the results of a t-statistics value obtained from the analysis of the first differences.

Table 3: Unit Root Test

Variables	ADF	PP	DF-GLS
lnCPI	-1.38	-1.86	-0.46
lnGDP	0.77	0.89	-0.60
lnER	-2.50	-2.50	-1.46
lnGI	0.68	-1.57	-0.14
lnUP	-0.93	-1.23	-0.59
lnCO2	-0.31	0.23	-0.17
ΔlnCPI	-4.09*	-4.52**	-2.29**
ΔlnGDP	-5.49*	-5.68*	-4.30*
ΔlnER	-5.24*	-5.24*	-5.34*
ΔlnGI	-5.59*	-9.03*	-5.66*
ΔlnUP	-4.14*	-4.40*	-4.12*
ΔlnCO2	-3.79*	-3.74*	-3.48*

Note: The critical values are obtained from ADF, PP and DF-GLS MacKinnon (1996), the symbols * and ** indicate the 10%, 5% significance levels of the rejection of the null hypothesis assuming the existence of unit root and Δ denotes the first difference of a time series.
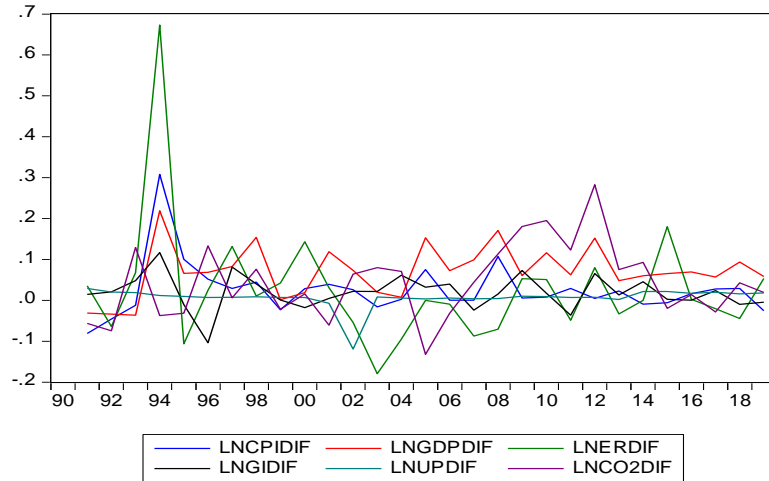
Figure 2: Graphical Representation of Differentiated Series

Table 4 presents the values of the probabilities less than 1% of all variables. Accordingly, the null hypothesis assuming the existence of linearity between the variables is rejected for the dimension 2 and 6 and the existence of nonlinearity is accepted for non-linear tests and further stages of the study. Table 4 shows the results of the nonlinearity test (BDS) test developed by Brock et al. (1987).

Table 4: The Results of The Nonlinearity Test (BDS Test)

Variables	Dimension	BDS Statistic	Std. Error	z-Statistic	Prob.
lnCPI	2	0.191	0.017	11.154	0.000***
	6	0.549	0.037	14.794	0.000***
lnGDP	2	0.183	0.007	23.304	0.000***
	6	0.457	0.016	28.289	0.000***
lnER	2	0.177	0.021	8.113	0.000***
	6	0.378	0.047	8.056	0.000***
lnGI	2	0.174	0.007	21.850	0.000***
	6	0.431	0.016	25.923	0.000***
lnUP	2	0.133	0.008	15.585	0.000***
	6	0.201	0.017	11.261	0.000***
lnCO2	2	0.148	0.0121	12.232	0.000***
	6	0.222	0.0258	8.603	0.000***

Note: The symbol *** states for 1% significance level.

3.2. KSS (2006) Nonlinear Cointegration Test Results

The lag length (lsm=3) was considered as 2 in conducting the nonlinear cointegration analysis and KSS test statistics were compared to the critical values of KSS (2006). Table 5 shows that the values of test statistics were less than those of the table values of model 2. Accordingly, the null hypothesis assuming the nonexistence of a cointegration

relationship between the variables of the study is not rejected. However, Table 5 shows that the null hypothesis is rejected, which implies the existence of long-term relationship between the consumer price index and GDP, GI, UP and CO2. The error correction model suggests that the short-term imbalances can be corrected in the long-term. Therefore, the ESTAR error correction model was used to examine the cointegration relationship between the variables.

Table 5: Kapetanios, Shin and Snell (2006) Nonlinear Cointegration

Model		Test Statistics	Critical Values		
			1%	5%	10%
Model 1: lnCPI= f(lnGDP)	KSS_c	-3.67 (1)**	-3.84	-3.28	-2.98
	KSS_t	-4.82 (1)*	-4.26	-3.71	-3.41
Model 2: lnCPI= f(lnER)	KSS_c	-2.16 (0)	-3.84	-3.28	-2.98
	KSS_t	-2.99 (1)	-4.26	-3.71	-3.41
Model 3: lnCPI= f(lnGI)	KSS_c	-2.02 (0)	-3.84	-3.28	-2.98
	KSS_t	-4.50 (1)**	-4.26	-3.71	-3.41
Model 4: lnCPI= f(lnUP)	KSS_c	-1.92 (0)	-3.84	-3.28	-2.98
	KSS_t	-4.73 (1)*	-4.26	-3.71	-3.41
Model 5: lnCPI= f(lnCO2)	KSS_c	-2.95 (0)	-3.84	-3.28	-2.98
	KSS_t	-4.93 (1)*	-4.26	-3.71	-3.41

Note: The values in parentheses states for the lag length. This test was based on the KSS (2006) critical values such as KSS_c and KSS_t. KSS_c denotes KSS test statistic obtained from demeaned data whereas KSS_t refers to test statistic obtained from both demeaned and detrended data. The symbols * and ** indicate the significance levels 10% and 5% respectively.

3.3. ESTAR Error Correction Model

Table 6 presents the values of the probabilities of the error correction terms $I(u^3)$. Accordingly, it shows that these probabilities values were less than 5% for all the models, which indicates that the parameters of the models were statistically significant. The results of the error correction model are presumed to be statistically significant if the value of the coefficient of the error correction model $I(u^3)$ is between -2 and 0. Hence, the ESTAR error correction mechanism had some problems. The values of the parameters of model 4 were between $-2< I(u^3) <0$. Accordingly, model 4 shows a significant long-term causality relationship and is appropriate for ESTAR error correction.

Table 6: The Results of The ESTAR Error Correction Model

Model	Coefficients	Estimate	t-Value	Pr(>| t |)
Model 1: lnCPI= f(lnGDP)	I(u^3)	-6.482	-2.933	-0.007
Model 2: lnCPI= f(lnER)	I(u^3)	-3.241	-1.477	0.000
Model 3: lnCPI= f(lnGI)	I(u^3)	-10.498	-5.096	0.000
Model 4: lnCPI= f(lnUP)*	I(u^3)	-0.789	-3.688	0.001
Model 5: lnCPI= f(lnCO2)	I(u^3)	-2.581	-4.413	0.000

Note: I(u^3) denotes the error correction terms.

3.4. Linear and Non-linear Granger Causality Test

The results of KSS (2006) analysis revealed the existence of a cointegration relationship between the variables, which might be unidirectional or bidirectional causality between the series. Table 7 presents the results of linear Granger causality tests and shows the existence of a bidirectional causal linkage running from the consumer price index (CPI) to CO_2 and from CO_2 to the consumer price index. In addition, there exists a unidirectional causal linkage running from the consumer price index to globalization whereas the causal linkage running from GDP to CPI was unidirectional.

Table 7: The Results of The Linear Granger Causality Test

Direction of Causality	Lags	F-statistic	p-Value	Results
lnCPI→lnGDP	3	0.18	0.83	GDP=>CPI
lnGDP→lnCPI		5.23	0.00**	
lnCPI→lnER	3	1.89	0.16	X
lnER→lnCPI		0.86	0.47	
lnCPI→lnGI	3	2.44	0.09*	CPI=>GI
lnGI→lnCPI		0.45	0.71	
lnCPI→lnUP	3	0.40	0.75	X
lnUP→lnCPI		0.08	0.96	
lnCPI→lnCO2	3	2.75	0.07*	CPI<=>CO2
lnCO2→lnCPI		2.72	0.07*	

Note: The symbols * and ** state for the significance levels 10% and 5% respectively.

The results of the linear Granger causality test and the direction of the causality are shown in Figure 3.
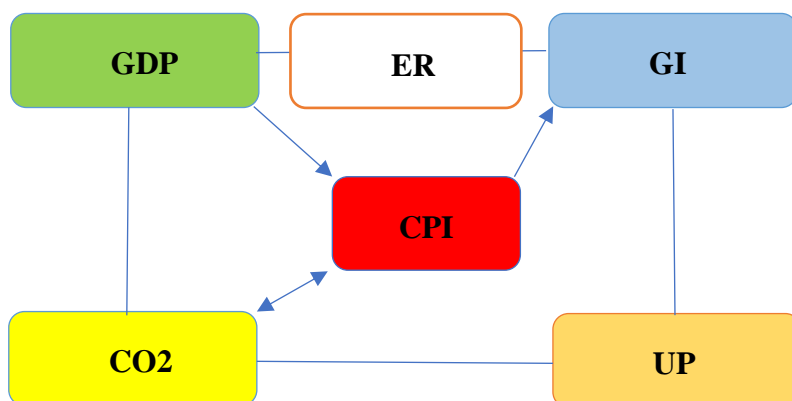
Figure 3: Results of Linear Granger Causality Test Results (Direction of Causality)

Table 8 presents the results of the non-linear causality test of Diks, Panchenko (2006). It shows the nonexistence of any causal linkage relationship and accordingly confirms the null hypothesis.

Table 8: The Results of The Nonlinear Causality Test

$L_x = L_y$	H_0: lnCPI does not cause lnGDP	H_0: lnGDP does not cause lnCPI	H_0: lnCPI does not cause lnER	H_0: lnER does not cause lnCPI
2	0.20	0.73	0.75	0.21
	H_0: lnCPI does not cause lnGI	H_0: lnGI does not cause lnCPI	H_0: lnCPI does not cause lnUP	H_0: lnUP does not cause lnCPI
2	0.27	0.21	0.86	0.22
	H_0: lnCPI does not cause lnCO2	H_0: lnCO2 does not cause lnCPI		
2	0.23	0.21		

Note: N= 30, Bandwith=1.5, Embedding dimenson= 2.

4. Discussion

The study investigates the causal relationship between Gross Domestic Product per capita, exchange rate, globalization, urbanization, carbon dioxide emissions and consumer price index during the periods 1990-2019 in the Niger republic. The results of KSS (2006) nonlinear cointegration test shows that the variables of the study are correlated in long run relationship. Specifically, the results of ESTAR Error Correction Model shows that the value of the coefficients of the model was comprised between -2< I (u^3) <0 Hence, model 4 was the most suited to evaluate the long-term causation link between urbanization and consumer index price. This finding implies that urbanization and consumer index prices have a substantial long-term causality relationship. From this finding, it can be inferred that urbanization results in an increase in the population living in urban regions. Consequently, there would be a greater demand for the products, which would drive up prices and, eventually, lead to inflation on the long-term. Previously, Stage et al. (2010) clarified that increasing urbanization leads to a decline in the availability of food and higher prices, especially for food products. Equally, Hovhannisyan and Devadoss (2020) uncovered that urbanization increases demand for some specific products like fruits, eggs, and meats in China.

The results of linear Granger Causality Test shows the existence of bidirectional causal linkage running from consumer price index (CPI) to CO2 and from CO2 to consumer

price index. In addition, the non-linear Granger Causality Test shows the nonexistence of causal linkage between Gross Domestic Product per capita, exchange rate, globalization, urbanization, carbon dioxide emissions and consumer price index. These results aligned with the findings of Moessner (2022) who uncovered that higher carbon dioxide emissions are correlated to higher inflation at the country level.

Conclusion

This study contributes to investigating the determinants of consumer price index in the Niger Republic. The study reveals the existence of nonlinear cointegration relationship between GDP, Gl, UP, CO2 and CPI whereas the results of the ESTAR error correction model uncovered the existence of significant long-term causality relationship running from UP to CPI. Although the results of linear Granger causality showed the existence of relationships between some variables, the nonlinear causality relationship based on Diks, Panchenko (2006) has not been determined.

In fact, the change in consumer price index is a key macroeconomic indicator for all the countries as it affects directly the decisions of both producers and consumers. Such change pose the problematic of income distribution and inequality, especially where high inflations are observed so stabilizing the prices is of great importance for economic decision-makers. Considering should include both economic and non-economic variables in investigating the determinants of the consumer price index might give another perspective of understanding the factors underlining the purchasing power of consumers in the country. Consequently, the findings of this study could guide the policy and decision makers to design numerous policies and strategies for the welfare of the population. Such policies and strategies might target increasing the productivity of industry and agriculture sectors as well as reviewing the investments allocated for education, health, and human capital.

References

Adenuga, Idris Abeodun et al. ''Is Inflation a Purely Monetary Phenomenon? Empirical Investigation From Nigeria (1970–2009)''. (2012). *European Scientific Journal*, *8*(17).

Adu, George - Marbuah, George. ''Determinants of Inflation in Ghana: An Empirical Investigation''. *South African Journal of Economics*. (2011), *79*(3), 251-269.

Aisen, Ari - Veiga, Francisco. Jose ''Does Political Instability Lead to Higher Inflation? A panel Data Analysis''. *Journal of Money, Credit and Banking*. (2006), 1379-1389.

Andrews, Douglas et al. ''Demography and Inflation: An International Study''. *North American Actuarial Journal*. (2018), *22*(2), 210-222.

Ayodeji, Idowu, Oluwasayo ''Panel Logit Regression Analysis of the Effects of Corruption on Inflation Pattern in the Economic Community of West African states''. *Heliyon*. (2020), *6*(12), e05637.

Bandara, Ranjith ''The Determinants of Inflation in Sri Lanka: An Application of the Vector Autoregression Model''. *South Asia Economic Journal*. (2011), *12*(2), 271-286.

Bobeica, Elena et al. ''Demographics and Inflation (No. 2006)''. ECB Working Paper, (2017).

Brock, W. et al. ''A Test for Independence Based on the Correlation Dimension''. University of Wisconsin at Madison, *Department of Economics Working Paper*. (1987).

Çelik, Ali ''Türkiye'de Enflasyonun Belirleyicilerinin VAR Yöntemi ile Analizi (2008-2019)''. *İzmir İktisat Dergisi* (2021), *36*(1), 135-153.

Central Intelligence Agency (CIA). Niger. The World Factbook. https://www.cia.gov/library/ publications/resources/the-worldfactbook/geos/ng.html. *Contemporary Research in Business.* (2013), Vol. 4, No. 9, pp. 245-253

Daviron, Benoit. vd. *La transmission de la hausse des prix internationaux des produits agricoles dans les pays africains: Rapport provisoire (Novembre 2008).*

Dickey, A. David – Wayne A. Fuller ''Distribution of the Estimators for Autoregressive Time Series with a Unit Root''. *Journal of the American Statistical Association.* (1979), *74*(366a), 427-431.

Diks, Cees - Panchenko, Valentyn ''A New Statistic and Practical Guidelines for Nonparametric Granger Causality Testing''. *Journal of Economic Dynamics and Control*, *30*(9-10). (2006), 1647-1669.

Fenira, Mohamed ''Democracy: a Determinant Factor in Reducing Inflation''. *International Journal of Economics and Financial Issues*. (2014), *4*(2), 363-375.

Ferguson, Roger. *Monetary Credibility, Inflation, and Economic Growth*: A Speech at the Cato Institute 23rd Annual Monetary Conference on Monetary Institutions & Economic Development, Washington*, DC, November 3, 2005* (No. 150).

Gonzalez, Andrew - Holt, Robert ''The Inflationary Effects of Environmental Fluctuations in Source–Sink Systems''. *Proceedings of the National Academy of Sciences*, *99*(23). (2002), 14872-14877.

Greenidge, Kevin – Da Costa, Dianna ''Determinants of Inflation in Selected Caribbean Countries''. *Journal of Business, Finance & Economics in Emerging Economies*. (2009), *4*(2).

Gülşen, Eda - Kara, Hakan ''Measuring Inflation Uncertainty in Turkey''. *Central Bank Review* (2019)., *19*(2), 33-43.

Gyebi, Francis - Boafo, K. Godfried. ''Macroeconomic Determinants of İnflation in Ghana from 1990-2009''. *International Journal of Business and Social Research (IJBSR)*. (2013), *3*(6), 81-93.

Hovhannisyan, Vardges - Devadoss, Stephen. Effects of Urbanization on Food Demand in China. *Empirical Economics* (2020), *58*(2), 699-721.

Huchet-Bourdon, M. ''Agricultural Commodity Price Volatility: An Overview '', *OECD Food, Agriculture and Fisheries Papers* (2011), No. 52, OECD Publishing, Paris. http://dx.doi.org/10.1787/5kg0t00nrthc-en

Inim, Victor et al. ''Other Determinants of Inflation in Nigeria''. *European Journal of Sustainable Development*, *9*(2). (2020), 338-338.

Institut National de la Statistique (INS), Le Niger en Chiffres (2020).

Islam, M. Mazharur et al. ''The Effects of Carbon Emissions, Rainfall, Temperature, Inflation, Population, and Unemployment on Economic Growth in Saudi Arabia: An ARDL investigation''. *Plos one*. (2021), *16*(4), e0248743.

Jelilov, Gylych et al. ''Impact of Inflation and Unemployment on Economic Growth in Ten (10) Selected Member's States of Economic Community of West Africa States (ECOWAS)(2001-2014)''. *Advances in Economics and Business*. (2016), *4*(5), 222-244.

Joshi, Binod ''Impact of Remittance on Consumer Price Index in Nepal''. *The Harvest* (2022), *1*(1), 15-28.

Kapetanios, George et al. ''Testing for Cointegration in Nonlinear Smooth Transition Error Correction Models''. *Econometric Theory*. (2006), *22*(2), 279-303.

Keho, Yaya ''Budget Deficits, Money Supply and Price Level in West Africa''. *Journal of Economic & Financial Studies*. (2016), *4*(05), 01-08.

Khan, Rana Ejaz Ali - Gill, Abid Rashi. ''Determinants of Inflation: A Case of Pakistan (1970-2007)''. *Journal of Economics*. (2010), *1*(1), 45-51.

Kumar, Satish. ''What determines the Gold Inflation Relation in the Long-Run?''. *Studies in Economics and Finance* (2017). Vol. 34 No. 4, pp. 430-446. https://doi.org/10.1108/SEF-04-2016-0084.

Lim, Yen Chee - Sek, Siok. Kun ''An Examination on The Determinants of Inflation''. *Journal of Economics, Business and Management*. (2015), *3*(7), 678-682.

Menji, Sisay ''Determinants of Recent Inflation in Ethiopia. Bachelor Degree Thesis'', Unity University. (2008).

Moessner, Richhild. ''Evidence on Climate Policy, Carbon Dioxide Emissions and Inflation''. *International Journal of Global Warming* (2022), *28*(2), 136-151.

Mohamed, Jama ''Time Series Modeling and Forecasting of Somaliland Consumer Price Index: A Comparison of ARIMA and Regression with ARIMA Errors''. *American Journal of Theoretical and Applied Statistics*. (2020). *9*(4), 143-153.

Phillips, Peter. C. - Perron, Pierre. ''Testing for a Unit Root in Time Series Regression''. *Biometrika*. (1988), *75*(2). 335-346.

Pitigala, Nihal - Lopez-Calix, Jose. ''Trade Policy Options for Export Diversification: The Case of Mali, Chad, Niger, and Guinea''. *Journal of Infrastructure, Policy and Development*. (2021), *4*(2), 261-286.

Raballand, Gael. *Commerce Informel Et Pertes Douanières Au Niger* (2017). Mimeo, Washington DC.

Ratnasiri, H. P. G. S. ''The Main Determinants of Inflation in Sri Lanka: A VAR based Analysis''. *Staff studies*. (2011), *39*(1).

Ribot, Jesse ''Theorizing Access: Forest Profits Along Senegal's Charcoal Commodity Chain''. *Development and Change* (1998), *29*(2), 307-341.

Stage, Jesper- Stage, Jorn- McGranahan, Gordon. ''Is Urbanization Contributing to Higher Food Prices?. *Environment and Urbanization* (2010). *22*(1), 199-215.

Swedberg, Richard. *Markets as Social Structures*. Univ., Department of Sociology, 1993

Szafranek, Karol. ''Bagged Neural Networks for Forecasting Polish (Low) Inflation''. *International Journal of Forecasting* (2019), *35*(3), 1042-1059.

Telatar, Erdinç et al. ''Political Instability, Political Freedom and Inflation''. *Applied Economics*. (2010), *42*(30), 3839-3847.

Word Trade Organization (WTO). Stabilization Programme and Market-Oriented Reforms Should Start Bearing Fruit. Available at https://www.wto.org/english/tratop_e/tpr_e/tp217_e.htm. Accessed on 14.01.2023

World Bank (2022). The country Overview. Available on https://www.worldbank.org/en/country/niger/overview. Accessed at 15.01.2023.

World Bank (2022a). Available at https://data.worldbank.org/indicator/SP.POP.GROW?locations=NE. Acessed on 15.01. 2023

World Bank. (2020). The World Bank in Niger: Niger Overview. https://www.worldbank.org /en/country/niger/overview

Yoon, Jung Won et al. ''Impact of Demographic Changes on Inflation and The Macroeconomy''. *KDI Journal of Economic Policy*. (2018). *40*(1), 1-30.