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Cyclical Crude Oil Price Movements and the Nigerian Growth Dynamics: An Empirical Approach

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Abstract

The paper examined the effect of cyclical crude oil price movements on the Nigerian economic dynamics, emphasizing empirics. The study spanned from 1989 to 2021. This is in view of evaluating how cyclical oil, petrol, diesel, and kerosene price movements impact real gross domestic products in Nigeria. Data for the analysis were obtained from the Central Bank of Nigeria (CBN) Bulletin and the World Bank database from 1989 to 2021, i.e. 33 years. The data analysis methods adopted are the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) and Vector Auto-regressive models. The study evidenced that cyclical movements in oil and diesel prices significantly reduce Nigeria's economic growth. In contrast, cyclical movements of petrol and Kerosene prices minimally improve the Nigerian economy's growth. Hence, the study concludes that cyclical movements in oil and diesel prices counter-productive to the Nigerian economy. Consequently, the Nigerian government should ensure that proceeds from oil products should be channelled to priority sectors of the Nigerian economy. Lastly, the ongoing debates on the diversification of the Nigerian economy need to be re-evaluated.

Keywords: Cyclical Crude Oil Price Movements, Oil Price, Petrol Price, Diesel and Kerosene Price, Economic Growth Dynamics

Introduction

Oil remained one of the major sourced for commodity in globally since its discovery. Within the Nigerian context, oil is highly sought for due to the huge revenue the Nigerian government generates annually from the sales of oil products. However, the continuing gap in poverty despite the vast natural resources has resulted in a "resource curse." Reportedly, 80% of the revenue from the oil sector goes to the public sector, 16% covers operational costs, and 4% goes to investors (Okonkwo & Mojekwu, 2018). Also, the recent sudden gyrations in crude-oil by products calls for concern as it has posed great challenge to the development of the industrial

sector, currency devaluation, depletion of foreign reserve, reduction in government revenue and rise in debt overhang. This gyration became more eminent in July, 2014 and was further reinforced during and posts Covid-19 (Ighoroje, Okorie, & Egberi, 2024). Though the oil sector contributes over 90% of the non-oil sector, the over-reliance of the crude oil revenue presents many structural issues. These structural issues cut across poor economic diversification strategies, underinvestment in human capital, inadequate infrastructure, weak governance, and vulnerability to external shocks, and diversion of funds from oil revenue (Ewiwile, Sinebe, Mokobia, Agbogun, & Ighoroje, 2024).

Although existing empirical studies have shown that cyclical movements of crude oil prices have a negative effect on economic growth from various economic climes (LiuXu & Ai, 2023; Zhang, Cao, Zhang, & Qu, 2023; Ren, Jin, & Lin, 2023; Shiro and Ibekw*e, 2022*; Ighosewe et al, 2021), most of these studies failed to consider the specific aspect of oil prices (crude, petrol, diesel, and kerosene). It should be noted that these oil price proxies may have more robust evidence for formulating policies that will improve the oil sector as a whole, considering its effect on the economy's growth (GDP). Also, the use of advanced econometric techniques like GARCH and VAR combined with its time-series data from 1989 to 2021 is timely considering the challenges facing the oil sector and the economy as well. Therefore, that study seeks to examine the effect of cyclical oil price movements (CCOM) on Nigeria's economic growth (ECG). The specific objective is to investigate the CCOM-ECG interaction.

Literature Review

Conceptual Review

Crude oil is one of the highly useful natural resources. However, crude oil on its own does not have any special importance except if it is refined and distilled into by-products. Wardhana, and Makaliwe (2023) defined CCOM as a downward upward movement in crude oil prices. Such movements are trigged by macroeconomic fundamentals like exchange rate,, inflation rate, domestic demands, global demands, political unrest/change in government.. Baumeister and Kilian (2016) defined CCOM as unplanned change in crude oil prices. Such change compares the actual (realized) and predicted (expected) oil prices. Nwanna and Eyedayi (2016) added that CCOM can sometime be drastic.

Manasseh, Abada, Ogbuabor, Okoro, Egele, and Ozuzu (2019) viewed CCOM as the persistent and consistent upward/downward swing/fluctuations in prices of crude oil over time. The authors further categorized the triggers into demand push and supply push. Nwanna and Eyedayi (2016) added geographical and other consideration to the triggers of oil price cyclical movements. Meanwhile, Kawai (2017) added that if the movement becomes volatility, it may occur daily, weekly or monthly. Kawai (2017) however stressed that such volatility debars economic growth and development especially in economies that depends solely on crude oil. Ajeigbe (2021) argues that country's response to such movements differs significantly.

In light of the above, Ighosewe, Akan, and Agbogun (2021); Akinlo, and Apanisile (2023) noted that oil-dependent economies like Nigeria are most likely to record low growth rate if

the price oil falls than oil-less dependent economies. Jabir, Karimu, Fiador, and Abor (2023) further stressed that if this persist it can drag the economy into chronic recession. This has been the case of Nigeria over the years.

Theoretical Framework

The Dutch Disease Theory (DDT) served as the theoretical framework for the study. Kawai (2017) categorized the extent the Dutch disease affects the economy into resource and spending effect movements. The resource movements place premium on the various aspects of the resources that trigger oil price to increase marginally, which in turn increases wage rates. This in turn shrinks the operations of various sectors of the economy. Contextually, the theory stresses that if oil prices change, oil-exporting countries' industrial sector will change alongside. Thus, the import concentration reduces the extent of competitiveness of the domestic producers (Ighosewe, Akan, & Agbogun, 2021).

Empirical Review

Given the numerous studies in this area, it is shocking that their contradictory results have been produced. For example, LiuXu and Ai (2023) examined whether different oil price movements reduce stock returns. The study adopted the generalized additive outlier (GAO) method. The study found that, expected oil price shocks reduce stock returns.

Ren, Jin, and Lin (2023) analyzed the extent sudden oil price movement affected Chinese enterprise from 2010 to 2019. The study adopted the panel methodology. The Heterogeneity analysis reveals that the sudden oil price movements reduced state-owned Chinese firms significantly.

Prince, Inim, Ogbodo, Samuel, and Victor (2022) examined the Ukraine-Russia Crisis effect on oil price surge and oil output in Nigeria. They confirmed that oil supply demand causes surge to the China economy.

*Shiro and Ibekw*e (2022) examined the impact of oil price changes on Nigeria's economic expansion from 1997 and 2020 and found that higher oil prices debar economic growth of Nigeria. This is similar to the findings of Garba, and Sikiru (2022); Ebimobowei (2022); Drebee, and Razak (2022); Tumala, Salisu, and Atoi (2022). Conversely, Miamo, and Achuo (2022) revisited the resource curse theory by examining the crude-oil price and economic growth of 32 SSA countries from 1980 to 2017. They evidenced that crude oil price improved the SSA economy from 1980 to 2017.

Alenoghena, and Aghughu (2022) evidenced that oil price volatility has a non-linear (asymmetric) effect on the Nigerian economy from 1981 to 2019 as reported by the non-linear autoregressive distributed lag (NARDL) model. However, Wardhana, and Makaliwe (2023) found that, money supply, exchange rates and oil price have mixed effect on capital market performance in Indonesia. Ighosewe et'al (2021) also evidenced that CCOM have mixed effect on the Nigerian economy from 1984-2018.

From the literature reviewed above, the current study stands out in three (3) strands. First, the current study offers unique and more thorough insights into the effects of specific oil price proxies (crude, petrol, diesel, and kerosene) on economic growth, unlike most studies reviewed. Although existing empirical discourse stressed on the negative (non-linear) effect of the cyclical movements of crude oil prices on economic growth from various economic climes (LiuXu & Ai, 2023; Zhang, Cao, Zhang, & Qu, 2023; Ren, Jin, & Lin, 2023; Shiro and Ibekwe, *2022*; Ighosewe et'al, 2021), the current study stands out as it adopted both GARCH and VAR. Justifiably, the current study was able to model and forecast volatility and at the same time capture the dynamic association among the target variables.

Research Methods

The *expost facto* research design was suitable for this research because the target variables are existing data and are not manipulated. Data were obtained mainly from the CBN bulletin, OPEC and World Bank data base from 1989 to 2021 i.e. 33 years. The paper adapted the empirical of Drebee, and Razak (2022) & Ighosewe et'al (2021). Although Ighosewe et'al (2021) models decomposed oil price fluctuations/dwindling into the four (4) crude oil price proxies, they did not incorporate exchange rate into their model. Hence, the modified model is specified as:

$$RGDPt = \propto_0 + \propto_1 COPB + \propto_2 CPPP + \propto_3 CDPP + \propto_4 CKPP + \propto_5 EXR + Ut - (1)$$

The GARCH Model is expressed as:

$$\sigma_t^2 = w + \sum_{i=1}^{q} \alpha i + U_{t-i}^2 + + \sum_{j=1}^{p} \beta j \, {}_{\delta}^{2} t - j \qquad (2)$$

Where:

W = Constant

$U_{t-i}^2 = P$ast shocks

${}_{\delta}^{2} t - j =$ Past conditional variances

VAR Form is expressed as:

$$\begin{bmatrix} RGDPt \\ COPP_t \\ CPPP_t \\ CDPP_t \\ CKPP_t \\ EXR_t \end{bmatrix} = \begin{bmatrix} RGDPt \\ COPP_t \\ CPPP_t \\ CDPP_t \\ CKPP_t \\ EXCR_t \end{bmatrix} +$$

$$\sum_{i=1}^{p}\begin{bmatrix} A_{RGDP,1i} & A_{COPP,1i} & A_{CPPP,1i} & A_{CDPP,1i} & A_{CKPP,1i} & A_{EXR,1i} \\ A_{RGDP,2i} & A_{COPP,2i} & A_{CPPP,2i} & A_{CDPP,2i} & A_{CKPP,2i} & A_{EXR,2i} \\ A_{RGDPR,3i} & A_{COPP,3i} & A_{CPPP,3i} & A_{CDPP,3i} & A_{CKPP,3i} & A_{EXR,3i} \\ A_{RGDPR,4i} & A_{COPB,4i} & A_{CPPP,4i} & A_{CDPP,4i} & A_{CKPP,4i} & A_{EXR,4i} \\ A_{RGDPR,5i} & A_{COPP,5i} & A_{CPPP,5i} & A_{CDPP,5i} & A_{CKPP,5i} & A_{EXR,5i} \\ A_{RGDPR,6\ i} & A_{COPP,6i} & A_{CPPP,6i} & A_{CDPP,6i} & A_{CKPP,6i} & A_{EXR,6i} \end{bmatrix} \quad (3)$$

Where:

RGDP = Real Gross Domestic Product (annually)

COPP = Cyclical movement of oil price per barrel (in % changes)

CPPP = Cyclical movement of petroleum prices (in % changes)

CDPP = Cyclical movement of diesel prices (in % changes)

CKPP = Cyclical movement of kerosene prices (in % changes)

EXR = Exchange Rate

$\propto 0$ = Intercept;

$\propto 1$- 6 = Coefficient

Ut = Error term.

Results and Discussions

Data Analysis

This section presents the summary descriptive statistics of the data collected to the study variables. Table 1:

Table 1: Summary (Descriptive) Statistics

	RGDP	COPP	CPPP	CDPP	CKPP	EXR
Mean	45189.39	51.77606	49.12136	55.32848	54.44061	135.7630
Maxi.	102543.8	116.8800	145.9200	225.0900	290.7500	414.0000
Min.	17082.56	14.14000	0.390000	0.350000	0.300000	7.360000
Std. Dev.	28500.67	35.56265	46.65996	67.02733	75.63545	107.3284
Jarque-Bera	3.993888	3.851626	3.132695	8.531909	30.00714	4.251077
Prob.	0.135750	0.145757	0.208806	0.014038	0.000000	0.119369
Observations	**33**	**33**	**33**	**33**	**33**	**33**

Source: Researcher's Compilation (2024)

Throughout the study period, RGDP reported had max./highest and min./least values of ₦102543.8 billion and ₦17082.56 billion, respectively. More so, the COPP by 35.56265at an average value of 51.77606 with a max./highest and min./least estimated at 116.88 and 14.14 respectively. This implies that COPP clusters around its mean value. Again, petroleum (petrol motor spirit) pump price fluctuate by 46.65996 with an average/mean value of 49.12136 and a highest and least value of 145.9200 and 0.30 respectively. Also, diesel prices fluctuate by

67.02733 with an average value of 55.32848 and also max./highest and min./least values of 225.09 and 0.30, respectively. Moreover, CKPP fluctuates by 75.63545 with an average/mean value of 54.44061 and also has a max./highest and min./least value of 290.75 & 0.20, respectively. Lastly, exchange rate had max./highest and min./least values of 414.0000 & 7.360000.

All the variables except CDPP and CKPP were volatile since the probability values of their Jarque-Bera test are below 5%. This suggests that, the model is fit for prediction. All the variables were logged and subjected to other diagnostic checks to ensure that the model is fit for prediction.

Unit Root Test

The model introduced unit root test to ensure that the dataset is suitable for analysis. The unit root test is presented in Table 2:

Table 2: Unit Root Test- ADF Test

Study Variables	At Level				At First Difference			
	ADF Test Statistic	MacKinnon Test Critical 5%	P-Value	Order of Integration	ADF Test Statistic	MacKinnon Test Critical 5%	P-Value	Order of Integration
RGDP	-1.9124	-3.0124	0.3203	1(0)	-11.1117	-3.0207	0.0000	1(1)
COPP	-2.5440	-3.0124	0.1200	1(0)	-5.2856	-3.0300	0.0005	1(1)
CPPP	-1.5819	-3.0124	0.4738	1(0)	-3.4895	-3.0207	0.0195	1(1)
CDPP	-2.0236	-3.0124	0.2752	1(0)	-6.0285	-3.0207	0.0001	1(1)
CKPP	-2.0653	-3.0124	0.2593	1(0)	-4.9505	-3.0207	0.0009	1(1)
EXR	-2.7665	-3.0124	0.0801	1(0)	-4.9861	-3.0300	0.0009	1(1)

Source: Author's Computation (2024)

From Table 2, none of the CCOM, exchange rate and economic growth proxies was stationary at order 0. However, they were stationary at order 1 (first differencing). By implication, the CCOM, exchange rate and economic growth proxies are likely to co-integrate. The Johansen Julius cointegration (JJC) Test was tested to confirm this.

Cointegration Test

Having established that all the study variables attained stationary at first differencing, we determine the existence of a long-run equilibrium relationship among the variables in the model using the Johansen Julius Cointegration test. The cointegration test estimate is presented herein:

Table 3: Johansen Cointegration Test (Logged Form)

	Cointegration Trace Rank Test				Max-Eigen Value Rank Test		
Numbers of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	Prob.**	Max-Eigen Statistic	5% Critical Value	Prob.**
None (0)	0.9997	343.6910	95.75366	0.0000	163.2981	40.0776	0.0001
≤ 1 *	0.9926	180.3929	69.81889	0.0000	98.1618	33.8769	0.0000

≤2 *	0.9302	82.23108	47.8561	0.0000	53.2511	27.5843	0.0000
≤3*	0.5898	28.97995	29.7971	0.0619	17.8201	21.1316	0.1367
≤4*	0.4014	11.15987	15.4947	0.2019	10.2634	14.2646	0.1952
≤5*	0.0438	0.896438	3.8415	0.3437	0.8964	3.8415	0.3437

Source: Author's Computation (2024)

The cointegration test stated in Table 3 clearly indicates that the variables reported three (3) cointegration. By implication, long run relationship exists between CCOM, exchange rates and economic growth.

Regression Result

To ensure that the regression estimate is robust, the following preliminary tests were done:

Table 4: VAR Estimate

Lags	LM-Stat	Prob
1	16.7350	0.4029

Source: Author's Computation (2024)

The result with p-value of 0.4029 which is higher than 5% level suggests that the model is not auto-correlated.

Table 5: VAR Residual Portmanteau Tests for Autocorrelations

Lags	**Q-Stat**	**Prob.**	**Adj Q-Stat**	**Prob.**	**df**
2	156.12	0.8442	200.23	0.0928	25

Source: Author's Computation (2024)

The VAR Residual Portmanteau Tests further affirmed that the model is not auto-correlated. By implication, the model is robust and reliable.

Table 6: VAR Heteroskedasticity Tests

Joint test:		
Chi-sq	**Df**	**Prob.**
178.45	27	0.0763

Source: Author's Computation (2024)

The VAR Heteroskedasticity Tests with a p-value of 0.0563 indicates that the model is Homoskedastic. The result further revealed that the number of residual series generated by VAR unrestricted equations.

Table 7: Roots of Characteristic Polynomial

Root	**Modulus**
0.6597 - 0.3615i	0.7522
0.6597 + 0.3615i	0.7522
0.5417 - 0.20337i	0.5786
0.5417 + 0.2034i	0.5786
-0.5476	0.5476

Source: Author's Computation (2024)

The VAR test shows that the model is stable. To further substantiate this, the Inverse Root (IR) of AR Characteristics Polynomial Test in figure 1 reaffirmed that the VAR satisfies the stability condition.

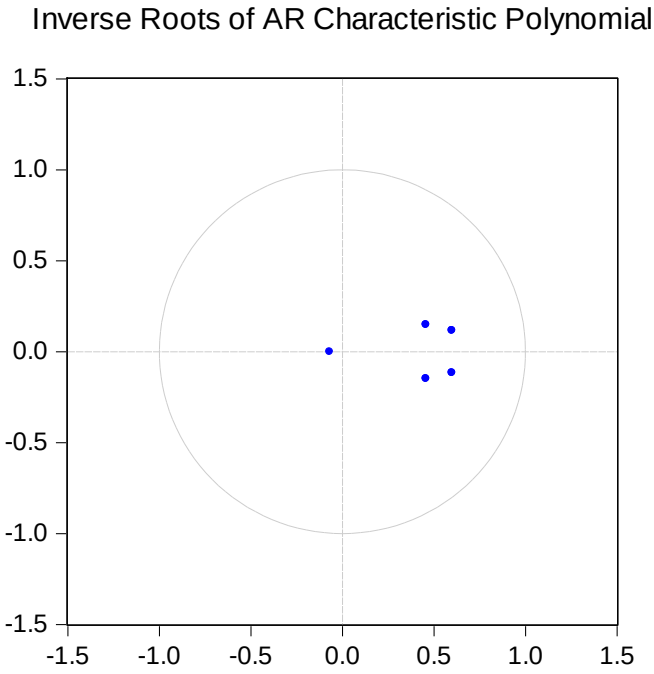

Figure 1 – IR of AR Characteristic Polynomial

Source: Authorial Computation (2024)

Having confirmed that the model is not auto-correlated, Homoskedastic and stable, the Vector Autoregressive (VAR) Estimate is presented in Table 8:

Table 8: VAR Estimates

Regressed: RGDP

Variables	Coef.	Standard Error	t-Statistic	Prob.
RGDP(-1)	0.647179	0.177007	3.656236	0.0023
COPP(-1)	0.091183	0.036413	2.504156	0.0235
CPPP(-1)	0.809538	0.371360	2.179929	0.0456
CDPP(-1)	0.650021	0.169192	3.841917	0.0014
CKPP(-1)	0.003960	0.039832	0.099415	0.9221
EXR(-1)	-0.494313	0.171046	-2.889941	0.0112
Constant (C)	0.830847	0.163245	5.089585	0.0001

R^2=0.920896; Adj. R^2 = 0.898747; Durbin-Watson stat.= 1.746335;
Fisher Statistic = 41.57696 & Prob.(Fisher Statistic) =0.000000

Source: Author's Computation (2024)

As reported in Table 8, past RGDP (RGDP(-1)) values respond positively to current RGDP values. More so, RGDP(-1), COPPP, CDPP, CPPP and CKPP are positively over the reviewed

periods. However, higher exchange rate reduces the value of the domestic economy, reducing her growth. This was reaffirmed by the GARCH estimates presented in table 9:

Table 9: GARCH Estimates

Dependent Variable: LOG(RGDP)
Sample: 1989 2021
Observations: 33

Variables	Coef.	Standard Error	t-Statistic	Prob.
Constant (C)	8.473975	0.283956	29.84257	0.0000
COPP	-0.420867	0.095965	-4.385617	0.0000
CPPP	0.548148	0.138661	3.953142	0.0001
CDPP	0.004937	0.003133	1.575725	0.1151
CKPP	0.320306	0.040496	7.909501	0.0000
EXR	-0.152121	0.039141	-3.886476	0.0001
Variance Equations				
C	0.001795	0.001420	1.264081	0.2062
RESID(-1)^2	-0.194538	0.063192	-3.078513	0.0021
GARCH(-1)	1.124857	0.111741	10.06664	0.0000

R^2=0.864787; Adj. R^2 = 0.839747; Durbin-Watson stat.= 2.127280

Source: Author's Computation (2024)

The GARCH model above revealed that the cyclical oil price movements explained 86.48% variation in the RGDP while the error term caused 13.52% variation. The high adjusted r-squared value further buttressed this. More so, the Durbin Watson teat value of suggests that the model is fit for prediction. Meanwhile, the results reaffirmed that, the current fall in RGDP of Nigeria is traced to her over dependence on crude oil products. Justifiably, the study evidenced that, COPP, with t-test value of -4.385617 suggests that it had a demeaning effect on the RGDP of Nigeria. This, however, does not suggest that, being an oil-endowed nation is a curse but that crude oil proceeds which would have been used to stabilize the Nigerian to cushion the multiplier effect on the oil prices is subverted by few privileged people. This is in tandem with the resource curse hypothesis alongside the findings of Prince, Inim, Ogbodo, Samuel, and Victor (2022); Miamo, and Achuo (2022); Drebee, and Razak (2022) but contravenes the Taylor rule, and the findings of Shiro, and Ibekw*e (2022);* Garba, and Sikiru (2022); Ebimobowei (2022). Also, the constant fall in the Nigerian currency at a high demeaning rate also resulted to the major reason why the high crude oil fluctuations reduces the RGDP of Nigerian economy. This was not captured by Ighosewe et'al (2021).

Furthermore, the study evidenced that, both CPPP and CKPP had a direct (positive) effect on the economy (RGDP) such that, a unit rise in CPPP and CKPP will increase RGDP by a noticeable value of 0.548148 and 0.320306 respectively. Statistically, both CPPP and

CKPP passed the test of significance since their p-values were below 0.05 level. By implication, petroleum price fluctuations and cyclical movement of kerosene prices a major economic growth predictors.. This is in tandem with the Taylor rule, and the findings of Shiro, and Ibekw*e (2022);* Garba, and Sikiru (2022); Ebimobowei (2022) but contravenes the resource curse hypothesis alongside the findings of Prince, Inim, Ogbodo, Samuel, and Victor (2022); Miamo, and Achuo (2022); Drebee, and Razak (2022).

Having controlled for exchange rate, the study reaffirmed that, CDPP had a direct (positive) effect on RGDP of Nigeria such that, a unit rise in CPPP and CKPP will increase RGDP by a minimal value of 0.004937. Statistically, CKPP has a p-value is above 0.05 level. By implication, CKPP are not a major factor influencing Nigeria's RGDP.

Table 10: Summary of GARCH Outcomes

Variable	Coefficient	z-Statistic	Prob.	Outcomes
COPP	-0.420867	-4.385617	0.0000	Negative and Significant
CPPP	0.548148	3.953142	0.0001	Positive and Significant
CDPP	0.004937	1.575725	0.1151	Positive and Insignificant
CKPP	0.320306	7.909501	0.0000	Positive and Significant
EXR	-0.152121	-3.886476	0.0001	Negative and Insignificant

Source: Researcher's Compilation (2023).

Concluding Remarks

This research evaluated how cyclical oil, petrol, diesel price and kerosene price movements impact on real gross domestic products in Nigeria. Data used for the analysis were obtained from the CBN Bulletin, and the World Bank data base from 1989 to 2021 i.e. 33 years. The data analysis methods adopted are the GARCH model and the VAR model. The study evidenced that cyclical movement in oil and diesel price reduce economic growth of Nigeria significantly while cyclical movements of petrol and Kerosene prices improves the growth of Nigerian economy minimally. Hence, the study concludes that cyclical movements in oil and diesel prices have counter-productive effect on the Nigerian economy. In this regards, the following submissions were made:

1. The proceeds from crude oil sales by products should be channeled to priority sectors of the Nigerian economy.
2. The current move to revamp the existing local refineries should be sustained.
3. License should be given to private investors to establish refineries. This will help to increase the volume of oil exported overseas.
4. Lastly, the ongoing debates on the diversification of the Nigerian economy need to be re-evaluated.

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