Global Journal of Business, Economics, and Management: Current Issues

Volume 13, Issue 1, (2023) 11-27

www.wjbem.eu

Tax burden and the growth of shadow economy in Nigeria: A focus on the corporate tax rate and net taxes on products

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Suggested Citation:

Okon, E. O. (2023). Tax burden and the growth of shadow economy in Nigeria: A focus on the corporate tax rate and net taxes on products. *Global Journal of Business, Economics, and Management: Current Issues. 13*(1), 11-27. https://doi.org/10.18844/gjbem.v13i1.7738

Received from January 11, 2023; revised from February 26. 2023; accepted from March 12, 2023

Selection and peer review under the responsibility of Prof. Dr. Andreea Claudia Serban, Bucharest Academy of Economic Studies, Romania.

Abstract

The purpose of taxation is to raise revenue to pay for public goods. The question of how tax mix affects the size of the underground economy is one of the most important issues for its application to tax policy. However, the empirical evidence on this subject is limited and also somewhat ambiguous. Empirically, this study specifically aims to evaluate the effect of corporate tax rate and net taxes on the product on shadow economy growth in Nigeria during the period 1996–2020. It employed augmented Dickey–Fuller (ADF) and Phillips and Perron tests to check for unit roots. Thereafter, the Autoregressive Distributed Lag model was employed to determine the short- and long-run effects. The findings of this study show that corporate tax rates and net taxes on products induced much less shadow economy in the long-run while corporate tax rates have a positive impact on shadow economy in the short-run.

Keywords: Autoregressive-distributed lag model, corporate tax rate, net taxes, products, shadow economy;

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1. Introduction

Nigeria is Africa's most populous country and second-largest economy after South Africa. By its size, improved economic management and strong economic growth in Nigeria would generate substantial prospects for growth and spillovers for the whole West African region (Pitigala and Hoppe, 2011). The country is governed by a federal system; hence, its fiscal operations also adhere to the same principle, a fact which has serious implications for how the tax system is managed. The country's tax system is lopsided and dominated by oil revenue. It is also characterized by unnecessarily complex, distortionary, and largely inequitable taxation laws (Odusola, 2006) that have limited application in the shadow economy that dominates the real economy.

The shadow economy is becoming too big to ignore for a country struggling with economic growth and job creation. The shadow or informal or underground economy encompasses the broad range of economic activities not captured in a country's official statistics (Omodero, 2019). Informality in Africa is highest in Nigeria, according to the World Bank, which values the activities of the sector at $302 billion (Akinmurele et al., 2019). That means the sector accounts for 80% of the country's Gross Domestic Product and is as big as Qatar and Angola combined. If viewed as a standalone economy, Nigeria's informal sector would also be the second fastest growing in Africa behind Ethiopia, going by estimates from consulting firm FDC Ltd, which shows the shadow economy has expanded by an average of 8.5% over the past 3 years (Akinmurele et al., 2019).

1.1. Purpose of study

The purpose of this paper is to empirically analyze the relationship between tax burden and shadow economy level in Nigeria. It specifically evaluates the effect of different types of taxes on the shadow economy size during the period 1996–2020. The choice of timeframe chosen in this study is guided by data availability and accessibility.

1.2. Background of study

As observed by Mbaye and Gueye (2018), how many taxes a company must pay creates a bottleneck for businesses. In Africa, Côte d'Ivoire has the most taxes – 63 different types for a private company – followed by Nigeria with 59, Senegal with 58, and Benin with 57. In West Africa, Cape Verde is exceptional, with only 30 taxes. In some countries outside West Africa, the number is relatively moderate: 29 in Rwanda, 26 in Gabon, and 23 in Madagascar. As such, estimating the effect of different types of taxes on a shadow economy is seen as a precondition for designing efficient instruments and policy measures to tackle the shadow economy. Simply put, the question of how the tax mix affects the size of the underground economy is one of the most important issues for its application to tax policy. However, the empirical evidence on this subject is limited and also somewhat ambiguous.

The empirical evidence on the severity of the underground economy and its relationship with the tax burden in Nigeria is very scanty, but a brief literature review according to Stankevicius and Vasiliauskaite (2014) shows that the shadow economy impacts negatively the formal economy. According to empirical evidence, about 1/3 volume of activities in the shadow economy would continue to take place in the formal economy following the elimination of the shadow economy (Jensen and Wöhlbier, 2012). Reduction in the size of the shadow economy will also reduce tax gaps and generate additional revenues for governments (Palda, 1998; Timbate, 2021; Omodero, 2022; Tackie et al., 2022). Empirical results of the influence of tax burden on the shadow economy are provided in the studies of Tanzi 1980; Schneider and Neck 1993; Johnson and Zoido-Lobaton, 1998; Schuknecht, 2011; and Schneider, 2012; Unver and Koyuncu, 2019; Němec et al., 2021; Wali, 2021.

The lack of a significant number of empirical studies on the relationship between tax burden and shadow economy level in Nigeria justifies the need to focus on the country and to take account of the country's specifics. Although, the evidence from another economy may be robust in terms of data and reality in the countries investigated may not be sufficiently adequate to guide policy decisions in the Nigerian economic context. This study aims to evaluate the effect of corporate tax rate (CORP) and net taxes on the product on shadow economy growth in Nigeria during the period 1996–2020.

2. Materials and Methods

2.1. Specification of Model

The ex-post-facto research design was employed to measure the impact of tax burden level on the shadow economy using an econometric model. Specifically, the focus was on the CORP and net taxes on products (NTP). Along the line, there was a need to extract the effect of other variables which encourage economic agents to do their transactions in the underground economy. As such, the following linear model was specified to represent the relationship of interest:

$$Y_t = \beta_0 + \beta_1 \text{Ӝ}_t + \beta_2 \text{Ў}_t + \varepsilon_t \qquad (1)$$

Where: Y = shadow economy (or informal sector) as a percent of total annual GDP.

Ӝ = vector of tax burden indicators or variables (CORP – A corporate tax, also called corporation tax or company tax, is a direct tax imposed on the income or capital of corporations or analogous legal entities.; and NTPs (net indirect taxes) are the sum of product taxes fewer subsidies. Product taxes are those taxes payable by producers that relate to the production, sale, purchase, or use of goods and services. Subsidies are grants on the current account made by the general government to private enterprises and unincorporated public enterprises. The grants may take the form of payments to ensure a guaranteed price or to enable the maintenance of prices of goods and services below costs of production, and other forms of assistance to producers. Data are in current U.S. dollars.

Ў = vector of other variables that encourage economic agents to do their transaction in an underground economy (EXC – the real effective exchange rate). The real effective exchange rate is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs; INF – Inflation, GDP deflator (annual %). Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole; INT – real interest rate (%). Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator.

t= time trend

ε = the random error term assumed to be normal, identically, and independently distributed.

All the variables are used in natural logarithmic form to attain more accurate empirical results. Using this natural logarithmic form has some advantages over using the level form of variables. The annual data for the study are from 1996 to 2020. The choice of this period is based on the availability of statistical data. The time series data regarding the variables used for the empirical analysis were sourced from the World Development Indicators database of the World Bank, Central Bank of Nigeria (CBN) statistical bulletin, Index Mundi.com, theglobaleconomy.com.

2.2. Econometric Technique

The econometric analysis starts with the identification of the stationarity of the considered variables in the econometric model. Unit root test is done using augmented Dickey–Fuller (ADF) test (Dickey & Fuller, 1979) and Phillips and Perron (1988) tests. Following the suggestion of Granger (1988), a test of possible cointegrating relationships among the series was conducted. Basically, in this study, the newly proposed

ARDL model is utilized to check co-integration and estimate short-run and long-run relationships. Some diagnostic tests were also done for confirming how robust the regression model is. Jarque–Bera (JB) Test was applied to test the normality of residual. Breusch–Godfrey Serial Correlation LM test was also applied to test the serial correlation problem. This was supported with a correlogram test. Furthermore, Breusch–Pagan–Godfrey heteroscedasticity test was applied to detect the heteroscedasticity problem. Furthermore, the correlograms of the squared residuals were used to check autoregressive conditional heteroskedasticity (ARCH) in the residuals. Ramsey RESET Test was conducted for misspecification. CUSUM and CUSUMSQ tests were applied to test the stability of the model.

3. Result

In Table 1, the mean of the variables shows their average values from 1996 to 2020. It was observed that the dependent variable (LOGISEC) had a maximum value of 4.176078 and a minimum value of 3.924742 with an average of 4.030222. The standard deviation shows that there is some dispersion in all the variables and that LOGCORP shows the least dispersion from its mean (0.004326). Half of the variables showed negative skewness while the other half showed positive skewness. The Kurtosis shows that most of the distributions of the series are peaked (normal distribution is 3). In general, the Jarque–Bera statistics show that a substantial number of the variables used in the study were normally distributed.

Table 1. *Descriptive Statistics*

	LOGCORP	LOGEXC	LOGINF	LOGINT	LOGISEC	LOGNTP
Mean	3.399854	4.677747	2.442074	1.788315	4.030222	21.39362
Median	3.401197	4.610357	2.449279	1.800058	4.038127	21.60665
Maximum	3.404525	5.617825	3.376563	2.900322	4.176078	22.65420
Minimum	3.384390	4.245347	1.682688	0.067659	3.924742	20.04854
Std. Dev.	0.004326	0.360112	0.374125	0.743313	0.073600	0.853943
Skewness	-1.846483	1.249547	0.201115	-0.955454	0.167254	-0.264188
Kurtosis	7.601161	3.936096	3.178786	3.295764	1.790972	1.612740
Jarque-Bera	36.25904	7.418483	0.201826	3.894837	1.639212	2.295492
Probability	0.000000	0.024496	0.904012	0.142642	0.440605	0.317351
Sum	84.99635	116.9437	61.05184	44.70787	100.7555	534.8404
Sum Sq. Dev.	0.000449	3.112341	3.359276	13.26033	0.130008	17.50123
Observations	25	25	25	25	25	25

Source: Author's computation using Eviews 10 software

To test the time series data for stationarity, the augmented Dickey–Fuller test (ADF) (Dickey & Fuller 1979) was applied. A time series with a unit root is said to be non-stationary. Other common methods for determining the stationary of a variable such as the Phillips-Perron (PP) test was adopted in this study. This test is similar to the ADF test but with a few alternations to allow for autocorrelated residuals. However, both tests often provide similar conclusions. In this study, the ADF test was conducted using the optimal lag length of 5 and the Schwarz information criterion which was automatically selected. Furthermore, New-west bandwidth was automatically selected when the Phillips–Perron test was carried out. Both results are shown in Tables 2 and 3.

The augmented Dickey–Fuller Unit root test result in Table 2 shows that some of the variables were found to be non-stationary at levels but became stationary at the first difference, implying that the variables of interest are integrated of order zero (I (0)) and order one (I (1)). The results obtained in Table 4 using Phillips–Perron tests for unit roots arrive at similar conclusions. Therefore, an ARDL procedure of cointegration test can be applied to this study. The ARDL method integrates the short-run impact of the given variables with a long-run equilibrium using an error correction term without dropping long-run information. The ARDL method provides robust and consistent results for small sample sizes (Pesaran &

Shin 1998; Pesaran et al. 2001) which are good for this study due to the sample sizes ranging from 1996 to 2020, about 25 observations.

Table 2. *Augmented Dickey–Fuller (ADF) Unit Test Result*

Variables	With intercept		With Trend and intercept		Order of Integration
	Levels	1st diff	Levels	1st diff	
LOGNTP	-1.504359	-4.471516*	-2.224263	-4.448117*	*I (1)*
LOGISEC	-2.290202	-7.973567*	-0.639375	-8.483335*	*I (1)*
LOGINT	-5.269416*	-8.824604*	-5.220453*	-8.621477*	*I (0)*
LOGINF	-4.827521*	-5.231518*	-4.785049*	-5.047727*	*I (0)*
LOGCORP	-5.555081*	-6.013380*	-6.408884*	-5.446662*	*I (0)*
LOGEXC	-2.310380	-5.077429*	-2.208068	-5.102383*	*I (1)*

*Significance level at 1%, 5% and 10 % as *, ** and *** respectively*
Source: Author's computation using Eviews 10 software

Table 3. *Phillips–Perron Unit Root Test Result*

Variables	With intercept		With Trend and intercept		Order of Integration
	Levels	1st diff	Levels	1st diff	
LOGNTP	-1.492905	-4.500697*	-2.224263	-4.741937*	*I (1)*
LOGISEC	-2.210535	-7.874913*	-1.922277	-8.796834	*I (1)*
LOGINT	-5.269416*	-14.29019*	-5.220795*	-16.20003*	*I (0)*
LOGINF	-4.787047*	-15.15763*	-4.757701*	-14.35287*	*I (0)*
LOGCORP	-5.123940*	-17.74267*	-5.541404*	-16.09698*	*I (0)*
LOGEXC	-2.283128	-5.214281*	-2.231657	-5.861865*	*I (1)*

*Significance level at 1%, 5%, and 10 % as *, **, and ***, respectively*
Source: Author's computation using Eviews 10 software

To determine if a long-run relationship exists among the variables, ARDL bound test was conducted. The null hypothesis is a long-run relationship does not exist among the variables, while the alternative is a long-run relationship exists among the variables.

The hypothesis test is not similar to regular hypothesis testing rather it involves both upper and lower bounds of critical values and the test has three different cases. To be able to reject or fail to reject the null hypothesis, one has to consider the critical values tabulated in Pesaran et al. (2001). If the computed F-statistic is greater than the upper bound, the null hypothesis is rejected and the existence of a long-run (level) relationship between the variables regardless of the order of integration of the variables is evident (Duasa, 2007). If the F-statistic falls below the lower bound, the null hypothesis cannot be rejected and the presence of cointegration is not significant. Finally, if the F-statistic falls in between the upper and lower bound, the test is inconclusive and additional information is needed before a conclusion can be made (Pesaran et al. 2001). Null Hypothesis: No levels of relationship.

Table 4. *F-Bounds test*

Test Statistic	Value	Signif.	I (0)	I (1)
			Asymptotic: n=1000	
F-statistic	3.050553	10%	2.49	3.38
K	5	5%	2.81	3.76
		2.5%	3.11	4.13
		1%	3.5	4.63
Actual Sample Size	23		Finite Sample:	

	n=35	
10%	2.831	3.879
5%	3.353	4.5
1%	4.849	6.511
	Finite Sample: n=30	
10%	2.907	4.01
5%	3.504	4.743
1%	4.85	6.473

Source: Author's computation using Eviews 10 software

Table 4 shows ARDL bound test for cointegration. The model is specified in its original form where LOGISEC is the dependent variable and LOGCORP, LOGNTP, LOGINT, LOGEXC, and LOGINF are independent variables. The test shows that the F-statistic (3.050553) falls in between the lower and upper bound of the test, that is, it is inconclusive. However, according to Haq and Larsson (2016), when the test provides inconclusive results, a possible remedy can be to examine the error correction term following the work by Banerjee et al. (1998) and Kremers et al. (1992). Pahlavani et al. (2005) and Bahmani-Oskooee and Nasir (2004) used a negative and significant ECM term in a similar framework to motivate cointegration and long-run relationship under the inconclusive case.

Table 5

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	28.49689	NA*	0.006984	-2.142561	-1.844126	-2.077793
1	31.06798	3.428119	0.006075	-2.292188	-1.944014	-2.216626
2	33.86055	3.457466	0.005194*	-2.462909*	-2.064996*	-2.376552*
3	33.94678	0.098551	0.005773	-2.375884	-1.928231	-2.278731
4	33.94878	0.002100	0.006506	-2.280836	-1.783445	-2.172890

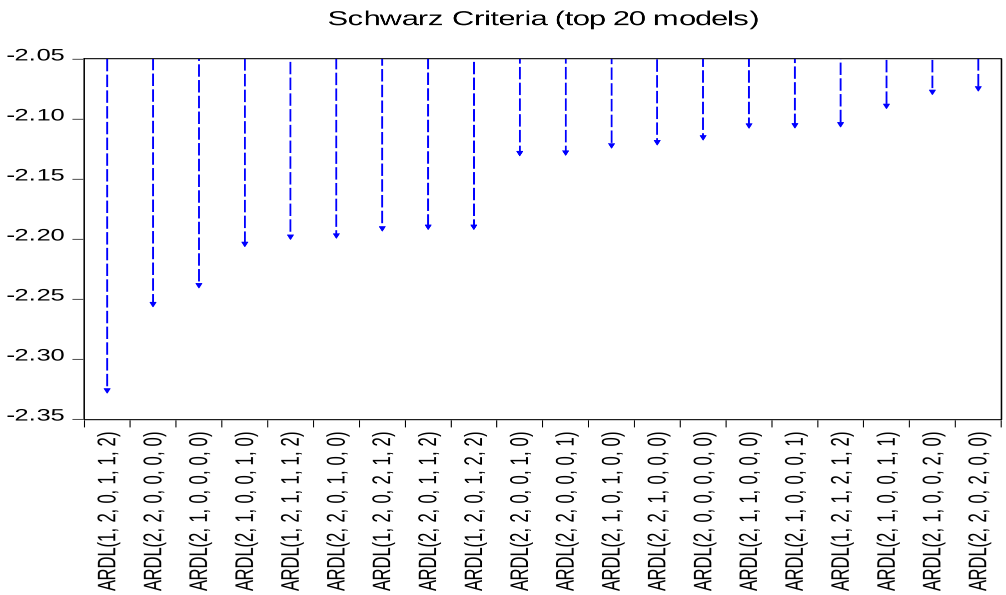
Source: Author's computation using Eviews 10 software

* Indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan–Quinn information criterion

Before estimating the long-run ARDL model, the optimal lag length for the vector error correction model was determined using six different selection criteria: Likelihood Ratio (LR), Final Prediction Error Criterion (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan–Quinn information criterion (HQ). The three criteria as shown in Table 5 (Hannan–Quinn information (HQ), Akaike information criteria (AIC), Schwarz information criterion (SC), and Final Prediction Error (FPE)) suggest an optimal lag length of two (2) and as a result the study employed this lag length in the long-run ARDL model selection. The model selection was based on the Schwarz information criterion (SC) because it provides slightly better estimates than the AIC criteria in small samples in the ARDL framework (Pesaran and Shin, 1998). The AIC criteria also tend to overestimate the number of lags to be included, which is not favorable in small samples as by increasing the lag the number of observations decreases. However, ordinary was selected in terms of the coefficient covariance matrix. There were no fixed regressors and the trend specification was restricted trend. After 486 models were evaluated, ARDL (1, 2, 0, 1, 1, 2) was selected as the most suitable model. Figure 1 displays the top 20 models from the 486 models evaluated by the Schwarz information criterion (SC). Table 6 shows the ARDL (1, 2, 0, 1, 1, 2) long-run estimates. The short-run dynamic parameters were obtained by estimating an error correction model associated with the long-run estimates. The result is presented in Table 7.

Figure 1. *Top 20 Models from Schwarz information criterion (SC)*



Source: Author's computation using Eviews 10 software

Table 6. *ARDL (1, 2, 0, 1, 1, 2) Long-Run Estimates*

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOGISEC (-1)	0.524438	0.215624	2.432184	0.0378
LOGCORP	-2.554220	4.204612	-0.607481	0.5585
LOGCORP (-1)	-13.57273	7.887902	-1.720702	0.1194
LOGCORP (-2)	-38.75564	10.57743	-3.663995	0.0052
LOGNTP	-0.197293	0.066924	-2.947991	0.0163
LOGINT	0.133264	0.049917	2.669721	0.0256
LOGINT (-1)	0.175416	0.051859	3.382532	0.0081
LOGEXC	-0.014804	0.116192	-0.127412	0.9014
LOGEXC (-1)	-0.424621	0.147314	-2.882421	0.0181
LOGINF	0.122042	0.052503	2.324492	0.0452
LOGINF (-1)	-0.162231	0.069668	-2.328613	0.0448
LOGINF (-2)	0.224202	0.074187	3.022128	0.0144
C	193.5409	66.34633	2.917130	0.0171
@TREND	0.018932	0.006827	2.773057	0.0216
R-squared	0.832524	Mean dependent var		4.023366
Adjusted R-squared	0.590614	S.D. dependent var		0.072761
S.E. of regression	0.046555	Akaike info criterion		-3.017237
Sum squared resid	0.019506	Schwarz criterion		-2.326066
Log-likelihood	48.69822	Hannan-Quinn criteria.		-2.843409
F-statistic	3.441465	Durbin-Watson stat		1.862403
Prob(F-statistic)	0.034854			

Source: Author's computation using Eviews 10 software

Table 7. *ARDL Error Correction Model Regression*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	193.5598	32.44482	5.965815	0.0002
D(LOGCORP)	-2.554220	1.760052	-1.451219	0.1807
D (LOGCORP (-1))	38.75564	5.883225	6.587483	0.0001
D(LOGINT)	0.133264	0.027132	4.911692	0.0008
D(LOGEXC)	-0.014804	0.054557	-0.271354	0.7922
D(LOGINF)	0.122042	0.026573	4.592778	0.0013
D (LOGINF (-1))	-0.224202	0.044420	-5.047367	0.0007
CointEq (-1) *	-0.475562	0.079716	-5.965717	0.0002
R-squared	0.786140	Mean dependent var		-0.000497
Adjusted R-squared	0.686339	S.D. dependent var		0.064389
S.E. of regression	0.036061	Akaike info criterion		-3.538976
Sum squared resid	0.019506	Schwarz criterion		-3.144021
Log-likelihood	48.69822	Hannan-Quinn criteria.		-3.439646
F-statistic	7.877068	Durbin-Watson stat		1.862403
Prob(F-statistic)	0.000437			

Source: Author's computation using Eviews 10 software

Table 7 shows the error correction estimates associated with the long-run estimates in Table 6. The coefficient on the lagged error-correction term (CointEq (-1) *) is both statistically significant and negative with probability value p = 0.0002 indicating significance at 1% level, which confirms cointegration among the variables and resolves the inconclusion from the bounds test concerning cointegration. In essence, the speed of adjustment implied by the coefficient of the lagged error-correction term (CointEq (-1) *) suggests that the deviation from the short run to the long run is corrected by -47.56% each year. Therefore, there is a stable long-run relationship between LOGISEC LOGCORP LOGNTP LOGINT LOGEXC, and LOGINF.

In addition, the estimated short-run model revealed that contrary to its negative significant long-run impact, 1 year-lagged value of corporate tax rate (LOGCORP) is the main contributor to shadow economy growth, followed by real interest rate (LOGINT) and inflation rate (LOGINF). Precisely, a 1 % increase in 1 year lagged value of corporate tax rate (LOGCORP (-1)) will cause the shadow economy to increase by 38.75564%, ceteris paribus. This shows that heavy corporate tax burdens exert a positive impact on the shadow economy. This impact is significant at a 1% significance level.

Some diagnostic tests were conducted on the residuals from the estimated equation. Figure 2 shows the normality test result. The reported probability is the probability that a Jarque–Bera statistic exceeds (in absolute value) the observed value under the null hypothesis – a small probability value leads to the rejection of the null hypothesis of a normal distribution. The probability value for the Jarque–Bera statistic is 0.651164 and it is >0.05. That means accepting the hypothesis of normal distribution of the variables at the 1%, 5%, and 10% significance levels.

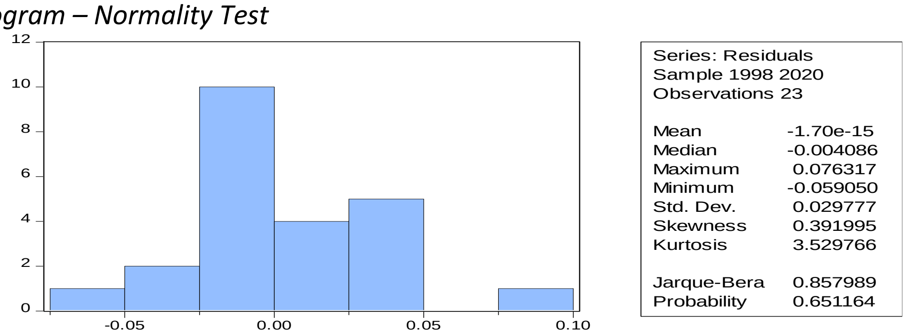
From Table 8, it is obvious that the probability Chi-Square (0.8772) is >0.05 at a 5% significant level. It can be concluded that the residual in the short-run ADRL model is not serially correlated. This is, also, confirmed by the correlogram, as shown in Table 9. Autocorrelations (AC) and partial autocorrelation (PAC) are within the two standard error bounds (the dotted lines), meaning that they are not significantly different from zero at the 5% significance level. Furthermore, the Q-statistics are insignificant at all lags (as shown by the probability values), indicating no serial correlation in the residuals. The result of Table 10 shows that the probability of the Obs*R-square (0.5256) is >0.05. Based on that, the null hypothesis of homoscedasticity or constant variance of the residual cannot be rejected. Similarly, the correlograms of the squared residuals were used to check autoregressive conditional heteroskedasticity (ARCH) in the residuals. The result in Table 11 shows that there is no ARCH in the residuals because the autocorrelations and partial autocorrelations are zero at all lags and the *Q*-statistics are all insignificant.

Table 12 shows that the probability value of the F-statistic (0.8708) is >0.05 indicating that the null hypothesis is not to be rejected at 0.05 levels. The bottom line is that the model estimated was correctly specified. Nevertheless, the model's residuals are serially uncorrelated, normally distributed, and homoscedastic. Therefore, the estimated set of results is devoid of the econometric problems of autocorrelation, misspecification, and heteroscedasticity.

To further assess the stability of the long-run and short-run coefficients, CUSUM and CUSUMSQ tests proposed by Brown et al. (1975) were conducted. The tests are based on the cumulative sum of the recursive residuals (CUSUM) and the cumulative sum of squared recursive residuals (CUSUMSQ) and are graphical whereby the residuals are updated recursively and are plotted against the breakpoints for the 5% significance line. According to Figure 3 (CUSUM), the model is reliable. The estimated plots from the model are within the critical boundaries of the 5% level. Consequently, the estimated coefficients show parameter stability and reliability. However, the CUSUM of Squares (Figure 4) test shows that the residuals significantly deviate from its mean value as it can be seen lying slightly outside the imposed parallel critical boundaries. This shows a structural break issue in the model.

Figure 5 represents the in-sample prediction values from the ARDL model. As seen in the figure, the predicted values follow the actual values during the entire period. For a few data points, the model underestimated or overestimated the actual values, but there are no very severe deviations or extremely large spikes. Figure 6 specifically shows the dynamic forecast for the dependent variable (i.e., shadow economy (LOGISEC) during the period 1996 through 2020). As can be seen, the shadow economy forecast or plot lies within the critical boundaries, with only a plus or minus 2 standard error points.

Figure 2. *Histogram – Normality Test*



Source: Author's computation/plot using Eviews 10 software

Table 8. *Breusch–Godfrey Serial Correlation LM Test*

F-statistic	0.040328	Prob. F (2,7)	0.9607
Obs*R-squared	0.261995	Prob. Chi-Square (2)	0.8772

Source: Author's computation using Eviews 10 software

Table 9. *Correlogram*

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat *	Prob
. | . |	. | . |	1	0.049	0.049	0.0622	0.803
. | . |	. | . |	2	-0.037	-0.039	0.0994	0.952
. *| . |	. *| . |	3	-0.091	-0.088	0.3401	0.952
. |* . |	. |* . |	4	0.095	0.103	0.6118	0.962

. *| . |	. *| . |	5	-0.122	-0.142	1.0896	0.955
.**| . |	.**| . |	6	-0.286	-0.283	3.8641	0.695
.**| . |	.**| . |	7	-0.262	-0.255	6.3358	0.501
. *| . |	.**| . |	8	-0.148	-0.242	7.1773	0.518
. |* . |	. | . |	9	0.077	-0.006	7.4202	0.593
. | . |	. | . |	10	0.057	0.018	7.5661	0.671
. | . |	. | . |	11	0.009	-0.062	7.5700	0.751
. | . |	. *| . |	12	0.034	-0.092	7.6316	0.813

Source: Author’s computation using Eviews 10 software

Table 10. *Heteroskedasticity Test: Breusch–Pagan–Godfrey*

F-statistic	0.758518	Prob. F (13,9)	0.6848
Obs*R-squared	12.02482	Prob. Chi-Square (13)	0.5256
Scaled explained SS	2.328939	Prob. Chi-Square (13)	0.9995

Source: Author’s computation using Eviews 10 software

Table 11. *Correlograms of Squared Residuals*

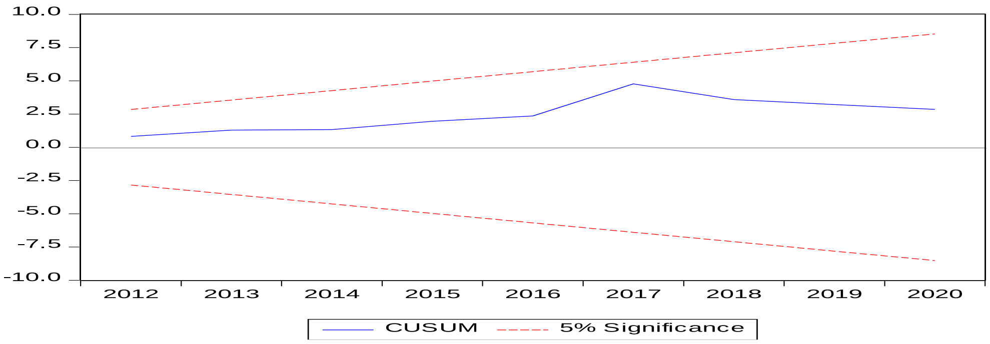
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. | . |	. | . |		0.022	0.022	0.0123	0.912
. | . |	. | . |		-0.049	-0.049	0.0769	0.962
. *| . |	. *| . |		-0.096	-0.094	0.3438	0.952
. *| . |	. *| . |		-0.148	-0.148	1.0038	0.909
. *| . |	. *| . |		-0.086	-0.095	1.2400	0.941
. *| . |	. *| . |		-0.123	-0.154	1.7481	0.941
. |* . |	. |* . |		0.116	0.078	2.2318	0.946
. |**. |	. |* . |		0.241	0.199	4.4571	0.814
. *| . |	. *| . |		-0.107	-0.156	4.9274	0.841
. | . |	. | . |	0	0.002	-0.003	4.9276	0.896
. *| . |	. *| . |	1	-0.106	-0.082	5.4610	0.907
. *| . |	. | . |	2	-0.083	-0.058	5.8208	0.925

Table 12. *Ramsey RESET Test*

	Value	df	Probability	
t-statistic	0.167901	8	0.8708	
F-statistic	0.028191	(1, 8)	0.8708	

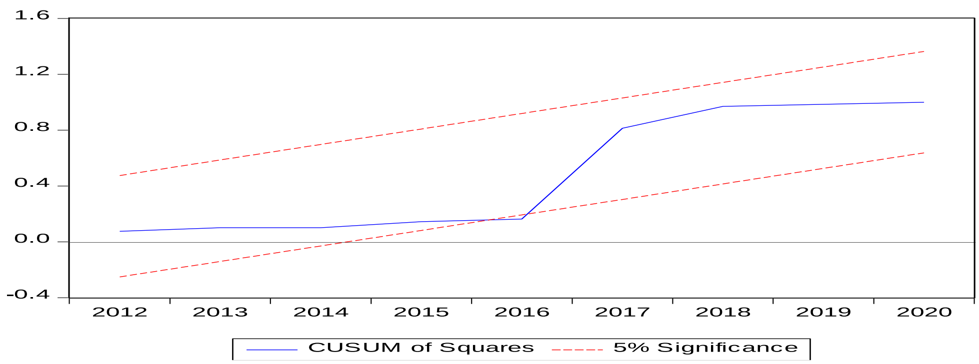
Source: Author's computation using Eviews 10 software

Figure 3. *Cumulative sum test of recursive residuals*



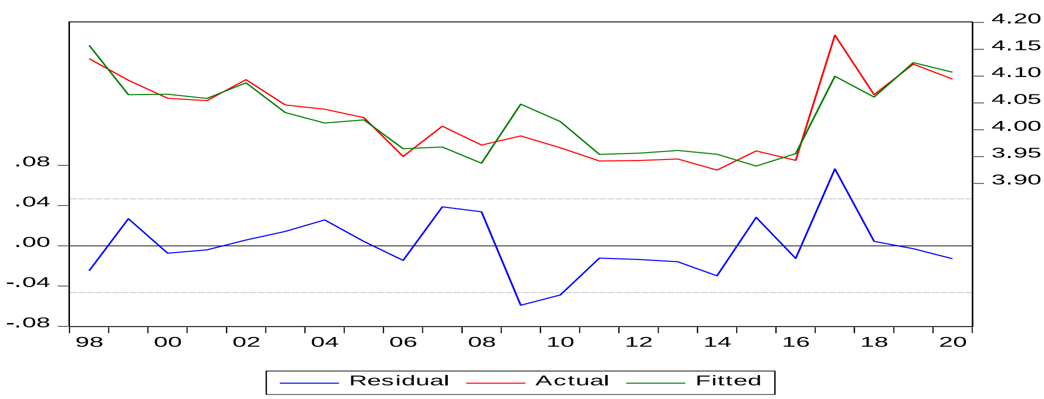
Source: Author's computation/plot using Eviews 10 software

Figure 4. *Cumulative sum of square stability test of recursive residuals*



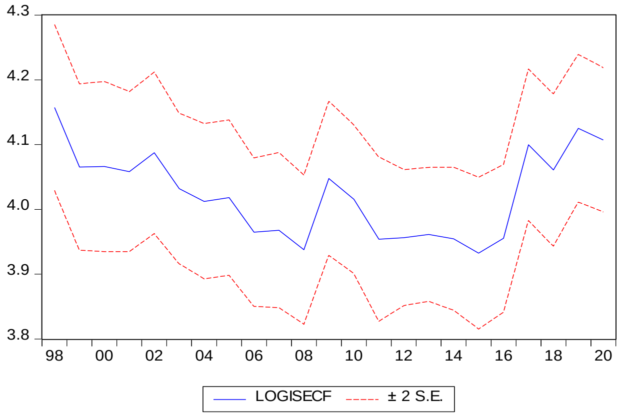
Source: Author's computation/plot using Eviews 10 software

Figure 5. *Actual, Fitted, and Residual Graph*



Source: Author's computation/plot using Eviews 10 software

Figure 6. *Dynamic Forecast for LOGISEC*



Forecast: LOGISECF	
Actual: LOGISEC	
Forecast sample: 1996 2020	
Adjusted sample: 1998 2020	
Included observations: 23	
Root Mean Squared Error	0.029122
Mean Absolute Error	0.022477
Mean Abs. Percent Error	0.558430
Theil Inequality Coefficient	0.003619
Bias Proportion	0.000000
Variance Proportion	0.045791
Covariance Proportion	0.954209
Theil U2 Coefficient	0.459351
Symmetric MAPE	0.558685

Source: Author's computation/plot using Eviews 10 software

4. Discussion

In Table 6, the regression coefficient of 1-year lagged value in respect of shadow economy (LOGISEC (-1)) in the long-run model is 0.524438 which is significant at a 5% significance level. This implies that if 1 year's lagged value of the shadow economy increased by 1%, the current year's shadow economy will increase by 0.524438%. This is in line with the International Monetary Fund report that indicated that the Nigerian informal economy grew at the rate of 8.5% between 2015 and 2017 and accounted for 65% of GDP. This figure had not changed much before the onset of the global pandemic in 2020 (Etim and Daramola, 2020).

Furthermore, Table 6 shows that a 1% increase in real interest rate (LOGINT) leads to about a 0.133264 increase in the shadow economy. It was found that the coefficient of LOGINT positively signs, indicating a positive relationship between real interest rate and shadow economy in Nigeria during 1996–2020, and this is in line with a priori expectation. This result is statistically significant at 5% with a p-value of 0.0256. This result is contrary to Ergene (2015) that reported that interest rate hurts both growth and the size of informal activities. Similarly, the estimated regression coefficient of 0.175416 demonstrates that if 1 year lagged value of the real interest rate (LOGINT (-1)) increased by 1%, the shadow economy will increase by 17.5%. This result can be attributed to the fact that the Interest rate has been remarkably high in Nigeria due to the high inflation rate. These high-interest rates stifle business growth and the development of the official economy, thus, leading to the growth of the shadow economy.

In addition, Table 6 shows that the corporate tax rate (LOGCORP) and 1-year lagged value of corporate tax (LOGCORP (-1) are not significant determinants of shadow economy even though their coefficient appeared negative but that 2 years lagged value of corporate tax rate (LOGCORP (-2)) inversely influence shadow economy significantly during the period of study. A similarly negative statistically significant relationship is depicted between LOGNTP and the shadow economy. These results are not in line with expectations and contrary to the study of Unver and Koyuncu, 2019. Although for several years, the Nigerian government has identified tax revenue as a source of funding. To this end, efforts have been made to grow the tax base and increase the number of compliant taxpayers while encouraging business growth and survival (Monye and Abang, 2020).

At present, the tax base mainly comprises companies in the formal sector which, arguably, has a fairly high level of compliance. In light of compliance, OECD (2022) reported that the highest share of tax revenues in Nigeria in 2019 was contributed by corporate income tax (46%). The second-highest share of tax revenues in 2019 was derived from value-added taxes (VAT) (14%), that is, taxes on products and services. This may explain the negative impact on the shadow economy as shown in this study. To further buttress this result, besides the compliance of companies concerning tax rates, the majority of people working for large companies have no opportunity to participate in the underground economy unless they quit their employment and set up an underground business (or set up a part-time business to supplement their salary income). Participation in the underground economy is rarely feasible for any business that is too large to be privately owned and run by family members.

Furthermore, a real effective exchange rate (LOGEXC) showed an inverse insignificant relationship with the shadow economy while 1 year-lagged value of a real effective exchange rate (LOGEXC (-1)) showed a significant negative impact on the shadow economy. This result is contrary to Edeme et al. (2020) that found that the exchange rate has a positive and significant effect on the informal economy in Nigeria. Furthermore, Tunji (2022) observed that Nigeria's exchange-rate management has resulted in the rise of parallel rates. Unable to access foreign exchange through the official exchange-rate window, businesses seek foreign exchange on the parallel market and other alternative sources.

Similarly, 1 year lagged value of the inflation rate (LOGINF (-1)) showed a statistically significant negative association with the shadow economy, while its 2-year lagged value (LOGINF (-2)) showed a positive statistically significant influence on the shadow economy just like the current year value of inflation rate (LOGINF). The positive signs on LOGINF (-2) and LOGINF confirm Koreshkova's (2006) result that the underground economy is positively associated with the inflation rate. However, given that LOGINF, LOGINF (-1), and LOGINF (-2) appeared to be statistically significant. This result is contrary to Ergene (2015) who found that Inflation does not have a significant effect on informality. Nevertheless, given the positive coefficient of inflation in this study, one plausible reason could be that Nigeria's inflation has been higher than the average for African and Sub-Saharan countries for years now, and even exceeded 16% in 2017 – and a real, significant decrease is nowhere in sight (O'Neill, 2021). The bigger problem is its unsteadiness; however, an inflation rate that is bouncing all over the place, like this one, is usually a sign of a struggling economy, causing prices to fluctuate, and unemployment and poverty to increase culminating in the growth of shadow economy because shadow economy serves as a buffer against unemployment, allowing an increasing share of the population to earn a livelihood from the informal sector rather than stay openly unemployed with no income.

Heavy corporate tax burdens exert a positive impact on the shadow economy. This result aligns with Klara (2009) and Unver and Koyuncu (2019) who found that tax burden indicators are found to have a statistically significant and positive impact on the shadow economy variable. This short-run result is contrary to the negative coefficient displayed by the current year value of corporate tax rate (LOGCORP) on the shadow economy in the short-run which implies that reducing the shadow economy is associated with higher corporate tax collections. Nevertheless, the inverse relationship was found to be statistically insignificant in the short run.

Similarly, real interest rate (LOGINT) has a positive significant short-run impact on the shadow economy at the 1% significance level. Specifically, a 1% increase in real interest rate will cause the shadow economy to increase by 0.133264 % approximately, ceteris paribus. This result is consistent with expectations and lends credence to a previous study by Horvath (2017).

Furthermore, the impact of the inflation rate (LOGINF) on shadow economy growth was found to be positive and statistically significant. This result is by Mazhar and Méon (2017). The significant impact probably could be attributed to the high inflation rate experienced in the country. For instance, in 2020, Nigeria recorded one of the highest inflation rates in the world at 12.9% (Sasu, 2022). According to the World Bank, Nigeria is projected to have one of the highest inflation rates globally and the seventh highest among Sub-Saharan African countries in 2022 (Tunji, 2022). According to the global financial institution, high inflation hampers the country's attempt to achieve economic recovery and erodes the purchasing power of most vulnerable households. The bank further highlighted the adverse effects of inflation on Nigeria, which include pushing eight million Nigerians into poverty, and the possible disruption of consumption, investment, and saving decisions, among other consequences (Tunji, 2022). This may further increase activities in the informal sector. However, 1 year-lagged value of the inflation rate (LOGINF) contrary reduces the shadow economy by 0.224202%. This negative relationship is statistically significant at a 1% significance level. This result could be attributed.

Finally, the result in Table 7 shows that a 1% increase in the real effective exchange rate (LOGEXC) has a 0.014804% short-run negative effect on the shadow economy in the short-run. The exchange rate policy in Nigeria, as observed by Sani (2006) has gone through many changes spanning two major regimes, namely, the fixed and flexible exchange rate regimes. The fixed exchange rate system was adopted between 1960 and 1985, while the flexible system has remained in use from 1986 till date, however, with a series of modifications. However, the result of this study shows that the real effective exchange rate is statistically insignificant in influencing the shadow economy in Nigeria over the period 1996 to 2020 that this study covered.

5. Conclusion

Tax is a compulsory contribution to state revenue, levied by the government on workers' income and business profits, or added to the cost of some goods, services, and transactions. One of the considerations that are all too often ignored in discussions of tax policy is the way; it affects the underground economy. This study empirically analyzes the relationship between tax burden and shadow economy level in Nigeria. It specifically evaluates the effect of CORP and net taxes on the product on shadow economy growth during the period 1996–2020. It employed augmented Dickey–Fuller (ADF), and Phillips and Perron tests to check for unit root. Autoregressive Distributed Lag (ARDL) bound test approach to check for the long-run relationship among the variables employed. Autoregressive Distributed Lag was employed to determine the short- and long-run effects. Finally, the regression model was subjected to post-test evaluation to test the validity of the estimated result.

The result shows that LOGCORP (-2), LOGNTP, LOGINT, LOGINT (-1), LOGEXC (-1), LOGINF, LOGINF (-1), and LOGINF (-2) are statistically significant influencing shadow economy in the long run. However, LOGCORP (-2), LOGNTP, LOGEXC (-1), and LOGINF (-1) showed negative effects on the shadow economy, while LOGINT, LOGINT (-1), and LOGINF showed a positive relationship with the shadow economy. The short-run results revealed LOGCORP (-1), LOGINT, and LOGINF positively and significantly influenced the shadow economy, while LOGINF (-1) showed an inverse relationship with the shadow economy. The speed of adjustment implied by the coefficient of the lagged error-correction term (CointEq (-11) * suggests that the deviation from the short run to the long run is corrected by -47.56% each year.

In sum, the findings of this study show that corporate tax rates and NTP induced much less shadow economy in the long-run while CORPs have a positive impact on shadow economy in the short run. If there is a major risk that a tax change being contemplated will push people into the shadow economy, then this should be a factor in setting tax policy. Invariably, an optimal tax rate may be realized when the shadow economy is taken into consideration. As such:

- Government should ensure that the tax system is based on comprehensive and up-to-date statistical information so that accurate forecasting is made possible for it to be certain of its revenue. The tax system should not be a mere leap in the dark. Its effects should be calculable with reasonable precision. Furthermore, the tax system, as a whole, should be convenient, that is, felt as little as possible. Similarly, the tax system should have to pay due regard to how each kind of tax change influences participation in the underground economy. In that regard, the government should take steps to reduce the tax burden on Nigerians, especially corporate income and taxes on products, in an attempt to boost the ease of doing business. This can be done by removing obsolete, ambiguous, and contradictory provisions in the tax laws. In terms of administration, the tax system should be simple to administer. There should be little scope for evasion. The tax system – should also be simple, financially adequate, and elastic so that it can respond to the new needs of the government.

- Critical reforms are needed to reduce inflation in Nigeria by implementing policies that support macroeconomic stability, inclusive growth, and job creation. Furthermore, Nigeria's high-interest regime reflects not only the cost of capital but also the cost of doing business in the country. To achieve a drop in lending rates, the government must tackle the aspects of lending rates that reflect the high cost of doing business in Nigeria.

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