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MODELING NIGERIAN GOVERNMENT EXPENDITURE, REVENUE AND ECONOMIC GROWTH: CO-INTEGRATION, ERROR CORRECTION MECHANISM AND COMBINED ESTIMATORS ANALYSIS APPROACH

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ABSTRACT

Nigeria's Economic growth has been one of the topical issues attracting several attentions in the recent time. This paper therefore seeks to model and investigate the impact of capital expenditure, recurrent expenditure and various sources of Government revenue on Nigeria's economic growth using secondary data gathered from Central Bank of Nigeria's publication from 1981 to 2011. The statistical and econometric tools used for the study include the unit root test, cointegration, error correction mechanism and combined estimators' analysis. Results reveal that the variables are not stationary in their original form but do in their first difference. The long-run relationship of economic growth (Gross Domestic Product (GDP)) on capital expenditure, recurrent expenditure, oil revenue, non-oil revenue, federation account and federal retained revenue reveal the existence of co-integration and multicollinearity problem among the variables. The use of Principal Component Estimator to correct for multicollinearity reveals positive effect of capital expenditure, recurrent expenditure, oil revenue and federal retained revenue on economic growth. The short-run modeling exhibits both problem of both multicollinearity and autocorrelation which were corrected using the combined estimators. Resulting from the analysis is positive impact of capital expenditure, oil revenue, federation account and federal retained revenue on economic growth. Consequently, the study recommends a re-evaluation and re-assessment of direction of recurrent expenditure and non-oil revenue towards Nigerian development to achieve positive influence on economic growth.

Keywords: Unit root test, Principal component estimator, Co-integration test, Error correction mechanism, Combined estimators.

JEL Classification: C22.

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Contribution/ Originality

This study uses new estimation methodology called Combined Estimators. These Estimators are obtained by combining Cochrane Estimator and Maximum Likelihood Estimator with principal components method respectively to jointly handle the problem of multicollinearity and Autocorrelation.

1. INTRODUCTION

Economic growth can be viewed as the ability of an economy to improve its production of goods and services over a period of time using the factor of production within the economy (Popkova *et al.*, 2008). Nigeria's economic growth has been unstable, remained unpredictable and unsatisfactory low over the years especially when compared with other nations (Machi, 2011; Audu, 2012). Consequently, the economic has witnessed many shocks and disturbances both internally and externally over the decades (Audu, 2012).

Government capital expenditure is the expenditure incurred by government on certain projects in order to improve and promote easy of living and comfortability of its citizen for a long period of time, usually more than one year. Examples include expenditures incurred on building of new hospitals, roads, electricity etc. Recurrent expenditure is basically recurring expenditure on wages and salary, and items that are consumables which include stationeries, drugs for health services, etc. They only last for a short period of time.

Over the years, Nigerians have been facing problems as regards Government expenditures in that there has been a steady increase in government spending without an appreciable increase in economic growth and development. Despite the huge amount of public expenditures, there is still insignificant level of development witnessed in the country (Mobede *et al.*, 2012). This problem is traceable to how fund is sought for to meet up with capital expenditure, how it is managed and disseminated to pressing capital projects, how it is monitored to ensure execution of capital projects, etc. These problems most of the time brings to questioning the activeness and the overall performance of the government from regime to regime, tenure to tenure.

Baro (1990), in a study on government expenditure with a simple growth model, investigated the relationship between size of government and rate of growth and saving, and found a positive and significant relationship between the variables. He concluded that government expenditure should be tailored towards productive services. In a latter study with increased number of observations and slight modification, the results reveal that government budgetary activity exerts influences on economic growth through examination of ECM which provided discrepancy between the short-run and long-run. Easterly and Rebelo (1993) studied the impact of government expenditure and income on Gross Domestic Product using regression analysis and found that government activities influence the direction of economic growth in Nigeria. The significant effects of both government capital and recurrent expenditure on economic growth were underscored in the work of Brons *et al.* (1999). Dar Atul and AmirKhalkhali (2002) conducted investigation on the endogenous growth model of fiscal policy and concluded that the endogenous growth model of fiscal policy (government expenditure and income) is very crucial in predicting future economic

growth. Ogbulu (2009) in a further research established the relationship between budgetary operation and economic growth with the application of regression analysis. In his study, Gross Domestic Product GDP was regressed on six-predictor variables including Oil Revenue, Non-Oil Revenue, Administrative Expenditure, Economic Expenditure, Social Expenditure and Transfer Expenditure of period each spanning thirty-seven years. In his findings, from the error correction approach, he discovered that the inability of oil revenue (though it seems to dominate the economy) to strongly cause an increase in the output level of GDP in the short-run is occasioned by the fact that most equipment, technology, fund and even expert man power used in the oil sector are imported. As such, the home economy where these things are imported from feels the positive impact of the oil activities in Nigeria than the Nigeria economy. The revenue accruing to these imported equipment, technology, fund and expert manpower helps to boost the national income of their home countries and do not positively help in the growth of the gross domestic product in Nigeria. The problem to be examined in this research paper is on the effect of all the different sources of government revenue and Government expenditure on the economic growth of Nigeria using data sourced from Central Bank of Nigeria Bulletin for a period of thirty (30) years.

2. METHODOLOGY

Nigeria is one of the major counties in Africa with great human and material resources that can guarantee sustainable economic growth and development. The country land mass is 923, 773km^2 with a population of over 160 million people of diverse cultural background. The major economic activities of the country include agriculture and industrialization. Crude oil is a key source of revenue to the Government. Secondary data on Gross Domestic Product (GDP), Government capital and recurrent expenditure, and different sources of Government revenue which are Oil-Revenue, Non-oil Revenue, Federation Account and Federal retained Revenue were extracted from the publication of Central Bank of Nigeria for the year 1981 to 2011. The methodology adopted in this study is that of linear regression model in which GDP (a measure of economic growth) is seen as a function of Government expenditure and the different sources of revenue. Thus, the model is of the form:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6) + u \qquad (1)$$

Where Y= Gross Domestic Product, X_1 = Capital Expenditure,

X_2 = Recurrent Expenditure, X_3 = Oil Revenue,

X_4 = Non-oil Revenue, X_5 = Federation Account,

X_6 = Federal Retained Revenue, u= stochastic error term

Then, the linear econometric model is then of the form:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \beta_5 X_{5t} + \beta_6 X_{6t} + u_t, t = 1,2,...30 \quad (2)$$

In order to carry out the modeling, it becomes very imperative to examine the stationary status of the variables because they are all time series data. The method used is Augmented Dickey-Fuller (ADF) proposed by Dickey and Fuller (1979). The methodology further adopted the technique of cointegration regression developed by Engle and Granger (1987) to study and examine the long-term, or equilibrium, relationship among the variables in the model. The error correction mechanism first used by Sargan (1984) and later popularized by Engle and Granger (1987) was also used to correct for disequilibrium in order to describe both the short-run and the long-run equilibrium relationship of the model. Various assumptions underlying the validity of the model are also examined.

3. RESULTS AND DISCUSSION

3.1. Descriptive Analysis

Figure 1 shows the graphical representation of Nigeria's economic growth over the years. It shows a steady increase as year increases. This becomes more noticeable as from 1995. The graphical representation of all other variables is also shown in Figure 2. From figure 2, it is observed that the trend of variable has not been stable over time. Revenue generated from oil seems to be the highest while amount spend through recurrent expenditure is least.

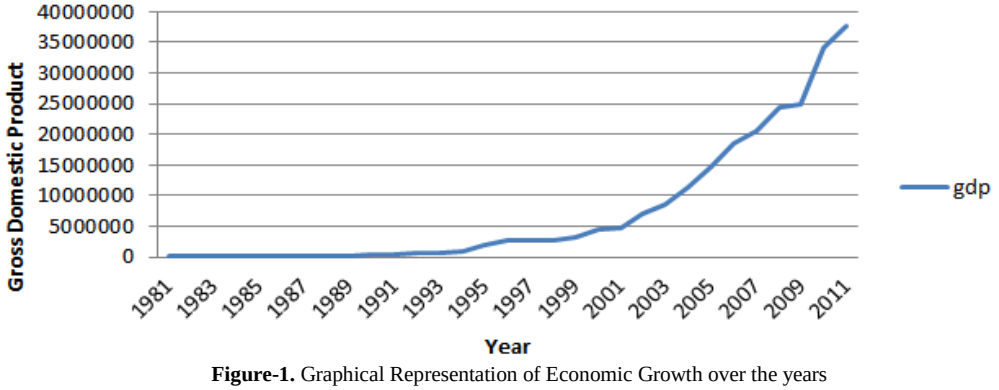

Figure-1. Graphical Representation of Economic Growth over the years

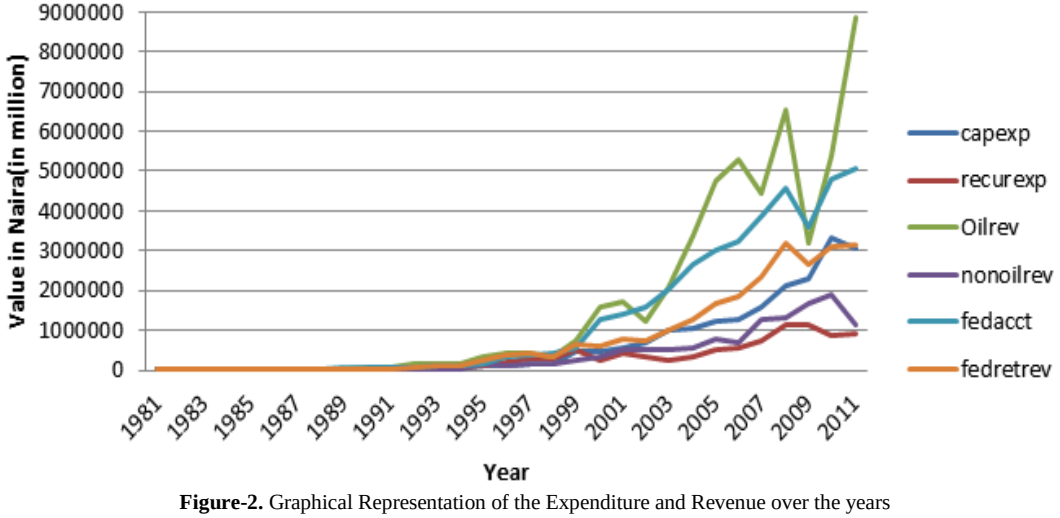

Figure-2. Graphical Representation of the Expenditure and Revenue over the years

3.2. The Unit Root Tests

Table 1 shows the results of the Unit Root Tests on both the original and the first difference of the original data of all the variables at lag 0.

Table-1. Summary of the Unit Root Stationary Tests Using Augmented Dickey-Fuller (ADF) Statistic at lag zero.

Variable Status	Variable Name	Variable	Statistics	RWOC	RWC	RWCT
Original	Gross Domestic Product	Y	Value P-value	7.50163 (1.000)	5.64095 (1.000)	2.05207 (1.000)
	Current Expenditure	X_1	Value P-value	3.36163 (0.9995)	2.21982 (0.9999)	-0.12422 (0.9919)
	Recurrent Expenditure	X_2	Value P-value	0.627299 (0.8463)	-0.285941 (0.9158)	-2.21186 (0.4663)
	Oil Revenue	X_3	Value P-value	1.33035 (0.9503)	0.598127 (0.9873)	-1.41098 (0.8369)
	Non-Oil Revenue	X_4	Value P-value	0.046755 (0.69)	-0.656969 (0.8427)	-2.17575 (0.4851)
	Federal Allocation	X_5	Value P-value	2.87557 (0.9984)	1.62968 (0.9993)	-0.924956 (0.9397)
	Federal Rent Revenue	X_6	Value P-value	2.46704 (0.9956)	1.30863 (0.9981)	-1.03134 (0.9241)
1^{st} Difference	Gross Domestic Product	ΔY	Value P-value	-2.52845 (0.0134)**	-3.32846 (0.02269)**	-6.11596 (0.0001266)***
	Current Expenditure	ΔX_1	Value P-value	-4.34865 (9.425e-005)***	-5.19294 (0.0001)***	-8.12312 (2.851e-007)***
	Recurrent Expenditure	ΔX_2	Value P-value	-5.3146 (4.982e-006)***	-5.57038 (7.987e-005)***	-5.61764 (0.0004295)***
	Oil Revenue	ΔX_3	Value P-value	-5.32659 (4.796e-006)***	-5.70997 (5.555e-005)***	-6.22738 (9.569e-005)***
	Non-Oil Revenue	ΔX_4	Value P-value	-4.41367 (7.785e-005)***	-4.66973 (0.0008374)***	-4.77124 (0.003375)***
	Federal Allocation	ΔX_5	Value P-value	-5.14353 (8.53e-006)***	-6.37164 (1.032e-005)***	-8.43357 (7.578e-008)***
	Federal Rent Revenue	ΔX_6	Value P-value	-5.35365 (4.401e-006)***	-6.44848 (8.536e-006)***	-8.11985 (2.889e-007)***

Source: Computer output
Notes:
RWOC = Random Walk Model without Constant,
RWC = Random Walk Model With Constant,
RWCT = Random Walk Model With Constant and linear trend.
* and *** indicate stationarity at 10% and 1% level of significance respectively.

From Table 1, it can be seen that the original variables examined under different types of random walk models are not stationary but their first difference are stationary. Thus, they are all of integrated order 1, I (1).

3.3. Cointegrating Regression

The cointegration linear regression model of all the variables is done and the stationarity status of their residuals was examined using Engle Granger Statistic so as to study the long term relationship of the variables. The results are shown in Table 2.

Table-2. Results of the cointegrating regression of the variables

Variable / Statistic	OLS Estimator		VIF	Estimate of Preferred Principal Component Estimator [PC1234]
	Estimate	Standard Error		
Constant	-84954.8	275739		-189522.25811
X_1	7.96019 (8.93e-07 ***)	1.21506	32.711	8.78810
X_2	-2.04719 (0.5049)	3.02418	28.462	0.11096
X_3	1.48084 (0.0828*)	0.818144	96.275	1.04093
X_4	1.21838 (0.7386)	3.60908	96.057	-0.98143
X_5	-1.90353 (0.1793)	1.37591	136.332	-0.50415
X_6	2.94361 (0.3132)	2.85740	232.069	1.35784
Standard Error of Regression	1084766			0.098548
DW	2.427182 (0.709776)			**1.86448** (<0.548)
Jarque-Bera Test	0.337745 (0.844617)			0.407643 (0.816)
LM Het. test	4.51618 (0.034)**			0.062317 (0.803)
Schwarz B.I.C.	965.6844			**-23.1199**
R2 Adjusted	0.989669			0.99029
Stationary of Residual	-6.76773 (0.006884)			-5.02747 (1.114e-005)

Source: Computer output

From Table 2, it can be seen that despite the non-stationarity of each of the variables, the results of the regression analysis reveal the existence of cointegration or long term or equilibrium relationship among the variables in that the residual of the linear regression model whose parameters were estimated using the OLS estimator is stationary. The Engle Granger test statistic value (-6.76773) is significant (P-value < 0.01).

Hence, the estimated linear regression equation (using the OLS estimator) shown in Table 2 is a cointegrating regression and this regression is not spurious. Moreover, it suffers multicollinearity problem in that the VIF statistic is greater than 10 (VIF>10) and also suffers heteroscedacity problem (LM Het. Test = 4.51618, Pvalue<0.05). The Principal Component Estimator was used to solve the problem of multicollinearity.

The results are shown in Table 6 of the Appendix. Moreover, the preferred estimates are that of PC1234 estimator using the minimum Schwarz B.I.C. criterion. These are also shown in Table 2. The model does not suffer any problem again. Hence, the estimated cointegrating regression equation is of the form:

$$\hat{Y}_t = -189522.26 + 8.79X_{1t} + 0.11X_{2t} + 1.04X_{3t} - 0.98X_{4t} - 0.50X_{5t} + 1.35784X_{6t} \quad (3)$$

Consequently, there is positive effect of capital expenditure, recurrent expenditure, oil revenue and federal retained revenue on economic growth.

3.4. The Short Run Relationship

In the short run there may be disequilibrium. Hence, the error term in (3) was treated as "equilibrium error" and used to tie the short run behavior of GDP to its long–run value and so expressed the relationship among the variables as Error Correction Mechanism (ECM). However, that error term due to that of the OLS estimator was also used. The results of the estimation were presented in Table 4.

From Table 4, the estimation of the OLS and that of PC1234 reveals the model suffers both multicollinearity and autocorrelation problem.

The autocorrelation problem is still very evident even after the estimation has been improved upon by using the Principal Component Analysis as done early. Table 7 in the Appendix provides the results and how PC12345 estimator is preferred based on Schwarz B.I.C.criterion.

The joint existence of both the multicollinearity and autocorrelation necessitated the use of combined estimators proposed by Ayinde and Lukman (2013). The results of the combined estimators of Principal Component Analysis with Cochrane Occult and Maximum Likelihood Estimator are given in Table 5.

Table-4. Results of the short run regression of various estimators of the model

	OLS Residual			PC1234 Residual		
Variable/ Statistics	OLS Estimate	VIF	Estimate of Preferred Principal Component Estimator [PC12345]	OLS Estimate	VIF	Estimate of Preferred Principal Component Estimator [PC12 456]
Constant	126392 (0.526)		202267.11689	189844 (0.381)		318596.796
ΔX_1	7.93522 (0.000)***	3.480	7.13596	8.1856 (0.000)***	3.512	6.97032
ΔX_2	1.92664 (0.507)	5.359	-0.73698	3.11668 (0.321)	5.167	-1.14211
ΔX_3	0.219818 (0.669)	13.813	0.56781	0.176881 (0.756)	14.106	0.54135
ΔX_4	-3.22437 (0.141)	7.867	-1.59524	-3.65094 (0.133)	8.079	-1.80606
ΔX_5	2.15584 (0.163)	12.582	0.43713	2.62101 (0.120)	12.306	0.16533
ΔX_6	-0.763023 (0.780)	18.464	1.24940	-2.32748 (0.421)	17.067	1.11557
ECM_{t-1}	-0.800616 (0.002)***	2.085	-0.87381	-0.566978 (0.018)**	1.743	-0.65532
Standard Error of Regression	819767		0.400669	897854		0.449955
DW	0.956567 (0.000824)***		1.08319 (<0.05)	0.913314 (0.00046)***		1.15021 (<0.051)
Jarque-Bera Test	0.412267 (0.814)		0.920522 (0.631119)	1.19058 (0.551)		1.01250 (0.603)
LM Het. test	0.214576 (0.643)		0.315557E-03 (0.986)	0.059906 (0.807)		0.387352E-02 (0.950)
Schwarz B.I.C.	460.024		20.8978	462.754		24.3781
R2 Adjusted	0.82886		0.83946	0.794703		0.79754

Source: Computer output

Table-5. Results of estimation of the short run regression model with combined estimators.

Variable/ Statistics	PC1234 Residual			PC1234 Residual		
	CORC Estimate	VIF	Estimate of Preferred Principal Component Estimator [CORCPC12345]	ML Estimate	VIF	Estimate of Preferred Principal Component Estimator [MLPC12345]
Constant	607933 (0.291)		492754.06472	457298 (0.262)		486559.5384
ΔX_1	6.4643 (0.000)***	3.512	5.01393	6.55154 (0.000)***	3.512	5.05434
ΔX_2	0.354933 (0.834)	5.167	-2.67132	0.499723 (0.767)	5.167	-2.63585
ΔX_3	0.052892 (0.861)	14.106	0.45820	0.058464 (0.845)	14.106	0.46140
ΔX_4	-3.05127 (0.004)***	8.079	-0.95375	-3.09282 (0.004)***	8.079	-0.96584
ΔX_5	2.52292 (0.001)***	12.306	0.72942	2.56118 (0.000)***	12.306	0.72490
ΔX_6	-1.31944 (0.509)	17.067	0.80321	-1.42666 (0.468)	17.067	0.81254
ECM_{t-1}	-0.597965 (0.003)***	1.743	-0.67545	-0.602341 (0.002)***	1.743	-0.68486
RHO	0.807891 (0.000)***		0.793225	0.776201 (0.000)***		0.766833 (0.000)
Standard Error of Regression	647721		0.340296	638043		0.335458
DW	1.37421		1.75178	1.31735		1.68403
Jarque-Bera Test	1.7783 (0.411006)		1.86776 (0.393026)	2.17522 (0.337022)		1.35681 (0.507426)
Schwarz B.I.C.	438.97		16.6297	453.836		16.9911
R2 Adjusted	0.92772		0.89061	0.900503		0.89185

Source: Computer output

From Table 5, it can be seen that having dealt with the two problems the estimation provided by COCRPC1234 is slightly better than that of MLPC1234, and so can be referred to the short run regression model. The equilibrium error is negative as expected and statistically non-zero, suggesting that GCE may not adjust to changes in the variables in the same time period.

Thus, if GDP (economic growth) is above its equilibrium value, it will start to fall to fall at the next period to correct the equilibrium error. Thus, the short run regression equation is of the form:

$$\hat{\Delta Y}_t = 492754.06 + 5.01\Delta X_{1t} - 2.67\Delta X_{2t} + 0.46\Delta X_{3t} - 0.95\Delta X_{4t} + 0.73\Delta X_{5t} + 0.8\Delta X_{6t} - 0.67545ECM_{t-1} + 0.79u_{t-1} \quad (4)$$

Consequently, the impact of capital expenditure, oil revenue, federation account and federal retained revenue is positive on economic growth on the short run modeling.

4. CONCLUSION

Having collected and analyzed the data on yearly expenditure, revenue generated from major sources and Gross Domestic Product of Nigeria, it has been observed there exist positive effect of capital expenditure, recurrent expenditure, oil revenue and federal retained revenue on economic growth on long run model assessment while the impact of capital expenditure, oil revenue, federation account and federal retained revenue on economic growth on the short run. Consequently, the study recommends a re-evaluation and re-assessment of direction of recurrent expenditure and non-oil revenue towards Nigerian development to achieve positive influence on economic growth.

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APPENDIX

Table-6. Summary of result of the Principal Component Estimator of the long run model.

Variable / Statistic	Principal Component Estimator					
	PC1	**PC12**	**PC123**	**PC1234**	**PC12345**	**PC123456**
Constant	-725062.604	-609968.62451	-245453.98687	-189522.25811	-83699.09387	-84954.78335
X_1	1.94078	1.92821	3.79368	8.78810	7.99394	7.96020
X_2	5.05343	2.76006	-3.97004	0.11096	-2.32121	-2.04719
X_3	0.73602	1.26737	0.97237	1.04093	1.32972	1.48084
X_4	3.32223	1.77637	4.22612	-0.98143	0.59788	1.21838
X_5	1.08651	1.32355	1.49326	-0.50415	-1.75061	-1.90353
X_6	1.74317	1.73678	1.40496	1.35784	3.38952	2.94361
Standard Error of Regression	0.17991	0.168029	0.142999	0.098548	0.097732	.099586
DW	0.80253 (<0.001)	.851209 (<0.001)	0.959851 (<0.005)	1.86448 (<0.548)	2.43143 (<0.970)	2.42718 (<0.980)
Jarque-Bera test	14.9606 (0.001)	2.47272 (0.290)	2.73240 (0.255)	0.407643 (0.816)	0.447315 (0.800)	0.337746 (0.845)
LM Het. test	15.3442 (0.000)	20.1679 (0.000)	7.99868 (0.005)	0.062317 (0.803)	1.55902 (0.212)	1.42506 (0.233)
Schwarz B.I.C.	-7.97852	-8.90479	-12.7319	-23.1199	-22.2456	-20.5539
R2 Adjusted	0.96763	0.97177	0.97955	0.99029	0.99045	0.99008

Table-3. Summary of results of the short run relationship with OLS and Combined Estimators of the short run model

OLS RESIDUAL							
OLS	PC1	PC12	PC123	PC1234	PC12345	PC123456	PC12345(
460.024	35.7218	36.1052	30.8095	29.2180	20.8978	22.5514	23.3409
PC1234 RESIDUAL							
OLS	PC1	PC12	PC123	PC1234	C12345	PC123456	PC12345(
462.754	35.1365	35.3288	29.7766	30.6334	24.3781	26.0285	26.0706
PC1234 RESIDUAL							
CORC	CORC PC1	CORC PC12	CORC PC123	CORC PC1234	CORC PC12345	CORC PC123456	CORC PC12345(
438.97	32.8357	32.61	20.8538	22.0714	16.6297	18.0880	16.9025
PC1234 RESIDUAL							
ML	ML PC1	ML PC12	ML PC123	ML PC1234	ML C12345	ML PC123456	ML PC12345(
453.836	33.666	33.4243	21.5317	22.6801	16.9911	18.4827	17.1814