

## **Exploratory Analysis of Some Sectors of the Economy: A Seemingly Unrelated Regression Approach**

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**Abstract.** The low performance in output of various sectors of Nigeria has been attributed to problems facing each sector such as inadequate capital. This study examined the impact of bank lending and some other economic determinant on economic growth in Nigeria for the period of 1981 - 2017. Data were sourced online from Central Bank of Nigeria. Seemingly Unrelated Regression Model was adopted to simultaneously determine factors that contribute significantly to the dependent variables. Bank lending had positive significant impact on agriculture, services and industrial sector.

**Key words:** Bank Lending, Nigeria Economic Sectors, Exchange rate, Money Supply, Credit to Private Sector, Seemingly Unrelated Regression (SUR)

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**Résumé** (Abstract in French) La faible performance de la production de divers secteurs du Nigéria a été attribuée aux problèmes auxquels chaque secteur est confronté en termes de capitaux insuffisants. Cette étude a examiné l'impact des prêts bancaires et d'autres facteurs économiques déterminant sur la croissance économique du Nigéria pour la période 1981 - 2017. Les données ont été obtenues en ligne auprès du site de la Banque centrale du Nigéria. Un modèle de régression apparemment non apparenté a été adopté pour déterminer simultanément les facteurs qui contribuent de manière significative aux variables dépendantes. Les prêts bancaires ont eu un impact significatif positif sur l'agriculture, les services et le secteur industriel. .

### 1. Introduction

In two decades, Nigeria has made remarkable progress in socio-economic term, although the country continues to face massive developmental challenges, which include insufficient infrastructure, public financial management and poor living conditions of the population [World Bank \(2019\)](#).

According to Census and Economic Information Centre(CEIC) reports, nominal Gross Domestic Product of Nigeria reached 100.6USD billion in June 2018 [CEIC \(2019\)](#). Domestic credit provided by banking sector in Nigeria was reported at 26.56% in 2016 according to the World Bank collection of development indicators. To ensure sustainability in the growth of Nigeria economy, the Central Bank of Nigeria (CBN) has gone beyond its primary mandate of maintaining monetary, price and financial system stability to directly support key sectors that are drivers of economic growth [CBN \(2018\)](#).

[Isola et.al \(2016\)](#) empirical results reported that exchange rate fluctuation has no effect on economic growth in the long run through a short run relationship, then suggested that the Central bank of Nigeria should control policies of foreign exchange for appropriate determination of exchange rate value. The inter-relationship between money supply and economic growth has received more attention than other issues of monetary economics [Ogunmuyiwa and Francis \(2010\)](#). Claims from different monetarists is that the changes in the amount of money lead to unexpected changes in nominal income because of money stability [Freedman \(1969\)](#). Several studies confirmed the significance of money supply and economic growth in Nigeria. The financial development affects growth by reducing the inequality through the process of human capital accumulation [Papaioannou \(2007\)](#)

[Edirisuriya \(2008\)](#) opined that financial sectors are expected to promote a more efficient allocation of resources and ensure efficient financial intermediation. The banking sector occupies a vital position in the stability of the Nation's economy which plays an essential role in fund mobilization, credit allocation, payment and settlement system as well as monetary policy implementation. Financial system plays important role to boost the efficiency of intermediation through reduction

of information, transaction and monetary costs [Adekunle et.al \(2013\)](#). In the context of developing countries, the importance of credit in economic development cannot be over-emphasized. Businesses need access to credit for private sector to develop and flourish, the Central bank of Nigeria (CBN) recognises that for the country economy to function efficiently.

Activities of the bank has been of immense support to the development of Nigeria economy through credit facilities offered to various sectors [Ugoani \(2013\)](#). Insufficient funding following a decline in the total loan granted by the Nigerian bank has been a major issue to Nigeria's private sector. Unease to lend from Deposit Money Bank (DMB), lack of long term financing and high interest rate are some of the greatest challenges facing the manufacturing sector in the country [NAN \(2019\)](#).

Various sectors have become an essential feature in economic growth process in Nigeria. In this paper we examined the impact of bank lending and some economic determinants (such as interest rate, exchange rate, inflation, money supply and credit to private sector) on some sectors of Nigerian economy (Agriculture, Industry, Services and Real Estate Sector). The rest of the paper is organised as follows: In Section 2, literature review, Methodology are presented in Section 3, Data presentation and Analysis in Section 4 , while Section 5 provides discussion of results, Section 6 presents some concluding remarks.

## 2. Literature Review

[Agbanike et.al \(2018\)](#) examined the impact of bank lending on economic growth, specifically to ascertain whether different sectors level bank lending impact on Nigeria's economic growth differently. Seemingly Unrelated Regression (SUR) equations model consisting of five systems of equations was adopted. Empirical result of their findings reported that bank lending to agriculture, industry, real estate and construction and commercial sectors has exerted significant positive impact on economic growth real gross domestic product of the respective sectors. Their study provided evidence that sector level bank lending impact on Nigeria economic growth differently. Bank lending to agriculture has the highest impact, followed by commercial sector, then industrial sector and real estate and construction, where bank lending does not have any significant impact on economic growth in the service sector.

With the use of error correction model, [Adebiyi and Dauda \(2009\)](#) reported that trade liberalization promote growth in the Nigerian industrial sector. [Obansa et.al \(2013\)](#) investigated the relationship between exchange rate and economic growth in Nigeria. Results of their findings revealed that exchange rate has a strong impact and its liberalization was good to the economic growth. [Akinwale \(2018\)](#) examined the relationship between bank lending and economic growth in Nigeria between 1980 to 2016. The study adopted Dynamic Ordinary Least Estimation techniques for data analysis. Results from the cointegration analysis showed a long relationship among the variables. Findings of Greenwood and Jovanovic hy-

pothesis established in the study reported that as bank lending rate decreased, the economic growth tend to increase. He recommended that policy that will reduce bank lending rate should be put in place so as to boost economic growth in Nigeria.

Abubakar and Gani (2013) also agreed that the real sector in Nigeria still face difficulty in the accessibility of financial resources especially from the commercial banks that hold about 90% of the total financial sector assets and high interest causing many firms to avoid bank-borrowing. Other formidable financial challenges include concentration of bank credit to the oil and gas, communication and general commerce sectors to the disadvantage of the core real sectors such as agriculture and manufacturing sectors. Also, banks are more disposed to financing government need as almost 50% of the assets are tied up by government debt. Based on this premise, the study therefore investigates the impact of bank credits on Nigerian economy growth.

Nwafor (2018) explored the effect of Nigeria's currency rate on the economic growth of Nigeria. He concluded that Naira rate has no impact on economic growth but has an impact on inflation rate. Marshal (2016) proposed that monetary authorities should emphasize on both short and long run relationship between money supply and real GDP in policy making to achieve economic growth of Nigeria.

Hashim (2012) posited that despite series of banks reform aimed at strengthening the ability of banks to efficient services delivery and branch networking as well as funding the real sector to boost Nigerian economy, the dynamic challenges still lingers on the efforts. The problems such as inefficient allocation of funds to the real sector, lack of long-dated funding, decline in domestic credit by the banking sector to the private sector, mismatch of liquidity in the Nigeria economy, etcetera were attributed to the financial inefficiency in the economy.

Amoo *et.al* (2017) used modified least squares to determine the local conditions and policy environment that influence the absorptive capacity of credit in Nigeria economy. The results that credit is growth enhancing even when trade openness, monetary policy, investment climate and infrastructure are low.

### **3. Methodology**

#### *3.1. Data Collection*

Secondary source of data on the hypothesized variables from 1981 to 2017 were from Central Bank of Nigeria (CBN) Statistical Bulletin (2017). The variables employed are real GDP for agriculture, industry, services and real estate; bank lending to agriculture, industry, services, and real estate; exchange rate, interest rate, inflation rate, credit to private sector and money supply.

### 3.2. The Model

Seemingly Unrelated Regression model is adopted. The SUR model was introduced by Zellner (1962). It is a system with sets of equations with distinct dependent and independent variables often linked together by some common unmeasurable factors. The structural form of the model described above can be written as follows:

$$y_i = X_i\beta_i + \varepsilon_i \tag{1}$$

for  $i = 1, \dots, M$ , where the matrices  $y_i$ ,  $X_i$ ,  $\beta_i$  are of dimension  $(T \times 1)$ ,  $(T \times K_i)$  and  $(K_i \times 1)$  respectively. The stacked system in matrix form is:

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_M \end{bmatrix} = \begin{bmatrix} X_1 & 0 & \cdots & 0 \\ 0 & X_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & X_M \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_M \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_M \end{bmatrix} = X\beta + \varepsilon \tag{2}$$

Although each of the M equations may seem unrelated (i.e. each has potentially distinct coefficient vectors, dependent variables and explanatory variables), the equations in (1) are linked through their (mean zero) error structure.

$$E(\varepsilon\varepsilon') = \Omega = \Sigma \otimes I_T = \begin{bmatrix} \sigma_{11}I_T & \sigma_{12}I_T & \cdots & \sigma_{1M}I_T \\ \sigma_{21}I_T & \sigma_{22}I_T & \cdots & \sigma_{2M}I_T \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{M1}I_T & \sigma_{M2}I_T & \cdots & \sigma_{MM}I_T \end{bmatrix}_{MT \times MT} \tag{3}$$

where

$$\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{1M} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{M1} & \sigma_{M2} & \cdots & \sigma_{MM} \end{bmatrix} \tag{4}$$

The efficient estimator in this context is the GLS estimator.

$$\hat{\beta} = (X'\Omega^{-1}X)^{-1}(X'\Omega^{-1}Y) = [X'(\Sigma^{-1} \otimes I)X]^{-1}[X'(\Sigma^{-1} \otimes I)Y] \tag{5}$$

The multi-equation model considered on economic growth is given as:

$$\begin{aligned} RGA &= \beta_{10} + \beta_{11}BLA + \beta_{12}INTR + \beta_{13}Exrate + \beta_{14}INFL + \beta_{15}CPS + \beta_{16}MS + \varepsilon_1 \\ RGI &= \beta_{20} + \beta_{21}BLI + \beta_{22}INTR + \beta_{23}Exrate + \beta_{24}INFL + \beta_{25}CPS + \beta_{26}MS + \varepsilon_2 \\ RGS &= \beta_{30} + \beta_{31}BLA + \beta_{32}INTR + \beta_{33}Exrate + \beta_{34}INFL + \beta_{35}CPS + \beta_{36}MS + \varepsilon_3 \\ RGR &= \beta_{40} + \beta_{41}BLR + \beta_{42}INTR + \beta_{43}Exrate + \beta_{44}INFL + \beta_{45}CPS + \beta_{46}MS + \varepsilon_4 \end{aligned} \tag{6}$$

where RGA, RGI, RGS, RGR are the real GDP for agriculture, industry, services and real estate sector respectively. BLA, BLI, BLS, and BLR are the bank lending to agriculture, industry, services and real estate sector respectively. INTR is the interest rate, Exrate is the exchange rate, INFL is the inflation rate, MS is the money supply and CPS is the credit to private sector.

### 3.3. Heteroscedasticity Test

Homoscedasticity is one of the important assumptions in classical linear regression. The violation of this assumption leads to heteroscedasticity. We considered Breusch-Pagan test for detection of heteroscedaticity in the data [Breusch and Pagan \(1979\)](#). The test statistic for the Breusch-Pagan Godfrey test is:

$$n \times R^2 \sim \chi_{(n)}^2 \tag{7}$$

where n is the sample size,  $R^2$  is the coefficient of determination.

### 3.4. Multicollinearity Test

Multicollinearity is another important course of invalid inference in classical linear regression. The severity of correlation in the data can be detected by the variance inflation factor (VIF). If the value of VIF is  $\geq 10$ , then multicollinearity is inherent among the explanatory variables. [O'Brien \(2007\)](#).

### 3.5. Model Selection

The Mallows CP statistic is a criteria used to assess fits when models with different numbers of parameters are being compared [Mallows \(1973\)](#). The  $C_p$  is computed as:

$$C_p = \frac{1}{n}(RSS + 2d\hat{\sigma}^2) \tag{8}$$

where d is the number of predictors,  $\hat{\sigma}^2$  is the estimate of the variance associated with each response in the linear model and RSS is the residual sum of squares.

Given the linear models in equation 6, then equation 8 was used to select important variables. The selected variables are: BLA, BLI, BLS, Exchange rate, Money Supply and CPS. The structural model used for the analysis is as follows:

$$\begin{aligned} \ln RGA &= \ln BGA + \ln Exrate + \ln MS + \ln CPS + \varepsilon_1 \\ \ln RGI &= \ln BGI + \ln Exrate + \ln MS + \varepsilon_2 \\ \ln RGS &= \ln BGS + \ln Exrate + \ln MS + \varepsilon_3 \\ \ln RGR &= \ln CPS + \ln Exrate + \varepsilon_4 \end{aligned} \tag{9}$$

where lnRGA, lnRGI, lnRGS and lnRGR are the natural log of real GDP for agriculture, industry, services and real estate sector respectively. lnBGA, lnBGI and lnBGS are the natural log of bank lending to agriculture, industry and services sector respectively. lnCPS is the natural log of credit to private sector, lnExrate is the natural log of exchange rate and lnMS is the natural log of money supply

## 4. Data Presentation and Analysis

Relevant data were presented in table 1 and analysed. Some of the presented variables are; real GDP for agriculture, industry, services, real estate sector, bank lending to agriculture, industry, real estate and services.

**Table 1.** Nigeria Sectoral Output of each Sectors (in billions of naira )

Year	RGA	RGI	RGS	RGR	BLA	BLI	BLS	BLR
1981	2364373	6603250	3668438	1063960	0.6	2.75	2.02	1.8
1982	2425961	6272828	3760135	1074049	0.8	3.13	2.45	2.1
1983	2409082	5264881	3775196	1086704	0.9	3.17	2.99	2.3
1984	2303505	5621181	3704125	1086932	1.1	3.25	3.01	2.4
1985	2731062	6379599	3779001	1091378	1.3	3.47	2.85	2.5
1986	2986835	6234407	3892216	1100909	1.8	4.68	3.59	2.8
1987	2891672	6135330	3968984	1112486	2.4	5.21	3.97	2.9
1988	3174568	6474984	4087626	1123078	3.1	6.31	3.57	3
1989	3325947	7100758	4290008	1139871	3.5	6.94	4.15	3.2
1990	3464716	8531587	4645605	1196554	4.2	8.25	5.48	3.2
1991	3590837	8094631	4761087	1244152	5	11.45	6.17	3.6
1992	3674793	8170470	4933418	1292348	7	16.16	8.14	4.1
1993	3743666	8122085	5125930	1346312	10.8	24.53	11.48	-
1994	3839675	7917396	5270211	1386534	17.8	34.82	33.99	-
1995	3977382	7985544	5422775	1430717	25.3	70.16	29.69	-
1996	4133548	8450310	5599481	1445024	33.3	87.29	15.89	-
1997	4305680	8561917	5855679	1536907	27.9	103.43	237.81	-
1998	4475241	8515829	6166853	1628648	27.2	119.58	96.36	-
1999	4703644	8031918	6451657	1690331	31	140.44	132.5	-
2000	4840971	8808652	6709177	1756078	41	173.58	268.38	-
2001	5024542	9351860	7416290	1843817	55.8	277.37	428.42	-
2002	7817085	9061670	8394518	1899132	59.8	303.64	564.43	-
2003	8364832	10893905	8531195	1956106	62.1	390.29	723.18	-
2004	8888573	11418598	9718301	2168329	67.7	463.17	956.99	-
2005	9516992	11674741	10624122	2408824	48.6	524.57	1377.15	-
2006	10222475	11481760	11788354	2690066	49.4	697.27	1724.95	-
2007	10958469	11332357	13161455	3005425	149.6	978.29	3619.07	-
2008	11645371	11068225	14792019	3359764	106.4	1779.74	5226.43	466.8
2009	12330326	11353422	16682413	3727342	135.7	2184.19	4569.03	778.1
2010	13048893	12033196	18966552	4127988	128.4	2165.74	3798.79	670.3
2011	13429379	12874246	19748682	4145866	255.2	2348.51	3463.65	453.5
2012	14329706	13028046	20728999	4379937	316.4	2625.17	3577.79	539.8
2013	14750523	13014510	22673413	4904637	343.7	2991.41	4342.3	726.9
2014	15380389	13791247	2486889	5155728	478.9	3369.08	5975.39	5514
2015	15952220	13319126	25374780	5264696	1870.5	17808.8	23568.7	2493.4
2016	16607337	12062049	25071936	4903605	1979.8	22801.7	26903.8	2927.7
2017	17179495	12320614	24904371	4694391	2012.3	25010.7	24092.9	3145

Source: Central Bank of Nigeria Bulletin (CBN, 2017)

#### 4.1. Results

Table 2 presents the correlation matrix of the dependent variables included in the model. The correlation matrix between real GDP of Agriculture sector and Real estate sector is 0.979548, Agriculture and services sector is 0.982937, Agriculture sector and industry sector is 0.940339, Real estate and services

sector is 0.996836, Real estate and industry sector is 0.910299 and services and industry sector is 0.902648. The cross correlation matrix shows high correlation among the equations across the sectors, which justifies the appropriateness of SUR estimation techniques rather than equation by equation techniques of OLS.

Tables 3 and 4 show the result of the heteroscedasticity and multicollinearity tests respectively. The Breusch Pagan test in table 3 reported that there is presence of heteroscedasticity in each equation except for equation 2. The variance inflation factor of MS and CPS in table 4 shows that the two variables are related. Table 5 shows the heteroscedasticity test after transforming data. The result reported that there is presence of homoscedasticity in the models.

The SUR model summary is shown in table 6. The  $R^2$  of the models are: 0.88983, 0.88749, 0.92407 and 0.97635 respectively for GDP of agriculture, industry, services and real estate sectors. The coefficients of the explanatory variables to the real GDP of agriculture shown in table 7 reported that the coefficient of bank lending to agriculture and exchange rate are: 0.20040 and 0.09724 respectively.

Also in tables 8, 9 and 10 show the coefficients of the explanatory variables to the real GDP of industrial sector, services sector and real estate sector respectively. The coefficients of bank lending to industrial sector and exchange rate in table 8 are: 0.03422 and 0.08546 respectively. The values are significant at 5%. The coefficients of bank lending to services sector and exchange rate in table 9 are:  $1.96723e^{-01}$  and  $8.21938e^{-04}$  respectively. The coefficients of CPS and exchange rate in table 10 are: 0.26943 and -0.10192 respectively which are significant at 5%.

**Table 2.** Correlation Matrix of Independent Variables

	RGA	RGR	RGS	RGI
RGA	1			
RGR	0.979548	1		
RGS	0.982937	0.996836	1	
RGI	0.940339	0.910299	0.902648	1

**Table 3.** Heteroscedasticity Test of the Raw Data

Equation	Breucsh Pagan	P-value
1	15.264	0.0183*
2	3.5702	0.7346
3	22.698	0.0009042*
4	26.08	0.0002151*

Note: \* Heteroscedasticity present since P-value < 0.05

**Table 4.** Multicollinearity Test of the Raw Data

Equation	Explanatory Variables					
	BL	INTR	EXRATE	INFL	MP	CPS
1	4.5595	1.4745	9.1914	1.5968	405.1249*	311.1627*
2	4.1858	1.4768	9.0647	1.5971	404.9310*	313.8083*
3	5.7669	1.4636	9.2148	1.5963	451.7371*	341.3908*
4	3.4687	1.4438	9.5041	1.5971	343.2335*	271.9965*

Note: \* VIF > 10 (Multicollinearity is present)

**Table 5.** Heteroscedasticity Test after Data Transformation

Equation	Breucsh Pagan	P-value
1	4.7724	0.09198
2	0.40803	0.8154
3	4.1866	0.1233
4	0.32698	0.8492

**Table 6.** SUR Model Summary

Equation	SSR	MSE	RMSE	R <sup>2</sup>	Adj R <sup>2</sup>
1	1.83455	0.05396	0.23223	0.88983	0.88334
2	0.31090	0.00914	0.09563	0.88749	0.88087
3	1.25995	0.03706	0.19250	0.92407	0.91961
4	0.26945	0.00793	0.08902	0.97635	0.97496

**Table 7.** Result of Real GDP for Agriculture

	Estimate	Std.Error	t-value	P-value
Intercept	14.59565	0.07835	186.28315	< 2.22e <sup>-16</sup>
BGA	0.20040	0.04377	4.57889	5.9976e <sup>-05</sup>
Exrate	0.09724	0.05137	1.89304	0.06689

### 5. Discussion of Results

The correlation coefficients among the models across the sectors are very high which indicated that SUR is more appropriate. The R<sup>2</sup> of the agriculture, real estate, services, and industry sector indicated that variations in the economic growth have been adequately explained by the variables in each model. The

**Table 8.** Result of Real GDP for Industry

	Estimate	Std.Error	t-value	P-value
Intercept	15.55831	0.03084	504.54786	$< 2.22e^{-16}$
BGI	0.03422	0.01301	2.62966	0.01274
Exrate	0.08546	0.01901	4.49455	$7.6896e^{-05}$

**Table 9.** Result of Real GDP for Services

	Estimate	Std.Error	t-value	P-value
Intercept	$1.49135e^{01}$	$6.23343e^{-02}$	239.25108	$< 2.22e^{-16}$
BGS	$1.96723e^{-01}$	$2.20871e^{-02}$	8.90668	$2.0738e^{-10}$
Exrate	$8.21938e^{-04}$	$3.70134e^{-02}$	0.02221	0.98241

**Table 10.** Result of Real GDP for Real Estate

	Estimate	Std.Error	t-value	P-value
Intercept	13.19726	0.03618	364.75001	$< 2.22e^{-16}$
CPS	0.26943	0.01308	20.60133	$2.22e^{-16}$
Exrate	-0.10192	0.01816	-5.61261	$2.7456e^{-06}$

coefficients of bank lending to agricultural sector, industrial sector and services are; 0.20040, 0.03422 and 0.19672 respectively. These reported that a unit increase in bank lending will lead to 20.040% increase in agricultural output, 3.422% increase in industrial output and 19.672% increase in services output [Agbanike et.al \(2018\)](#).

Also, the coefficient of exchange rate to industrial sector and real estate sector are: 0.08546 and -0.10192 respectively significant at 5%. These reported that a unit increase in exchange rate will increase industrial output by 8.546% but decreases real estate output by 10.192% [Obansa et.al \(2013\)](#). The coefficient of exchange rate to agriculture and services sector are: 0.09724 and  $8.21938e^{-04}$  which are not significant at 5%.

## 6. Conclusion

Bank lending to agriculture, services and industry sector had positive significant impact on economic growth, while credit to private sector impacted significantly on economic growth of real estate sector. Exchange rate has significant positive impact on economic growth of industrial sector and a negative impact on real estate sector.

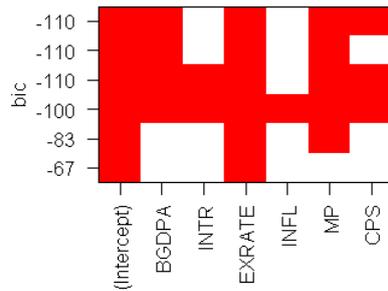
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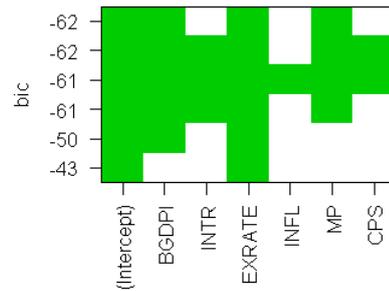
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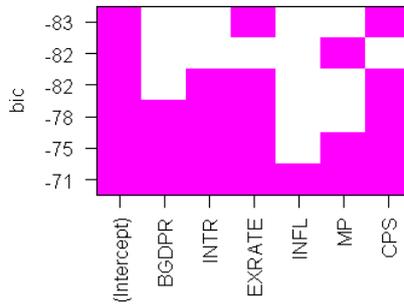
**Appendix : Mallow's CP Plot for models in equation 6.**



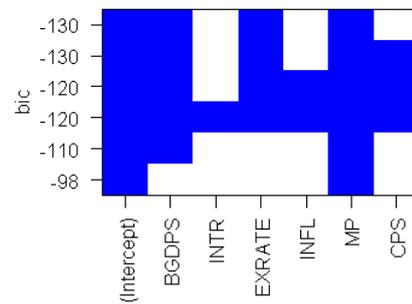
Mallow's CP Plot for model 1



Mallow's CP Plot for model 2



Mallow's CP Plot for model 4



Mallow's CP Plot for model 3