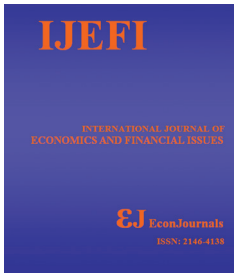

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Poisson-model Analysis of Power Alternation in Africa

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ABSTRACT

In Africa, there are many countries that rarely know the change of their president. The aim of this paper is to study the economic and non-economic determinants of number of power alternation in Africa over the period 1990-2015. The poisson regression is used. The results indicate that the growth of the gross domestic product per capita has a negative impact on the number of political change while the democracy index and the coup have a positive influence.

Keywords: Poisson Model, Power Alternation, Africa
JEL Classifications: D72, C53

1. INTRODUCTION

In Africa, there are many countries that rarely know the change of their president. As Okem (2013) pointed out, following the decision by president Hastings Kamuzu Banda of Malawi to declare him self president for life, the african political landscape in the past two decades has witnessed a steady increase in the number of leaders who sought to extend their hold on power by either abolishing constitutional limits on tenure or by extending the number of terms allowed by the constitution. The authors sought to explore what motivates presidents to hold on to power in Africa. Kiwuwa (2013) argues that the rulers have utilized the weak democratic institutional structures of their countries. Baturo (2010) and Baker (2002) pointed out factors such as corruption, immunity from prosecution for a sitting president and the prospect of retaining assets acquired determine whether a president will leave at the end of his/her tenure. The willingness to leave is even more difficult because many african leaders use their elective office to enrich themselves (Okem, 2013). But seeking to hold on to power, leaders can create social tensions leading to undemocratic political alternation by a military coup or an assassination of the president. This african literature on the lack of power alternation gives many importance to the non-economic variables such as the weak democratic institutional structures and the corruption. But it is also possible that the lack of alternation in power can come from good economic performances. Indeed, if the macroeconomic performance of the previous tenure are good, voters will re-elect the outgoing president. On the other hand, in the case of poor macroeconomic performance, the voters vote against the outgoing president in order to sanction him. In the literature, this behavior is called retrospective voting.

Dubois (2007) provided a quasi-exhaustive literature on politico-economic models that explains the vote in French case. This literature provides informations on how the vote is model through an voting equation. This voting equation is a statistical relationship between the vote and its determinants. The determinants used in the literature are often economic and political variables. The key macroeconomic variables such as unemployment, inflation, and income are often used (Kramer (1971), Lewis-Beck et Bellucci (1982)). Three political variables are commonly used: The abstention, the vote in previous elections and popularity (Dubois, 2007).

The aim of this paper is to study the economic and non-economic determinants of number of power alternation in Africa over the period 1990-2015.

This paper will be organized as follows. Section 2 describes the methodology. Section 3 presents estimations results. Finally, section 4 draws a conclusion.

2.METHODOLOGY

Model

The traditional model of econometric literature to analyze the count data is the poisson model (Ambapour, 2001). The endogenous variable y_i, the number of times that an african country i has experienced power alternation over the period 1990-2015, can be assumed to follow a poisson distribution. The probability that a country i experiences k power alternation over the period 1990-2015 is therefore given by

$$P(y_i = k) = \frac{\exp(-\lambda_i)\lambda_i^k}{k!}, i = 1,2,...,n \text{ and } k=1,2,... \quad (1)$$

where λ is the parameter of the poisson distribution. This parameter is linked to exogenous variable through the relationships $E[y_i|x_i]=\lambda_i$ and $g(\lambda_i)=x_i\beta$ with an link function. The natural log is generally used as the link function in the poisson model. Thus, the model becomes:

$$E[y_i|x_i]= \lambda_i =\exp(x_i\beta)$$

The coefficient vector β can be estimated by maximum likelihood. The log-likelihood function is given by

$$\log(L) = \sum_{i=1}^{n}(-\exp(x_i\beta) + y_i x_i\beta - \log(y_i!)) \quad (2)$$

The maximization of $\log(L)$ with respect to β gives estimated valuesby maximum likelihood of β.

But it is important to note that the poisson distribution is characterized by the property of *equidispersion* --- that is $E[y_i|x_i]=V(y_i|x_i)=\lambda_i$ --- while in practice, count variables often have a variance that is greater than the mean, which is called overdispersion. In the cas of absence of the equidispersion, the negative binomial regression model (Negbin) introduced by Haussman et al. (1984) that allows to take into account the overdispersion is generally used. In this model, the dependent variable y_i still follows a poisson distribution but in which the parameter λ_i is replaced by the random variable $\lambda_i^* = \lambda_i \exp(\varepsilon_i)$ where ε is a random error that is assumed to be uncorrelated with x. The random term $u_i=\exp(\varepsilon_i)$ is assumed to follow gamma distribution with parameter v, $E[u_i]=1$ and $V(u_i) = \frac{1}{v}$ so that

$$\lambda_i^* = \lambda_i \exp(\varepsilon_i) \quad (3)$$

When estimating the negative binomial model, the parameter α is also estimated with the coefficients vector β. This allows to test the equidispersion. If $\alpha=0$ the equidispersion is accepted and the negative binomial regression gives estimation results close to those of the poisson regression.

2.2. Variables and data

The aim is to study the number of power alternation in Africa over the period 1990-2015 which is a count variable. The independent economic variables are the average annual growth rate (AAGR) of the gross domestic product (GDP) per capita, the inflation rate, the unemployment rate and the current account balance as a percentage of GDP. The independent non-economic variables are the occurrence of at least one successful coup, the democracy index and the freedom from Corruption Index.

For macroeconomic variables, the averages are calculated by author from World Bank data. For the GDP per capita, the AAGR is calculated. Averages of non-economic variables index corruption and democracy index are calculated using data from the University of Sherbrooke[1]. The Democracy Index takes into account electoral process and pluralism, civil liberties, the functioning of government, political participation, and political culture. This index is between 1 and 10. More the value is close to 10, more the level of democracy is high in the country. The freedom from corruption index is between 0 and 100. An Index close to 100 means that corruption is low or does not have a limitation on individual freedom.

To the best of my knowledge, there is not an available database of number of power alternation that can be directly used. This variable is obtained by counting the number of president of each country over the period 1990-2015 reduced by the unit. In the counting, the authorities having occupied the office of president by interim or transition are not taken into account. However anyone who comes to power by coup is counted.

2.3. Descriptive Analysis

Table 1 presents some descriptive statistics[2] of the variables used.

The average of the number of power alternation is 2.55. Figure 1 shows the observed frequencies of the number of power alternation and the poisson distribution with parameter λ=2.55.

From this figure, when the mean is 2.55, a poisson distribution predicts that about 7.5% of the number of power alternation will be zeros; but in reality the observed proportion of zero power alternation is 15%. So, one see more observed zeroes than predicted zeros. Apart from this difference, for numbers of power alternation >0, it appears that the poisson distribution with parameter λ=2.55 describes in acceptable way the observed proportions of the number of power alternation.

Note that the predicted probabilities from the poisson distribution with parameter λ=2.55 corresponds to the predicted probabilities from the poisson regression without explanatory variables. As one remark from the literature, the absence of power alternation can be related to non-economic variables such as the democracy. Also,

1 These data are available (http://www.perspective.usherbrooke.ca) for recent years. But we assume that their averages give a good idea of these of indices over the period of the study.

2 In the Appendix, we present the list of the countries in the study. The monarchies (Morocco, Lesotho and Swaziland) are not part of the study.

Table 1: Descriptive statistics

Variables	Mean±standard error	Min	Max
Number of power alternation	2.55±1.78	0.00	7.00
Growth of GDP per capita (PPP, 2011)	1.53±2.66	−2.11	14.13
Unemployment rate	9.84±7.22	0.99	29.67
Inflation rate*	84.66±289.87	2.40	1445.80
Current account balance (% GDP)	−5.60±8.29	−42.11	7.49
Freedom from corruption index	27.84±10.32	13.99	56.20
Democracy index	4.19±1.64	1.56	7.79
Coup	0.40±0.50	0.00	1.00

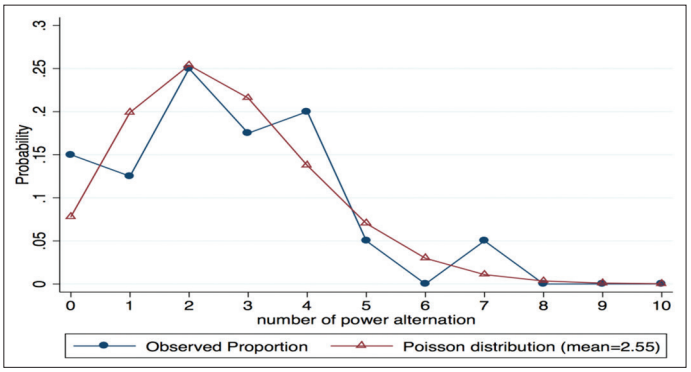
*This high average and Standard error of inflation rate is due especially to countries like Zimbabwe, Zambia, Angola and Democratic Republic of the Congo that often have very high rates of inflation, GDP: Gross domestic product

Table 2: Estimation results

Variables	Poisson regression		Negbin regression	
	Coefficient	Standard error	Coefficient	Standard error
GDP per capita (PPP, 2011)	−0.145**	(0.0670)	−0.145**	(0.0670)
Unemployment rate	−0.00176	(0.0150)	−0.00176	(0.0150)
Inflation rate	−0.000659	(0.000597)	−0.000659	(0.000597)
Current account balance (% GDP)	−0.0198	(0.0208)	−0.0198	(0.0208)
Corruption	0.00655	(0.0162)	0.00655	(0.0162)
Democracy	0.169*	(0.0940)	0.169*	(0.0940)
coup	0.617**	(0.253)	0.617**	(0.253)
_cons	−0.135	(0.524)	−0.135	(0.524)
N	40		40	
pseudo-R^2	0.1334		0.1283	
χ^2_7	20.82		19.91	
P-value	0.0040		0.0058	
Test of equidispersion				
ln(α)			−16.75	(820.6)
α			5.32×10^{-8}	(0.0000437)
P-value			0.500	

GDP: Gross domestic product

Figure 1: Observed distribution and poisson distribution with parameter λ=2.55



Source: Authors' computation

some macroeconomic variables such as growth of living standard of population may influence the number of power alternation. Such relationships between democracy, the living standard and the number of power alternation also seems to characterize the data (Figure 2). So one can hope that the introduction of economic and non-economic variables in the poisson regression will solve the problem of under-prediction of the proportion of countries without power alternation.

3. RESULTS

The estimation results of poisson model and binomial negative model (negbin) are presented in the Table 2.

The first remark is that the parameter α=0.0000 has a P=0.5. Thus, the equidispersion hypothesis cannot be rejected and the poisson model can be used. In addition, the binomial negative model gives quasi-identical results with those of the poisson model.

To verify that the poisson model fits the data, the predicted probabilities of the poisson model are calculated according to the procedure of Long et Freese (2001) and the tests of goodness of fit are performed.

Figure 3 shows the representation of the predicted probabilities of the poisson model and the observed proportions.

From this figure, the poisson model (with explanatory variables) predicts that about 13.5% of the number of power alternation will be zeros. This predicted proportion is very close to the observed proportion of zero (15%). So, this figure suggests that the predicted probabilities of the poisson model fit in acceptable way the observed proportions of the number of power alternation.

Figure 2: Number of power alternation, Growth in per capita Gross domestic product and demcracy index

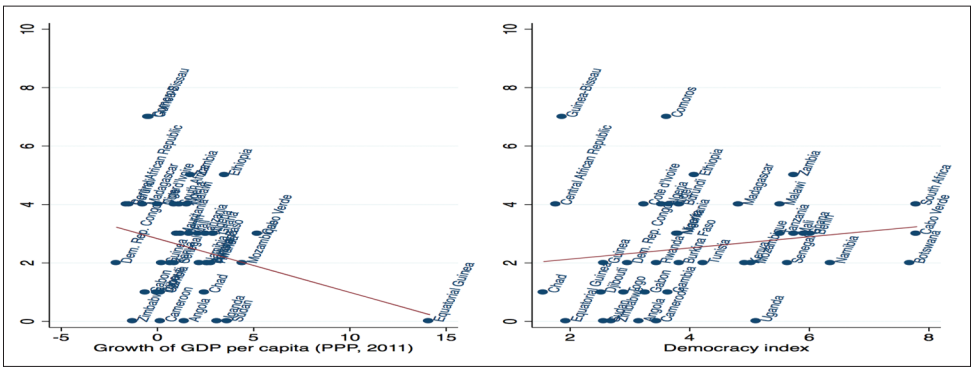


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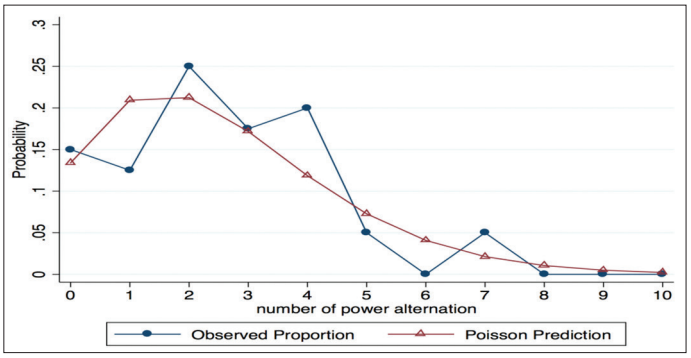
Figure 3: Observed distribution and distribution predicted by a poisson model



Source: Authors' computation

Table 3: Goodness of fit tests

Deviance goodness-of-fit	37.48
$Prob > \chi^2_{32}$	0.232
Pearson goodness-of-fit	36.67
$Prob > \chi^2_{32}$	0.261

To confirm this result, we perform tests of goodness of fit which permit to compare the observed distribution with the distribution predicted by a poisson model. The results of the tests of goodness of fit of Hosmer-Lemeshow and of Pearson are presented in Table 3.

The χ^2_{32} statistics have all p-values greater than 0.05. So, these two tests suggest that the H_0 hypothesis according to which the poisson model fits the data can't be rejected.

This estimate shows that among the economic variables, only the coefficient estimate on the growth of the GDP per capita is negative and significant at 0.05 level. Thus, more the growth of the GDP per capita is important in a country less there is power alternation. For the three non-economic variables used, the coefficient estimate on the freedom from corruption index is not significant at 0.1 level. The coefficient estimate on the democracy index is significant at 0.1 level. Thus, more the level of democracy is high in a country more there is power alternation. Also, the coefficient estimate on the coup is significant at 0.05 level. This means that the coups are also a cause of a significant number of power alternation.

4. CONCLUSION

The aim of this paper is to study the economic (gross domestic product per capita, inflation rate, unemployment rate and current account balance) and non-economic (democracy, corruption and the coup) determinants of number of power alternation in Africa over the period 1990-2015. As the number of power alternation is a count variable, a poisson model is used. The hypothesis of equidispersion underlying the poisson model and the goodness of fit of the model have been approved. The estimation results indicate that a low GDP per capita growth, a high level of democracy and coups explain the power alternations in Africa over the period 1990-2015.

These results are consistent with the literature. The increase of GDP per capita reflects an improvement in the living standard of the populations. This constitutes a good macroeconomic performance that can lead the voters to re-elect the outgoing president. This implies a low number of power alternation. Regarding democracy, the result is in line with the finding of Kiwuwa (2013), that is the weak democratic institutional structures has enabled an increasing number of african leaders to negate power alternation.

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APPENDIX: LIST OF COUNTRIES USED IN THE STUDY

South Africa, Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Central African Republic, Comoros, Dem. Rep. of Congo, Cote d'Ivoire, Djibouti, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Equatorial Guinea, Kenya, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Uganda, Rwanda, Senegal, Sudan, Tanzania, Chad, Togo, Tunisia, Zambia, Zimbabwe.