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The Effects of Demographic Factors on Kenya Economic using Multiple Linear Regression Analysis

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***Abstract*: Kenya's economy is a market-based with a few state-owned infrastructure enterprises and maintains a free external trade system. The country is generally perceived as Eastern and central Africa's nave for Communication, Financial and Transportation services. The major industries that lead to the increment of the country's economy include; agriculture, fishing and forestry, mining and minerals, industrial manufacturing, energy, tourism, and financial services. The general objective of the study was to examine the effects of births, deaths and net migration to the Kenyan economy. This study takes into account the predictor variables as birth rates, death rates, and net migration and the explained variable as the GDP per capita growth which acts as the indicator of the economy with an application of multiple linear regression model. The findings of the study support the existence of a short-run relationship between population growth and economic growth in Kenya. The causality test is bi-directional causality between population growth and economic growth. Kenya is termed as the second stage of demographic transition. The study used a secondary data source from www.knbs.or.ke and www.aphric.org. The variables of interest were birth rates, death rates, net migration rates and the country's Per capita GDP in Kenya. This study is of great importance to the researchers in the field of population, economic growth policymakers, and academicians.**

***Keywords*: demographic factors, multiple linear regression analysis**

1. Introduction

The economy of Kenya is a market-based with a few state-owned infrastructure enterprises and maintains a free external trade system. The country is generally perceived as Eastern and central Africa's nave for Communication, Financial and Transportation services. The major industries that lead to the growth of the country's economy include; agriculture, fishing and forestry, mining and minerals, industrial manufacturing, energy, tourism, and financial services. As at 2018 estimates, Kenya had a GDP of $85.980 billion making it the 69th largest economy in the world. Per capita GDP was estimated at $1,790 [1].

As of September 2018, economic prospects were positive with above 6% GDP growth expected, largely because of expansions in transport, telecommunications, construction and a recovery in agriculture. These improvements are supported by a large pool of English-speaking professional workers. In 2018, Kenya was ranked 80th in the World Bank ease of doing business rating from 113th in 2016 out of 190 countries [2]. Growth rates are the annual variations in population resulting from births, deaths and net migration during the year. Population projections are common demographic tools. They provide a basis for other statistical projections, helping governments in their decision making and for the planning of the country's resources. This indicator is normally measured in terms of annual growth rate and in thousands of people. Notably, the rapid population growth tends to reduce the savings per capita and decrease the growth of physical capital per worker [3].

A tremendous increase in population not only has unfavorable effects on improvement in food supplies but also increases the constraints on the development of foreign exchange, savings, and human resources. Furthermore, high population worsens the problem of improving the health of the population and increases pressure on employment and the amount of investment available per labor market entrant [4].

The general objective of this study was to examine the effects of the demographic factors on the Kenyan economy. This study took into account the predictor variables as birth rates, death rates, and net migration and the response variable as the Per capita GDP which acted as the indicator of the Kenya's economy.

2. Literature review

There have been various theories on whether population growth influences economic growth. In relation to the literature review, most of the theories support that populations increase leads to the growth of the economy of a country [5], [6], [7], though a few contradict this idea. There are some theories that support the idea that the population growth has zero effect on the economic growth for instance, theory on economic growth [8]. Most of the researches done on the relationship between population and economic growth had some limitations due to the data used such as cross-sectional data in a country at a given time.

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3. Research methodology

A. Research design

In this study, the focus is on the impact of population growth on the Kenyan economy growth and, therefore, the research design used was descriptive. The study goes further beyond the issue of describing whether the effect is either positive or negative and tries to explain the implications that arise from the increase and decrease of the population on the economy of the country. Moreover, the research study used a correlational research design since the model of the study was based on the association of the population factors on economic growth (Per capita GDP). Employing the design was to help the researcher explain the specific methods in which population change impacts on the economic growth of a country.

B. Methods of data collection

This study specifically, dealt with archival research that is, the data source was secondary. The data of country's Population was obtained from census, that of Births and deaths rates were obtained from vital statistics records, while the GDP data set was collected from the Bureau of Labor Statistics and the Treasury by the Kenya National Bureau of Statistics.

C. Methods of data analysis

In order to perform various data analysis, the study used both descriptive and inferential statistics where regression analysis and correlation was carried out for the dataset ranging from 2007 to 2018. The trends of the population were determined in various analysis procedures. The multiple linear regression was one of the econometric models used to determine the relationship and significance of the independent variables and also to predict the dependent variable. The model was:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Where; Y= GDP per capita income, X_1=Birth rate, X_2=Death rates, X_3= Net migration, B_0= Intercept of GDP per capita income, B_1= Coefficient of Birth rates, B_2= Coefficient of Death rates, B_3= Coefficient of Net migration n= time (in years).

4. Results and discussion

A. Normality test

The variables of interest were tested for normality. This test was important in determining whether the sampled data had been drawn from a normally distributed population. The test used was the Shapiro-Wilk normality test. The p-value as compared with the level of significance at α=5% and the rule was to reject H_0 when the p-value was less than α=0.05 otherwise you fail to reject the null hypothesis.

Since the calculated p-values were greater than the level of significance α=0.05 the study failed to reject the null hypothesis and concluded that the sampled datasets were normally distributed.

```
> #TEST FOR NORMALITY OF THE VARIABLES (Shapiro Wilk test)
> shapiro.test(gdp.rt)

        Shapiro-Wilk normality test

data:  gdp.rt
W = 0.92598, p-value = 0.2677

> shapiro.test(birth.rts)

        Shapiro-Wilk normality test

data:  birth.rts
W = 0.93955, p-value = 0.4126

> shapiro.test(death.rts)

        Shapiro-Wilk normality test

data:  death.rts
W = 0.90109, p-value = 0.117
```

B. Granger test for causality: test for association

The association between the dependent variable and the independent variables was determined.

```
> #GRANGER CASUALITY TEST-CAUSAL RELATIONSHIP
> library(lmtest)
> grangertest(gdp.rt~birth.rts,data=data)
Granger causality test

Model 1: gdp.rt ~ Lags(gdp.rt, 1:1) + Lags(birth.rts, 1:1)
Model 2: gdp.rt ~ Lags(gdp.rt, 1:1)
  Res.Df Df      F Pr(>F)
1     10
2     11 -1 0.5816 0.4633
> grangertest(gdp.rt~death.rts,data=data)
Granger causality test

Model 1: gdp.rt ~ Lags(gdp.rt, 1:1) + Lags(death.rts, 1:1)
Model 2: gdp.rt ~ Lags(gdp.rt, 1:1)
  Res.Df Df      F Pr(>F)
1     10
2     11 -1 0.0461 0.8343
> grangertest(gdp.rt~net.mig.rt,data=data)
Granger causality test

Model 1: gdp.rt ~ Lags(gdp.rt, 1:1) + Lags(net.mig.rt, 1:1)
Model 2: gdp.rt ~ Lags(gdp.rt, 1:1)
  Res.Df Df      F Pr(>F)
1     10
2     11 -1 0.1052 0.7523
> grangertest(gdp.rt~pop.grw.rt,data=data)
Granger causality test

Model 1: gdp.rt ~ Lags(gdp.rt, 1:1) + Lags(pop.grw.rt, 1:1)
Model 2: gdp.rt ~ Lags(gdp.rt, 1:1)
  Res.Df Df      F Pr(>F)
1     10
2     11 -1 2.7734 0.1268
```

One of the objectives of the study was to investigate the causal relationship between population growth factors (birth rates, death rates, and net migration rates) and the economic growth rate in Kenya. To test this, simple Granger-causality test was carried out to find the causation between the dependent variable and independent variables.

The rule was to reject the null hypotheses that GDP growth does not granger cause the independent variables when the p-value < α (0.05). Following the above output, all the p-values of the independent variables were greater than α =0.05. Thus, the study rejected the null hypothesis that there was no granger causality between the dependent variables and independent variables.

As a result, causality test was unidirectional between the death rates and GDP per capita where the direction of causality flows from GDP per capita to death rates that is an increase in GDP per capita will lead to an increase in death rates. The causality was bidirectional between the birth rates and GDP per capita and between the population growth and GDP per capita, that is, the two affect and are affected by overall economic growth. On the other hand, the causality was unidirectional between net migration and GDP per capita that is the causal effect flows from net migration rate to economic growth rate meaning that an increase in net migration leads to an increase in economic growth. In general, there is a mutually reinforcing bilateral causality between population growth and economic growth.

C. Multicollinearity test

The test investigates if there are two or more predictor variables in a regression model which are highly correlated. The test was to fail to reject the null hypothesis when the VIF<5 (Ringle et al., 2015). In the analysis, all the independent variables the VIF<5, therefore, the study upheld the null hypothesis and concluded that there was no multicollinearity between the independent variables.

```
> #TEST FOR MULTICOLINEARITY
> vif(lm(gdp.rt~birth.rts+death.rts+net.mig.rt)) #variance inflaton factor.
 birth.rts  death.rts net.mig.rt
  3.821473   3.739714   1.126072
```

D. Population growth and economic growth in kenya

The trend in Gross Domestic Product (GDP) growth and population growth in Kenya from 2005 to 2018 is as shown in figure 1. The trend in population growth rate in Kenya has been fluctuating over the years 2005-2018 (though with minimal amplitude difference). The GDP growth tends to be fluctuating up to 2015 where it tends to increase. In 2008 the economy recorded a negative growth possibly due to the negative effects of politics that occurred in 2007. The country recorded the highest GDP in 2010 with the value of 6.367 which can be attributed to improved health services, improved telecommunication and infrastructure, advanced agricultural practices and increased remittance resulting from immigrants.

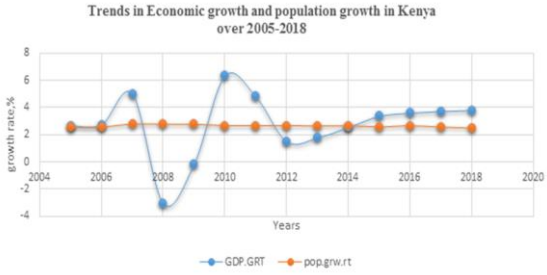

Fig. 1. Trends in the GDP per capita growth and population growth over 2005-2018

E. Impact of population increase on economic growth in Kenya

The results indicate that population increase and economic growth were negatively correlated with a correlation coefficient of -0.361849. This means that an increase in population will impact to a decrease in the economic growth in Kenya. Higher population depresses economic growth through diminishing returns. Moreover, an increase in the population growth rate leads to a decline in the growth rate of per capita [9].

```
> cor.test(gdp.rt,pop.grw.rt,alternative=c("two.sided"),
+ method=c("pearson"),exact=NULL,conf.level=0.95,
+ continuity=FALSE)

        Pearson's product-moment correlation

data:  gdp.rt and pop.grw.rt
t = -1.3446, df = 12, p-value = 0.2036
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.7486855  0.2088279
sample estimates:
       cor
-0.3618439
```

Another objective of the study was to check whether the relationship between population growth and economic growth was a long-run or short-run phenomenon. To confirm this, the coefficient of the population growth rate was negative and the adjusted R-squared was 0.05851 (very small) which clearly explains that the relationship between the population growth and economic growth was a short run relation. As shown in the following model;

```
> econ.model<-lm(gdp.rt~pop.grw.rt,data=data)
> summary(econ.model)

Call:
lm(formula = gdp.rt ~ pop.grw.rt, data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-4.6615 -0.8793 -0.3030  0.7470  3.8016

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   28.531     19.156   1.489    0.162
pop.grw.rt    -9.613      7.150  -1.345    0.204

Residual standard error: 2.26 on 12 degrees of freedom
Multiple R-squared:  0.1309,    Adjusted R-squared:  0.05851
F-statistic: 1.808 on 1 and 12 DF,  p-value: 0.2036
```

The model explains 13.09% of the variability of the economic growth around its mean.

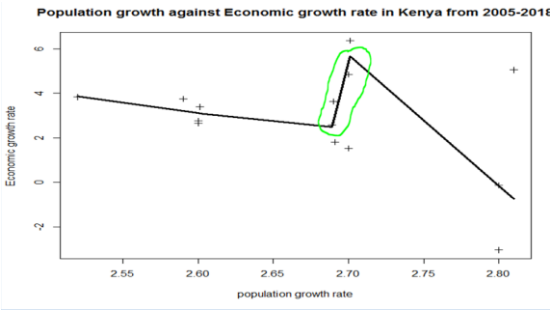

Fig. 2. Relationship between Population growth and economic growth in Kenya from 2005-2018

Notably, as the economic growth increases, it tends to increase the population growth through devaluation (that is increasing domestic demand), increasing real wages and lowering interest rates. As shown by the circled region (in green).

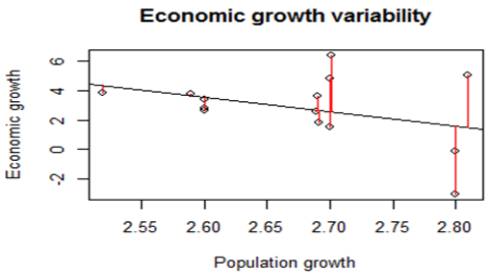

Fig. 3. Variability of economic growth

To visualize the variability of economic growth, segmentation plot was the best to show how the model between population growth and economic growth behaved.

F. Model Identification

Following the above analysis, the estimated model was;

$$Y = 14.6480 - 0.4575X_1 + 0.3937X_2 - 2.2179X_3$$

In the model, birth rates and net migration slightly influence the GDP per capita with a negative effect, while death rates slightly influence the GDP per capita with a positive effect.

The response variable was well predicted by the above model. Considering the intercept only we had null deviance of 70.531 on 13 degrees of freedom. Moreover, including the independent variables in the model decreased the null deviance to 53.488 on 10 degrees of freedom, a quite significant reduction in deviance. As a result, the residual deviance has reduced by 17.043 with a loss of three degrees of freedom. Fisher scoring was useful when comparing models. The model above was, therefore, to be iterated twice in order to fit the model.

5. Summary and recommendations

A. Summary

The findings of the study support the existence of a short-run relationship between the population growth and economic growth in Kenya over the period of analysis and provided strong support on the hypothesis that population growth affects the economic growth. In this case, the relationship was bidirectional causality. As a result, this indicates that Kenya seems to be in the second stage of demographic transition, the so-called post-Malthusian regime which explains the relationship between economic growth and population growth remaining strong and positive as time increases.

Economic growth granger causes birth rates and death rates and the relationship was unidirectional in which the direction of causation runs from economic growth to birth rates and death rates without any strong feedback. On the other hand, the net migration growth rate was a key determinant of population and economic growth in Kenya. In conclusion, the findings gave support to the population-driven economic growth in Kenya.

B. Recommendations

The government should carefully put measures to ensure that the economy grows at a higher rate than that of population. Moreover, openness to trade can be a key driver of economic growth which helps to positively boost the benefits Kenya receives from the demographic transition. The study majorly concentrated on only three demographic factors. There are other indicators of economic growth which includes; inflation rate, unemployment rate, interest rate, Government Debt to GDP, and balance to trade. The study suggests further research using these economic indicators as predictors of economic growth.

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