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POPULATION DYNAMICS IN DEMOGRAPHIC TRANSITION AND ECONOMIC DEVELOPMENT: A GEOGRAPHICAL ANALYSIS

Dr. Muniraja D. H.
Assistant Professor of Geography, Government First Grade College, Bannur,
T. Narasipura Taluq, Mysore District, Karnataka
Email - dr.munivenkatappa@gmail.com

Abstract: *The universal process of population change has significant attainment of social and economic implications at global level. Demographic transition is not onlyconsisting of population growth tendency but much more along with economic con-sequences Karnataka is in the third stage of demographic transition and this scenario is marked with opportunities and challenges. This paper examines the demographic trends of Karnataka by using different Census data collected from Census reports and time series data over the time period of 1991–2014 collected from SRS. The fertility and mortality levels in the state have declined considerably. The districts in the Karnataka state have shown considerable increment in HDI from decade to decade. The study used the bound testing approach to co-integration; Autoregressive Dis- tributed Lag (ARDL) model was also applied for analyzing the long run relationship whereas Error Correction Mechanism (ECM) was applied for analyzing the short run link of the demographic variables with economic growth. The study exhibited that the demographic transition positively affected the economic growth in the long run and negatively in the short run.*

Key Words: *Demographic transition · Economic development · ARDL · Co-integration.*

1. INTRODUCTION:

Demographic Transition is a multidimensional process in which a country's popula-tion attributes are changed with the passage of time and the interaction of mortality transition and fertility transition cause variations in the population growth.

The population development of both developed and developing countries takes places in different stages depending on the fertility and mortality behavior and thesestages are sometimes termed as population cycle or demographic transition.
These phases are divided on the basis of different peculiarities of interaction of birth and death rates of the country and due to these peculiarities; population of the country either increases, decreases or remains constant. No public health policy can be made by neglecting these characteristics of the population.

There are three or five stages through which every population passes and moves towards modernity (Chesnais 1992). Notestein (1945) defined the three phases and Becker et al. (1949) subdivided it into two phases. This five phase distinction was reiterated by Davis (1945) and defined the fifth stage differently (Chesnais 1992). The most developed nations are in the fourth stage while developing nations are in the second and third stage.

India is the second most populous country in the world, with over 1.22 billion people (Census of India 2011), containing 17.5% of the world's population, India is projected to be the world's most populous country by 2022, surpassing China, its population reaching 1.6 billion by 2050 (UN 2010). India is in later half of third stage demographic transition with 1.23 billion populations. It is nearly 40 years behind in demographic transition process compared to EU countries, Japan, etc,.

Karnataka is the 9th most populous state among all the states of the country consid- ering 5.05 per cent of country's 1.2 billion population in 2011. The State is witnessing constant raise in the Effective Literacy Rate over the past decades. In continuation of the trend witnessed during the previous decades the Literacy Rate of the State has increased with 66.64–75.36% from 2001 to 2011 (Census of India 2011). The work participation rate also increased form last two decades in state with 41.99–45.65% from 1991 to 2011 census. Karnataka is in third stage of demographic transition rac- ing with the other states of the country to attain modernity. Demographic Transitionaffects productivity and this is due to the size and structure of cohort of working agepopulation (Feyrer 2007). The change in age structure of the population into different ages is vital factor for the economic growth and productivity (Bloom and Williamson 1998; Mason 2005). Along with demographic transition working-age adults grow and cause a potential opportunity of prompt economic growth (Bloom et al. 2002).

2. Methods and Materials:

This paper is to understand the current demographic trends of Karnataka state in terms of birth-death rates and also to understand relationship between the Demographic Transition and Economic Development. The data is collected from census of India, Sample Registration System (SRS) and various Government reports from Karnatakafor over a period of time. In order to verify the relationship, we included variables viz. Rate of Natural Increase, Life Expectancy, Literacy Rate, Gross State DomesticProduct, Work Participation Rate and Human Development Index. This study applies a linear dynamic model based on Pesaran et al. (2001) Autoregressive Distributed Lag (ARDL) modeling technique to analyze the short-run and long-run dynamics ofdemographic transition and economic growth in Karnataka over the sample period between 1991 and 2014. We have tested the stability of the

model by Cumulative sum (CUSUM) and Cumulative sum of square (CUSUMSQ).

2.1 Trends and Levels in Demographic Transition

The decadal growth of population of Karnataka over the decades from 1901 to 2011is given in Fig. 1. The population growth in the state has not been uniform in the last century, with variations from decade to decade. There was a slight fall in the population during 1911 to 1921, may be due to famines and epidemics after the First World War. Historically, the population growth in Karnataka has been close to the national average. However, there was a sharp decline in the growth rate during the last two decades. According to 2011 census, Karnataka state is having 61,095,297 (61 million) popu- lation with a decadal population growth rate of 15.6% against 17.64% for the country. The decadal growth rates of the state are on a constant decline since 1971. The statehas been identified to beat the stage three of the four stage model of demographic transition.

Karnataka has achieved considerable progress in demographic transition over lastfour decades. The fertility and mortality levels in the state have declined considerably. Karnataka mortality has substantially declined since 1951. This may be due to several steps and measure taken by the health and family welfare programs by Karnataka Government over the period. According to the (SRS 2009; Karnataka Human devel-opment Report 2005; Men and Women in Karnataka 2014) the CDR of the state was

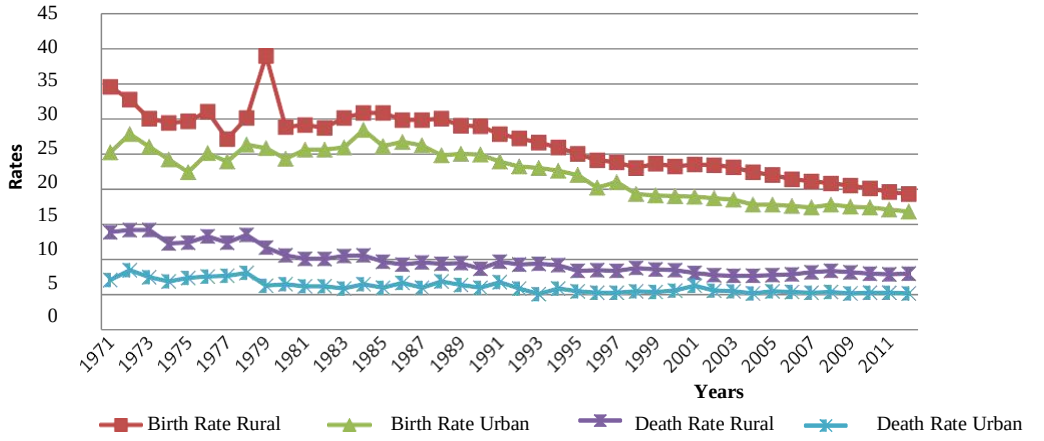


Fig. 2 Trends and levels birth and death rate of urban and rural in Karnataka 1971–2012. Source: SampleRegistration System Bulletins, Registrar General of India

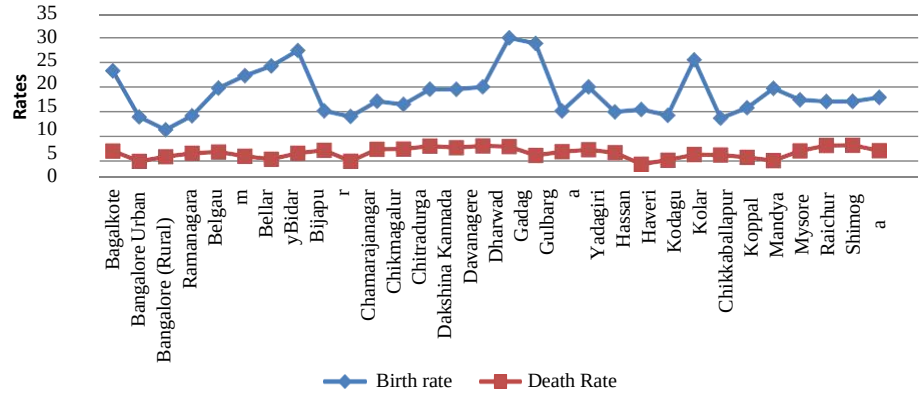


Fig. 3 Birth and death rates of different districts of Karnataka, 2012. Source: 2011-Annual Report onRegistration of Births and Deaths Act. 1969

7.2 it is slightly less than the national average (7.3). However CDR is higher in Rural areas (8.3) than the Urban areas (5.3) of the state.

The crude birth rate (CBR) has been declining in Karnataka since the early 1970s, Fig. 2. presents the levels and trends in birth rates. According to (SRS 2009; Karnataka Human development Report 2005; Men and Women in Karnataka 2014) the CBR inthe State is 18.5 (19.5 in rural and 16.5 in urban area) which is much lower than the national average (22.5). When we observe into the levels and trends of Karnataka, CBR which remains relatively stable at higher level of about 32 or more in 1970s and 1980s it is reached level of 23 in 1999 and further reduced to 18 births per thousandpopulation in 2012.

Figure 3 Represents the birth rate and death rate of different districts in Karnataka of the year 2012. There is high fluctuation in birth rate compare to death rate through- out all the districts in Karnataka and the districts like Bangalore, Dakshin Kannada, Chikmagalure, Chitradurga, Hassan, Chikkabalapur, Mandya, Mysore and Udapi are showing downfall in birth rate and reaching the goals of National Rural Health Mission (NRHM) but rest all other districts are struggling to meet goals NRHM.

2.2 Econometric Interpretation of Demographic and Economic Variables

The Autoregressive Distributed Lag (ARDL) Model was introduced by Pesaran andShin (1999) and later on revised and developed by Pesaran et al. (2001). ARDL approach to co-integration also provides unbiased results for the long run models (Harris and Sollis 2003). It is applied for the estimation of long run coefficients and standard errors by using Akaike Information Criterion (AIC) or Schwarz Information Criterion (SIC). Schwarz Information Criterion (SIC) is consistent and slightly better in performance. The use of ARDL models does not impose pre-testing of variables for unit root testing problems. However, unit root tests are conducted in this study to find out if there are mixtures in the order of integration of our variables. The order of integration of the time series was investigated by applying the Augmented Dickey Fuller (ADF) test. The ADF unit root test results for the time series variables are presented in Table 1 below.

In the results shown in Table 1. above, the ADF test statistic for each of the variables are greater than the respective critical values. Thus, the variables became stationary after first difference. Hence, they are integrated of order I(1). Once all the series are non-stationary in the level, one can estimate an econometric model only if they are co-integrated. Thus co-integration tests can be applied for all variables.

The Table 2 shows that the lower bound is 2.14 while the upper bound is 3.34 at 5% level of significance. The calculated F-test value with the bound is 4.23 by using intercept and no trend as presented by Pesaran et al. (2001). The value of F-statistics shows the overall significant effect of the model. So, the calculated result shows that there is a co-integration among the variables and long run relationship exists amongst the variables.

Table 1 Unit root test results

Variables	ADF test statistic	95% critical ADF value	Order of integration	Remarks
ΔGSDP	−5.0937*	−3.005	I(1)	Stationary
ΔHDI	−4.3476*	−3.012	I(1)	Stationary
ΔLE	−5.1467*	−3.012	I(1)	Stationary
ΔLR	−5.9008*	−3.004	I(1)	Stationary
ΔRNI	−4.3103*	−3.004	I(1)	Stationary
ΔWPR	−4.8559*	−3.005	I(1)	Stationary

Source: Authors' Computations Note: * = 1 percent significance; ** = 5 percent significance

Table 3 Estimates long run coefficients of ARDL model for demographic and economic variables

Variable	Coefficients	Std. error	T-ratio [prob]
C	0.8695*	0.2831	3.0690 [0.0073]
LnGSDP(−1)	0.2807*	0.0746	3.7613 [0.0017]
RNI	0.0571*	0.0054	10.5843 [0.0000]
LE	−0.0081	0.0050	−1.6123 [0.1267]
LR	0.0027	0.0019	1.4213 [0.1744]
WPR	0.0126*	0.0054	2.3316 [0.0333]
HDI	0.0125	0.2490	0.0504 [0.9604]
	R-Square	0.98642	

Source : Author Computations.* 1%, ** 5%, and ***10% Level of Significance

The ARDL Model developed to test the impact of demographic transition on eco- nomic growth of Karnataka.

Table 4 Estimates short run coefficients of ARDL model for demographic and economic variables

Variables	Coefficients	Standard error	T-ratio [prob]
C	0.0078	0.0080	0.9815 [0.3430]
ΔLnGSDP(−1)	1.1447	0.9081	1.2605 [0.2281]
ΔRNI(−1)	−0.0374	0.0592	−0.6320 [0.5574]
ΔLE(−1)	−0.0058	0.0114	−0.5151 [0.6145]
ΔLR(−1)	−0.0069	0.0038	−1.8199 [0.0902]
ΔWPR(−1)	−0.0105	0.0140	−0.7539 [0.4634]
ΔHDI(−1)	−0.4608	0.6278	−0.7340 [0.4751]
ECM(−1)	−0.8692**	0.3353	−2.5917 [0.0213]
	R-Square	05561	

Source : Author Computations * 1%, ** 5%, and ***10% Level of Significance

Table 5 Results of diagnostic tests

Test statistics	Chi-square	F
Serial correlation	CHSQ(1) = 17.49	F(2,2)=3.8782
	[0.002]	[0.25]
Functional form	CHSQ(8) = 0.211	F(8,13)= 4.1256
	[0.01528]	[0.937423]
Normality	1.188 [0.55]	Not applicable
Heteroscedasticity	CHSQ(1) = 0.844	F(17,4)=0.7230
	[0.0373]	[.0165]

The left-hand side is the economic growth proxies by the Gross State Domestic Product (GSDP). The expressions with the summation sign (a_1 to a_6) on the right-hand side represent the short-run dynamics of the model. The next consecutive expressions ($b_1$to b_6) on the right-hand side correspond to the long-run relationship of the model (Table 3).

The results of Table 4 show that the most important factors in the demographic transition have played a vital role in the economic growth of Karnataka. The dynamic variable of dependent i.e. (Gross State Domestic Product) indicating that 28.07% increase in economic growth in long run, which illustrates that there is a significant effect of its lag on dependent variable.

The coefficient of the RNI (Rate of Natural Increase) is 0.0571, which indicates that 1 unit increase in RNI brings 5.71% increase in economic growth in the long run. The T-value of RNI is 10.5843, which shows that there is a significant effect of population raise upon the economic growth. The slow and steady decline of birth and death rates in Karnataka observed in Fig. 2. Shows the third phase of demographic transition which gradually contributes for the growth of economic development. The coefficient of LE (Life Expectancy) is −0.0081, which shows that 1 unit increase in LE brings 0.81% decrease in economic growth in the long run. The T-value of LE is1.6123, which shows insignificant effect of LE upon economic development.

The coefficient of LR (Literacy Rate) is 0.00271, which states that 1 unit increase in LR brings 0.27% increase in economic growth in the long run and that there is aninsignificant effect of LR on economic growth of Karnataka. The coefficient of WPR (Working Participation Rate) is 0.0126, which shows that one unit increases in WPR 1.26% increase in economic growth in the long run. The T-value of WPR is 2.3316,which illustrates that there is a significant effect of Working Participation Rate upon economic growth.

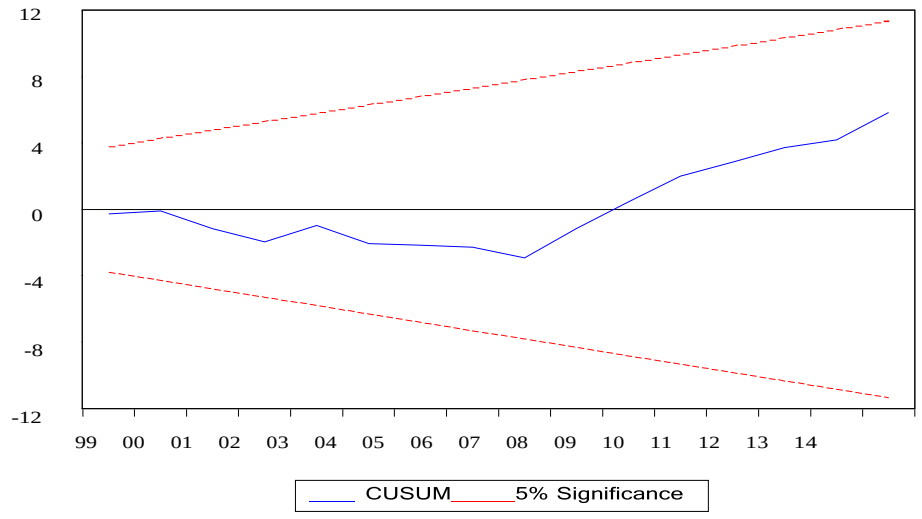
The coefficient of HDI (Human Development Index) is 0.0125, which shows thatone unit increases in HDI 1.25% increase in economic growth in the long run. The T-value of HDI is 0.05040, which is showing insignificant effect of HDI on economic development.

The ECM (Error correction Term) is−0.8692 which shows that 86.92% con- vergence in short run to long run within a year with a change of Rate of Natural Increase, Life Expectancy Literacy Rate, Work Participation Rate, Gross State Domes- tic Product and Human Development Index variables. In short run all variables expect its lag i.e. Gross State Domestic Product impacts economic growth neg- atively so that demographic transition slowdowns economic growth in the short run.

2.3 Stability of the Model

The stability of the model is very important issue and unstable model does not remain valid in the testing circumstances. The CUSUM and CUSUMSQ tests are applied toassess the stability of the model and these tests were developed by Brown et al. (1975). These tests are cumulative sums and sums square of residuals that are plotted against time. The hypothesis is formed to check whether coefficients are to test stability of the model.

Plots of CUSUM and CUSUMQ are within the boundaries, if the plot line does not crosses the boundary at any level then accept the Null hypothesis and reject the alternative hypothesis. If the plot line crosses the boundary at any level then reject the null hypothesis and accept the alternative hypothesis. Both the plots show that line within the boundaries at 5 percent significance level. We are safe to conclude that economic development is stable (Fig. 4).



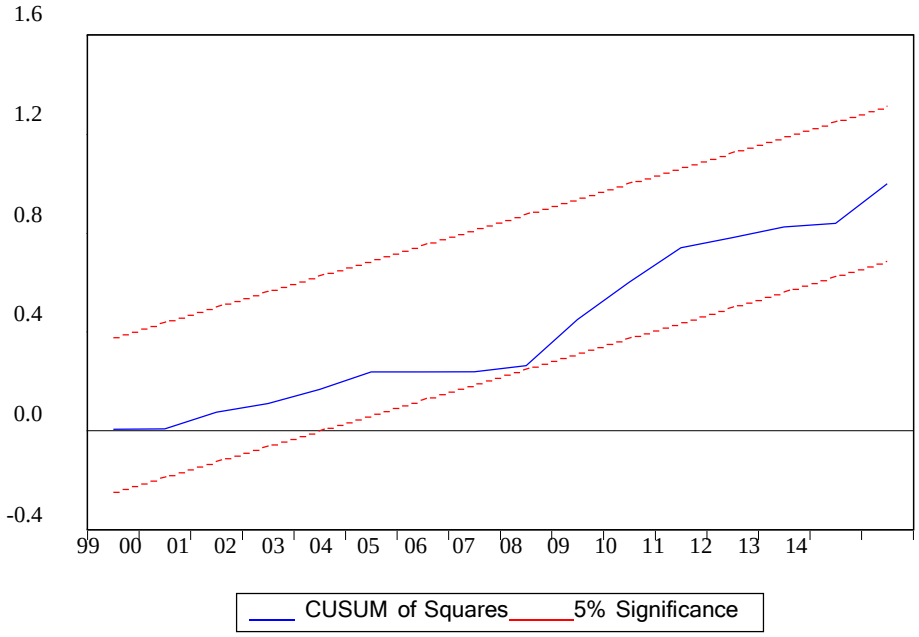


Fig. 4 Plots of cumulative sum and cumulative sum of squares of recursive residuals

3. Conclusions and Recommendations :

The population growth rate of Karnataka is observed to be in decreasing tendency from the last three decades. The birth and death rate in Karnataka showing consid- erable difference in comparing with urban and rural Karnataka but when we observe throughout the districts we identify the consistency in death rate and more fluctuations in birth rate.

The empirical analysis shows that the coefficients of Lag of Gross State Domes- tic Product, Rate of Natural Increase and Work Participation Rate are positive and significant; Whereas Literacy Rate is positive but insignificant. Contrary to this the coefficient of life Expectancy appears to be negative and insignificant. Here Rate ofNatural Increase is the dominant variable in making economic growth stable because of its high significance compare to other positive variables. In short run the model shows significantly negative impact on economic growth except lag of dependent variable.

Demographic variables may pick up or delay economic growth during a process of demographic transition but this is temporary phenomena. So a significant part of economic growth can be attributed to demographic transition. The Government should form integrated and consistent policy framework in health, education and in labor sectors to obtain the dividend and take advantage of the opportunities in Karnataka effectively and face the challenges.

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