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### Original article

## Nexus between population and economic growth in india: a co-integration analysis

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#### ABSTRACT

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The study of population and economic growth has been the subject of intense debates between the two schools of thought. One relates to pessimistic opinion that population has a negative impact on economic growth while the other is convinced that the effect is positive. Recently, third group argues that the rise in population is neutral on economic growth. However, till date, the issue remains inconclusive. To analyse causality, using 51 years time series data of GDP and population growth, a Granger Causality Test was done and found that population growth causes neither GDP nor vice versa in India.

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### 1. Introduction

Population related issues and policies are the integral parts of cultural, economic and social development of a nation. The nexus between population and economic growth has been a subject of intense debate in economics for nearly two centuries between the two schools of thought, basically the *Malthusian* view of Coale and Hoover (1958), and the *Cornucopian* views of Julian Simon (Birdsall, *et al.*, 2001). The former school of thought maintains that population has negative impact on economic growth, while the later is convinced with the notion of positive impact (Bloom, 2011; Boserup, 1981). Recently, another school (third group) argues that the population growth is absolutely neutral on economic growth. It may not determine economic growth, but the former variable does not hamper the latter (Lindsay, 2005; Simon, 1987). If there is any, it may be the problem of employment,

development and distribution of the increased population (Todaro and Smith, 2006; Mitra and Nagarajan, 2005; Kuznets, 1955).

In conventional population theories, especially for the pessimists group, rise in population has often been cause of war, poverty and famine, whereas victory in battles has been cause of conquest of lands and prosperity, agricultural and economical (Verma and Bhandari, 2010). These result in economic crisis, starvation and social problems. But, it is not true everywhere, every time. In the opinion of new school, rise in population becomes an issue only when it retards the process of growth and development of an economy or a society. There is no point of discussion when the role of population growth is neutral on development (Singha, 2007; Kuznets, 1955). Global population growth has not met Malthus' pessimistic predictions of human misery and mass mortality. During the past few decades, rapid population growth has been accompanied by an unparalleled decline in mortality rates and by an increase in income per capita in India and China (Bloom, 2011).

However, the centre of gravity for research on economic development (to take one example) does not lay in hand of demography or even in the journals that are most likely to be read by the demographers (Hirschman, 2004). There are many schools of research and paradigms on economic development (Hirschman, 2004; Birdsall, *et al.*, 2001). Still, there is no consensus opinion on the issue even after the complete reign of modern economists in this twenty first century; the issue remains an inconclusive today (Birdsall, *et al.*, 2001).

## 2. Materials and methods

Though the issue of population is gaining increasing recognition in the field of development economics, there is no consensus opinion of its effect on the economy. However, one of the most significant stylized facts in all contemporary developed nations is that over the past couple of centuries, they have passed through three stages, i.e., demographic transition (Lee 2003). Conventionally, the study of population centres on the effects of it on economic growth; be it positive or negative. To understand the issues in a deeper manner, the present paper tries to find out whether the population growth has promoted or obstructed economic development or growth in India. Conversely, does economic growth increase population is also discussed. If they do not, what is the limit of population that the country can expand?

In the present study, two variables have been included GDP and population growth of India for a period of 51 years from 1960 to 2010. Based on the secondary data collected from World Development Indicator of World Bank, stationarity of the variables were explored and Johansen's co-integration test was also employed to know the co-integration of the variables to know long term relationship between the two. It was followed by Error Correction Model (ECM) to test short run effect. In this study, the term "economic growth" is confined to real GDP growth level (it will be interchangeably using with material well-being as well) of the country.

### 2.1. Literature Review

Malthus (1798) basically focused on the gloomy sides of population growth, and predicted for economic crisis, shortage of food supply in the country in the long run, if the growth of population is not controlled on time. It was supported by Ehrlich and Ehrlich (2009) and predicted that the "population explosion" would lead to world famine, the death of the oceans, and a reduction in life expectancy to 42 years.

On the contrary, the study of Lindsay (2005) centres on whether population growth has a neutral or positive effect, but there clearly is no significant negative effect. Population grows as the resources permit or the society needs. Similarly, the scholars like, Simon (1987) and Liddle (2001) opined that the population growth is not inimical to economic development. How population grows, not just how much it grows, is important in determining its effect on development. In the words of Liddle (2001), "whether population growth is good or bad for a country's *sustained* per capita income growth depends on that country's human capital and technology levels".

Boserup (1981) opined that population density compelled societies to invent new technologies in order to increase food production. So, population growth has positive impact in the society. It enlarges labour force and, therefore, increases economic growth. A large population also provides a large domestic market for the economy. Moreover, population growth encourages competition, which induces technological advancements and innovations. The study by Furuoka (2009) in Malaysia, using Johansen co-integration test and the Error Correction Model (ECM), found that there exist a long-run equilibrium relationship between the population growth and per capita Gross Domestic Product (GDP) growth. Similarly, Jones (2003) also opined that endogenous growth in the scale of the economy through fertility leads to endogenous growth in per capita income. Growth of population

becomes an asset of the countries, especially those who have invested more in human capital. However, in a slightly different connotation, Liddle (2001); Mitra and Nagarajan (2005); Bloom and Canning (2003); Fogel (1993); and others have found that the relationship between population and development depends on three variables: population size, rates of change, and age structure.

## 2.2. Population and GDP Growth in India

The world experienced dramatic population growth during the twentieth century, with the number of inhabitants doubling from 3 to 6 billion between 1960 and 2000. India too, saw very rapid population growth during this period – from 448 million to 1.04 billion – and to 1.21 billion in 2010 (Bloom, 2011). However, India can boast a workforce of over 500 million in sectors like agriculture, which is the highest accumulation of workers, industry, and service. Also, India boasts a low 6.8% unemployment rate. This figure also accounts for the recent boom in outsourcing of jobs from the US. Another recent trend from the 2000s was the developing IT sector of India’s economy. India quickly developed a large group of highly skilled, well-educated workers who could speak English fluently and would work for cheap wages. From this pool of workers, India saw a boom in outsourced work from other countries that have led to the GDP from IT related work to rise from 4.8% in 2005 to 7% in 2008 (Business Teacher, 2012).

On the darker side of the issue, with all these prosperous aspects of India’s economy, few see and understand the staggering cost. As India continues to grow in population, which is one of the factors in making it so prosperous, natural resources become scarce as land, formerly used for farming, is instead used for expanding cities. Further more, India is riddled with 80% of its population living on less than \$2 per day, which doubles China’s rate. Also, much of India’s children go hungry and malnourished. Are these all statistically proved? We need further investigation.

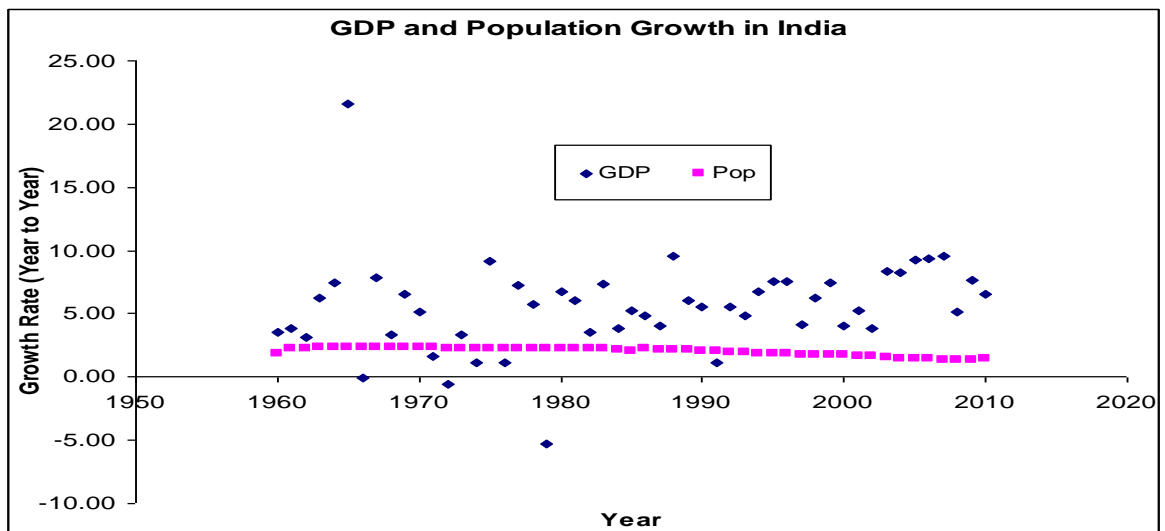


Fig. 1. GDP and Population Growth Trend (Year to Year) in India (1960- 2010)

From the Figure 1 and 2, we can find that the growth of population has been declining constantly in the fifty years. However, the growth trend of GDP in the country during the fifty years has been increasing with a highly volatile manner. In 1965, the growth rate of GDP in the country was found to be extremely high with 22 percent and in 1979 it went down to negative (-5.24 percent). However, from 1980 to 2010, the growth trend of GDP has been increasing (positive growth) marginally at the rate of 1.4 percent. While, the growth trend of population was found to be declining at the tune of -1.9 percent in the thirty years period, after 1980 (refer to Figure 2).

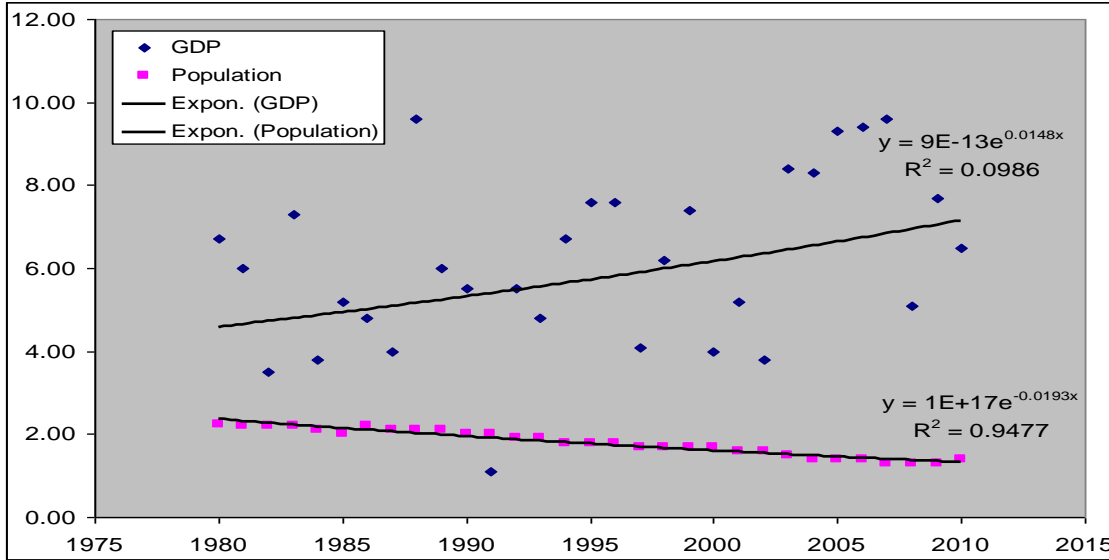


Fig. 2. Population and GDP Growth in India (1980- 2010)

Fillip side of the India’s demographic trend is- though the country’s population had grown very rapidly and imposed a substantial burden of youth dependency on economy in the past, in recent years, India’s demographic profile has begun to evolve in a way that is potentially more favorable to economic growth (Bloom, 2011). However, empirical econometric analysis can interpret better result in this context.

**2.3. Results and discussion**

Before testing causality between the variables (GDP and Population growth), both Augmented Dickey-Fuller (1981) and Phillips-Perron (1988) unit root tests were employed for examining stationarity of the variables in order to ensure the causality test do not produce spurious results. It was followed by Johansen (1988) Co-integration Test (Trace and Eigen-Values statistic) for proceeding to the Granger causality test (1969), between GDP and population growth in the country.

**Table 1**  
Unit Root Tests

Variable	ADF		P-P	
	Level	1 <sup>st</sup> Diff	Level	1 <sup>st</sup> Diff
GDP	c	-7.244*(0.0000)	-7.247*(0.0000)	-40.342*(0.0001)
	ct	-7.504*(0.0000)	-7.934*(0.0000)	-47.446*(0.0000)
Population	c	-0.620(0.8563)	-1.298(0.6234)	-15.224*(0.0000)
	ct	-4.996*(0.0009)	-7.936*(0.0000)	-4.981*(0.0009)

\* Significant at 1% level

**Table 2**  
Co-integration Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.354327	31.74025	18.39771	0.0004
At most 1 *	0.189657	10.30459	3.841466	0.0013

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.354327	21.43567	17.14769	0.0112
At most 1 *	0.189657	10.30459	3.841466	0.0013

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level  
 \* denotes rejection of the hypothesis at the 0.05 level  
 \*\*MacKinnon-Haug-Michelis (1999) p-values

Cointegrating Equation(s):	Log likelihood	-117.13
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Normalized co-integrating coefficients	
GDP	Population
1.000000	9.040570 (2.81648)

Table 1 above shows that all tests do not reject the null hypothesis of non-stationary in the level form for all variables by considering both individual effect and individual linear trend effect. However, all tests reject null-hypothesis of non-stationary when variables are used at first difference. ADF and P-P test statistics are found to be significant at the 1% level. From the Table 2 we can summarize that the two variables are co-integrated at the 5 percent level. It implies that the variables- GDP and Population growth have long run equilibrium relationship. The co-integration equation normalized form on GDP is given below.

$$gdp = -9.04pop \dots\dots\dots (1)$$

$$(-2.8164)*$$

Equation (1) explains that the two variables are found to have long run relationship between the two, and its t-statistic is -2.8164 which is significant at 1% level. The ECM result of the variables is given below in the equations (2) and (3).

$$\Delta gdp_t = \alpha + \beta_1 \Delta gdp_{t-1} + \beta_2 \Delta gdp_{t-2} + \gamma_1 \Delta pop_{t-1} + \gamma_2 \Delta pop_{t-2} + \delta ect_{t-1} \dots\dots\dots (2)$$

$$\Delta pop_t = \alpha + \beta_1 \Delta pop_{t-1} + \beta_2 \Delta pop_{t-2} + \gamma_1 \Delta gdp_{t-1} + \gamma_2 \Delta gdp_{t-2} + \delta ect_{t-1} \dots\dots\dots (3)$$

$$\Delta gdp_t = 0.181 - 0.014 \Delta gdp_{t-1} + 0.059 \Delta gdp_{t-2} + 2.733 \Delta pop_{t-1} + 1.296 \Delta pop_{t-2} - 1.120 ect_{t-1} \dots\dots\dots (2a)$$

0.327                      -0.061                      0.379                      0.904

$$\Delta pop_t = -0.032 - 0.658 \Delta pop_{t-1} - 0.281 \Delta pop_{t-2} - 0.0124 \Delta gdp_{t-1} - 0.008 \Delta gdp_{t-2} + 0.0150 ect_{t-1} \dots\dots\dots (3a)$$

-1.0196                      -4.376                      -1.970                      -1.072

As t- statistic value of co-efficient of  $\Delta pop_{t-1}$  given in equation (2a) is insignificant, denoted by 0.904 indicates that population does not Granger cause GDP of the country. Similarly, t- statistic value of co-efficient of  $\Delta gdp_{t-1}$  given in equation (3a) is also found to be insignificant, denoted by -1.072. It also indicates that DGP does not Granger cause population growth of the country. In nutshell, both the variables are independent to each other; do not cause one another in the short run even if they have long run co-integration relation between them.

**3. Conclusion**

It is clear that the population cannot be the sole factor for the underdevelopment of the country and population size in the country is determined by the level of their material well-being and the level of economic status desired by them (Singha 2007). One should not be very panic about the result of population explosion in the country, but should think more on the efficient and proper utilisation of resources. Simon (1990); Eberstadt (1997); and others have analysed that free market mechanism will always adjust to any scarcity created by population pressure. Often, India's blame on population growth for economic backwardness has no relevance. In this context, Bloom (2011) commented that many factors influence economic growth; few are more important and reliable than

demography. For instance, richer sections of the society or urban dwellers have relatively small family size whereas poor or rural dwellers have large number of children. It is perhaps due to either the rearing cost of baby is much lower in rural area or need more labour force. According to Todaro and Smith (2006), whether to have more children or not is determined by its opportunity cost. So, the growth of population in a transitional stage in any society is inevitable. It will be declining after certain level of population in which per person physical quality of life index starts dropping (Prasad, 2004; Kuznets, 1955).

Simon (1987) blamed to the country's education policy that- had the level of education been developed, India and China could have been richest nations of the world long before. In the recent past, with the growth of education, both nations have become one of the fastest growing economies in the world. Similar idea is also portrayed by Friedman (2006) in his book "*The World is flat*", about how China could capture the American and European markets by their quality and value education. Since the growth of population concerns with socio-economic development issues, strict measures should be taken to improve the quality of existing population (Singha 2007). Planner and policy makers should emphasis more on economic development activities, rather than population politics in India. Population cannot be controlled by force as we have experienced the downfall of Indira Gandhi's government in 1977, as a result of forced sterilization program in 1975 (Singha, 2011). India's population growth rate is declining as the economy is grows. It is the result of self correction measures enthused by market economy.

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