Econometric Model on Population Growth and Economic Development in India: An Empirical Analysis

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Abstract

The debate on the relationship between population growth and economic growth has been undergoing over a long period of time. Economists are turn between three schools of thoughts. The first school of thought view population growth as a factor that adversely affects economic growth. The second school of thought states that population growth stimulates economic growth. While the third school states that population growth is a neutral factor to economic growth. This study developed an Econometric Model taking India as a case study using time series data from 1980 to 2013, aimed at providing additional evidence to the ongoing debate, by employing Johansen Cointegration Test and Vector Error Correction Model to find out whether the relationship between population growth and economic growth is positive, negative or neutral, and whether the relationship is short run or long run. The study further used Granger Causality Test to find out the direction of causality between the variables. During these periods, the study found that the relationship between population growth and economic growth is positive and there exist a unidirectional relation, running from economic growth to population growth. The policy implications of the outcome suggest among other things that, government should take population as virtue by investing more resources in human capital development through quality education, infrastructures as well as encouraging small and medium scale industries to achieve the long run economic growth.

Key words*: *Population Growth, Economic Growth, Urbanization, Employment

1. Introduction

The global demographic trend has become a subject of discussion by researchers, policymakers, and the mass media. Economic performance in any country is, to a substantial degree, affected by the country's demographic situation. In recent decades, the developed countries have been experiencing declining fertility rates that caused serious shortages of the workforce. Besides, the plunging fertility rates have led to the phenomenon called "ageing population" which has become a socio-economic reality in many developed countries and which has put a big strain on their pension systems. Furthermore, in 2014, there was a campaign tagged "Do it for Denmark" where Danes were encouraged to go for more babies to check the decreasing birth rates. On the other hand, the poor economic performance of especially developing economies is related to their demographic growth; therefore, funds are allocated for campaign against their population growth. The importance of the relationship between population growth and economic development has been well recognized by development economists. As Dawson and Tiffin (1998: 149) have pointed out, "most textbooks on economic development include a section on population and development".

Despite the fact that there are numerous research studies on the relationship between population and economic development, there is no universal consensus as to whether population expansion is beneficial, detrimental or neutral to economic growth. Thirlwall (1994: 143) has observed that "the historical evidence is ambiguous, particularly concerning what is cause and what is effect" in the relationship between a country's population and its economic growth. On one hand, the relationship between population growth and economic performance could be regarded as positive when the upward demographic trends stimulate the economic development and leads to a rise in living standards. In this situation, the population growth promotes competition in business activities because it leads to market expansion, which in its turn encourages entrepreneurs to set up new businesses. On the other hand, the relationship between population growth and economic performance could be described as negative when the increase in population becomes an impediment to the country's economic development because the rapid expansion of population decreases output per capita, exhaust the resources available, increases dependency burden (i.e., the number of people who are considered to be economically unproductive, such as children and the elderly).

In 1800, the world population was about a billion and increased to 2.5 billion in 1950. In the year 2013, the population of the world was 7.1 billion and is projected to rise to 9.2 billion by 2050 with large percentage of the growth to occur in developing regions.

Current Population of India is estimated as 1,270,272,105 (1.27 billion) people which is the second most populous country in the world, while China is on the top with over 1,360,044,605 (1.36 billion) people (Detail on this in chapter two).

Economists are torn between three theories; first, based its theory on Robert Malthus' findings. Malthus (1798) stated that population increase is detrimental to a nation's economy due to a variety of problems caused by the growth. For example, overpopulation and population growth places a tremendous amount of pressure on resources, which result in a chain reaction of problems as the nation grows. He pointed out that population tends to grow geometrically, whereas food supplies grow only arithmetically. According to the Malthusian model, the causation goes in both directions. Higher economic growth increases population by stimulating early marriages, high birth rates, and reducing mortality rates from malnutrition. On the other hand, higher population depresses economic growth through diminishing returns. This dynamic interaction between population and economic growth is the centre of the Malthusian model, which implies a counter balancing effect on population in the long-run equilibrium.

Second theory states that more people may mean a country can produce and consume more goods and services, leading to economic growth. But this can only occur when employment opportunities grow at least as fast as the labour force and when people have access to the necessary education and training. According to the neo-classical growth model, population is beneficial to an economy due to the fact that population growth is correlated to technological advancement. Rising population promotes the need for some sort of technological change in order to meet the rising demands for certain goods and services. With the increased populace, economies are blessed with a large labour force, making it cheaper as well, due to its immense availability. An increase in labour availability and a low cost for labour results in a huge rise in employment as businesses are more inclined to the cheap labour. Low labour costs results in a shift of money usage from wages into advancement through technology (Coale and Hoover, 1958).

The third theory believes that population growth have no impact on economic growth and development.

1.1 Statement of the Problem

Due to these divergent views among scholars on whether its population growth that drives economic growth or vice versa, the following research questions emerged:-

1.2 Research Questions

1. What is the relationship between population growth and economic growth in India?
2. Is the relationship a short term or a long run phenomenon?
3. Is there any causal relationship between population and economic growth?
4. What is the direction of the causality?

1.3 Research Objectives

1. To determine the relationship between population growth and economic growth in India.
2. To determine if the relationship between population growth and Economic growth in India is a short run or a long run phenomena.
3. To determine the causal relationship between population and economic growth in India.
4. To find out the direction of the causality.

2. Literature Review and Theoretical Frame Work

2.1 Conceptual Issues

2.1.1 Population

According to Thomas Frejka, 1973, the population of an area is the total number of all individuals alive at particular point in time. It is defined as the total number of persons inhabiting an area, district, city or a country.

2.1.2 Economic growth

Economic Growth can be defined in two ways; first, It is refers to growth of potential output i.e. production at full employment" rather than growth of aggregate demand (David Begg, 1994). Second, Economic Growth can be defined as the increase in the real per capita income over a long period of time. In other words it is an increase in the output per head of the population.

2.1.3 Economic Development

There are two major ways of defining Economic Development:-

Traditional view: Economic development implies growth together with structural changes in the economy. In other words, it implies sustained increase in output and institutional arrangement by which it is produced.

Modern view: According to prof. Dudly economic development refers to the sustainable increased in per capita income along with decrease in unemployment, poverty and inequality in the economy. Prof. Amartya Sen argued that the concept of economic development consist of enlargement of opportunities for people and freedom of human choices.

2.1.4 Demography of India

India is a country in South Asia which is situated at the north of equator between $8^0$4' and $37^0$6' north latitude and $68^0$7' and $97^0$25' east longitude. It is the seventh largest country in the world with a total area of 3,287,264 km^2 (1,269,220 sq. mi). The population of India based on the survey carried out on March, 2011, was recorded to be 1,210,193,422 (1.21

billion) persons, thus making it the second largest populated country in the world after China. The current population of India as per the 2015 estimates is recorded as 1,271,702,542 (1.27 billion) people. This figure shows that India represents almost 17.31%, which means one out of six people of this planet live in India. Although China is still the world most populous country in the world, India is set to take the numero uno position by 2030. With the population growth rate at 1.58% India is predicted to have more than 1.53 billion people by the end of 2030.

2.2 Theoretical Framework

2.2.1 Pessimistic Theory

The pessimistic theory traces its lineage to a publication of an English scholar Reverend Thomas Malthus, titled "An Essay on the principle of population" in the year 1798. Malthus asked whether the future improvement of society was possible in the face of ever larger populations. He reached his famously dismal conclusion that the human species would increase in the ratio of 1, 2, 4, 8, 16, 32, 64, 128, 256, 516, etc. and subsistence as 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, etc. that is to say, the population would rise geometrically - by factors of four, eight, sixteen and so on while the food production (substances) would rise arithmetically – by factors of three four, five and so on. In two centuries and a quarter the population would be to the means of subsistence as 512 to 10; in three centuries as 4096 to 13, and in two thousand years the difference would be incalculable. Malthus theorized that food production would quickly be swamped by the pressures of a rapidly growing population. In other words, this scenario of arithmetic increases in food supply coupled with simultaneous exponential or geometric increases in population predicted a future when humans would have no food to survive on.

In 1968, Paul Ehrlich opened his influential book "The Population Bomb" with the words, "The battle...is over. In the 1970s hundreds of millions of people are going to starve to death. He claimed that scarce resources will get so bad that people will begin to think of eating the body of their deaths. Ehrlich work can be considered as an extension of Malthus theory since he asserted that human beings were wrong and going to fail in the battle against hunger. More measured studies undertaken by the US National Academy of Sciences (NAS) in 1971 and the United Nations in 1973 also predicted that the net effect of population growth would be negative.

In addition to the effect of total population growth on the fixed resources, pessimistic advocates also explained that there is potential negative relationship between increases in the number of people with capital accumulation of a given economy. Higher population requires more homes to house, more factories to employ and more infrastructures to provide for their needs which may lead to reduce capital per worker and lower living standards.

2.2.2 Optimistic Theory

Optimistic theories can be traced from the work of Ester Boserup, a Danish economist, who uses similar arguments to turn the Malthusian world-view around i.e. instead of agricultural method determine population as assumed by Malthusians, Boserup argued that population determine agricultural method. A major theme of her work is that “necessity is the mother of invention”. Population growth creates pressure on resources. People are resourceful and are stimulated to innovate, especially in adversity. When rising populations swamped traditional hunter-gatherer arrangements, slash-burn-cultivate agriculture emerged. When that, too, became inadequate, intensive multi-annual cropping was developed. More recently the world experienced what is known as Green Revolution which has almost quadrupled world food production since 1950 using just 1 percent more land, was a direct reaction to population pressure.

According Simon Kuznets, ‘an increase in population means, other thing being equal, increase in the labour force’. If the labour force increases at the same rate as total population, it will be able to turnout as much or more product per worker. Also an increase in the labour force would permit a greater utilisation of unexploited natural resources. This utilisation, combined with a more specialised division of labour would, in all probability lead to a greater product per worker”.

Julian Lincoln Simon’s 1981 book “The ultimate Resource” is another criticism of Malthus theory of population growth which predicted a catastrophe to occur as population grow larger. That’s to say economic growth is negatively related to population growth. Simon viewed that population is the solution to resource scarcity and environmental problems with innovation from both the people and the markets.

2.2.3 The Neutralist Theory

According to Allen Kelly, population neutralism has been the predominant school of thinking among academics for the last half century. Even the United Nations and National Academy of Science reports are becoming more moderate in their views especially in the 1980s. In those days, it was discovered that the so – called exhaustion of natural resources was found not to be strongly affected by population growth as the pessimists thought. There was no empirical evidence that decreasing in saving which affect economic growth happens as a result of population growth. Multi-country studies showed no evidence of diversifying resources from productive physical capital sectors to less productive sectors such as health care, social security and education as assumed by pessimists thought. Kelly opined that the outcomes of these studies together with argument made by Julian Simon were significant reasons for the development of neutralist school of thought.

2.2.4 Empirical Evidences

Tsangyao et'al (2014) using bootstrap panel causality test proposed by Konya (2006), which account for both dependency and heterogeneity across countries, to test the causal link between population growth and economic growth in 21 countries over the period of 1870-2013. With regards to the direction of population growth-economic growth nexus, the study found one-way Granger causality running from population growth to economic growth for Finland, France, Portugal, and Sweden, one-way Granger causality running from economic growth to population growth for Canada, Germany, Japan, Norway and Switzerland, and no causal relationship between population growth and economic growth is found in Belgium, Brazil, Denmark, Netherlands, New Zealand, Spain, Sri Lanka, the UK, the USA and Uruguay. The study also found bidirectional Granger causality between population growth and economic growth in both Austria and Italy. These results suggest that for these two countries the population growth and economic growth both are endogenous, indicating that they mutually influence each other. In other words, while population growth influence economic growth through increase in the labour force, large market and economy of scale, on the other hand economic growth influence population growth through increase in fertility rate, healthcare delivery, decrease mortality rate and improve life expectancy. Their mutual reinforcement has important implications for the conduct of economic or population policies in both Austria and Italy.

Gideon K. et'al (2010), using Vector Auto Regression Estimation technique, found that, the relationship between population growth and economic growth of Kenya is positively which means an increase in population will impact positively on the economic growth in the country. The study concludes that the country's population growth promotes economic growth.

Adediran O. (2012) used ordinary least square method of analysis in examining the relationship between population growth and economic growth of Nigeria. The study discovered that population growth has positive and significant impact on the real GDP.

Aniceto C. (1999), in his reviewed on Philippines concludes that, 'while rapid population growth cannot solely be blamed for all or any of the country's development problems, it is clearly a critical factor. The prospect for catching up with its neighbours is evidently hampered by the country's rapid population growth.

Fumitaka Furuoka and Qaiser Munir in a joined study (2010) found a bilateral causality between population and economic development in an island-state of Singapore. This highlights a dynamic nature of the population-development relationship in the country. In other words, Singapore's population growth did contribute to the nation's economic development, which in return stimulated population expansion in the country.

Fumitaka Furuoka, (2009) employed bounds test (Pesaran et al., 2001) to analyse a long-run relationship between population growth and economic development in Thailand. The findings of this study indicate the existence of a long-run equilibrium relationship between population growth and economic development in Thailand. Also, it shows that there exists a unidirectional causality from population growth to economic development in Thailand. This means that population growth in Thailand has a positive impact on the country's economic performance. These findings support the population-driven economic growth hypothesis which states that population growth promotes economic development.

Rohan Kothare (1999), in his study on the relationship between population growth and economic growth concludes that India has become one of the world's fastest growing country primarily due to the rise in population which creates a positive effect on its long run economic growth. In many cases, economists are correct in saying that population growth has a positive effect on economic growth of a nation.

3. Methodology

3.1 Data Type and Source

This study made use of secondary data for the period ranging from 1980 to 2013 to analyse the model. The main sources of these data are: World Bank Group, World Population Data Sheet, National Commission on Population; Government of India, and Trading Economics (an online data base for more 190 countries including historical data of more than 300 economic indicators).

The relationship between population growth and economic development is an area that received little attention from the researchers. This is perhaps due to campaign against population growth by the western world. Few researches done on this area uses certain methodology such as bound test (Fumitaka Furuoka, Thailand), ordinary least square; fully modified ordinary least square; canonical cointegration regression; and dynamic ordinary least square (Fumitaka Furuoka and Qaiser Munir, Singapore), bootstrap Panel causality test proposed by Konya (Tsangyao et al, 21 countries), vector auto regression estimation technique (Gideon Kiguru et al, Kenya), ordinary least square (Adediran Olanrewaju, Nigeria), Uzawa Lucas Model (Boucekkine et al 2011). Other studies used theoretical methods to analyse population – economic growth relations. These include Aniceto C. (Philippine), Akinwade et al (developing countries) and Andrew Mason (East Asian countries).

In India also, few researchers devotes their time to find the exact relation between the second largest populated economy with its growth and development. In March 2012, Rathore Bhawna used theoretical analysis to study the impact of demographic features on economic development of India.

To make this study different from previous ones, I employed Johansen cointegration technique, Vector Error Correction Mechanism in the study. Furthermore, most of the study used bivariate method to their analysis while this study uses multivariate technique in studying demographic growth and economic development of India during the period 1980 to 2013, a time series analysis.

3.2 model specification

This study adopts the framework of popular neoclassical growth model developed by Robert Solow, which was an extension to the Harrod- Domar (1946) model. The Solow's growth model attempts to explain long-run economic growth by estimating capital accumulation or produced capital, labour or population growth, and increase in productivity which is known as technological progress. The model could be expressed as:-

$$Y_t = f(K_t, A L_t) \qquad (*)$$

Where:-
Y_t = Is the total output at time t
K_t = is the accumulated or produced capital at time t
L_t = is the labour at time t
A = is the labour augmenting technology or knowledge

One important feature of this model is that it can be used and reformulated in slightly different ways using different productivity assumptions, or different measurement metrics. Therefore the study borrows the framework and reformulating it into a model using some other variables. Thus, Y_t which is the total output is replaced with Growth Domestic Product (GDP); K_t which is the produced capital is replaced with infrastructure or simply rate of Urbanization; L_t which is labour is replaced with two variables i.e., employment and Population. This result in a model such as:-

$$GDP_t = f(URB_t, POP_t, EMP_t) \qquad (**)$$

Where:-
GDP_t = Gross Domestic Product
URB_t = rate of urbanisation
POP_t = population growth
EMP_t = employments
Econometrically:-

$$GDP_t = \alpha + \beta_1 POPt + \beta_2 URB_t + \beta_3 EMP_t + \varepsilon_t \qquad (***)$$

3.3 Lag Selection

Before going deep into the test of cointegration, there is need for appropriate selection of the lag length to be used. Estimating the lag length in many econometric analyses is very crucial exercise. The lag length in this study is selected using explicit statistical information criteria obtained through unrestricted VAR estimate. These statistical information criteria include, Akaike Information Criterion, Schwartz Information Criterion, Posterior Information Criterion (PIC) and Final Prediction Error (FPE). The study will use among the lag selection criteria, the Akaike Information Criterion.

3.4 Cointegretion Test

In time series analysis, we are allowed to model one nonstationary time series (Y_t) as a linear combination of another nonstationary time series ($X_{1t}, X_{2t}, \ldots\ldots X_{nt}$). In other words:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \ldots\ldots\ldots + \beta_k X_{kt} + \varepsilon_t \qquad (1)$$

A regression model like the one above gives spurious (nonsense) results unless their linear combination eliminates the stochastic trend and produces stationary residuals.

$$Y_t + \mu_1 X_{1t} + \mu_2 X_{2t} + \ldots\ldots + \mu_k X_{kt} \sim \boldsymbol{I}(0) \qquad (2)$$

In principle, testing for cointegretion is similar to testing the linear regression residuals for stationarity. Thus, we refer to a set of variables as cointegrated when the residuals from their linear combination are stationary even though the variables ($Y, X_1, X_2 \ldots\ldots X_k$) are individually nonstationary. The outcome from such regression can no longer be considered as spurious or nonsense result. To create cointegration relationship, one needs to run first an OLS regression model for the variables and subject the residuals for stationarity test using perhaps the popular Augmented Dickey Fuller (ADF) or Phillips Perron (PP) unit root tests.

Cointegration methods have been very popular tools in applied economic work since their introduction few decades ago. One important test for cointegration that is invariant to the ordering of variables is the full-information maximum likelihood test of Johansen Test of Cointegration.

3.5 Johansen Test

Named after S. Johansen, the Johansen Test is a procedure of testing cointegration of several time series data. This test permits for more than one cointegrating relationship and turnout to be more applicable than the Engle Granger test which is based on the Augmented Dickey Fuller (ADF) test for unit roots in the residuals from a single (estimated) cointegrating relationship.

The Johansen test takes its starting point in the Vector Autoregression (VAR) of order p given by

$$\mathbf{Y_t = \mu + A_i Y_{t-1} + A_i Y_{t-2} + \ldots\ldots\ldots + A_p Y_{t-p} + \varepsilon_i} \qquad (3)$$

Where $\mathbf{Y_t}$ is an **nx1** vector of variables that are integrated of order one commonly expressed as $\boldsymbol{I}(1)$, and $\boldsymbol{\varepsilon_t}$ is an **nx1** vector of innovations. The above equation can be re-writing as

$$\mathbf{\Delta Y_t = \mu + \Pi Y_{t-1} + \Sigma\, \Gamma \Delta Y_{t-I} + \varepsilon_t} \quad (4)$$

Where

$\Pi = \Sigma\, A_i - \mathbf{I}$ and $\Gamma_i = - \Sigma A_j$

If the coefficient matrix **Π** has reduced rank **r<n**, then there exist **nxr** matrices **α** and **β** each with rank r such that $\mathbf{\Pi} = \boldsymbol{\alpha}\, \boldsymbol{\beta}'$ and $\boldsymbol{\beta}'\mathbf{Y_t}$ is stationary. **r** is the number of cointegrating relationships, the elements of **α** are known as the adjustment parameters in the vector error correction model and each column of **β** is a cointegrating vector. It can be shown that for a given **r**, the maximum likelihood estimator of **β** defines the combination of $\mathbf{Y_{t-1}}$ that yields the **r** largest canonical correlations of $\Delta\mathbf{Y_t}$ with $\Delta\mathbf{Y_{t-I}}$ after correcting for lagged differences and deterministic variables when present. Johansen proposes two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the **Π** matrix. These tests are: the trace test and maximum eigenvalue test. More than 90% of the outcomes of these tests are the same though in rear cases, their inferences might be a little bit different.

$$\int_{trace} = - T\, \Sigma \ln (1 - \lambda_i)$$

$$\int_{max} = - T \ln (1 - \lambda_{r+1})$$

T is the sample size and λ_i is the **i**th largest canonical correlation. The trace test tests the null hypothesis of r cointegrating equations against the alternative hypothesis of n cointegrating equations. On the other hand, the maximum eigenvalue tests the null hypothesis of **r** cointegrating equations against the alternative hypothesis of **r + 1** cointegrating equations. These tests follow asymptotic critical values which can be found in Johansen and Juselius (1990).

3.6 Vector Error Correction Model

The appropriate econometric specification for two or more nonstationary variables found to be cointegrated, that is to say, the variables have underlying stochastic trends along which they move together on a nonstationary path, is the Vector Error Correction Model (VECM). VEC is just a special case of the VAR for variables that are not stationary at their level form and become stationary after differences (i.e., *I*(1)).

Consider two variable x and y that are cointegrated (i.e., *I*(1)), then there exist a unique $\boldsymbol{\alpha_0}$ and $\boldsymbol{\alpha_1}$ in which:

$$u_t \equiv y_t - \boldsymbol{\alpha_0} - \boldsymbol{\alpha_1} x_t \sim I\,(0) \quad (5)$$

The error correction model of this single equation where y is the dependent variable and x is the independent variable can be appropriately specified as:

$$\Delta y_t = \beta_0 + \beta_1 \Delta x_t + \lambda u_{t-1} + \varepsilon_t = \beta_0 + \beta_1 \Delta x_t + \lambda\,(y_{t-1} - \boldsymbol{\alpha_0} - \boldsymbol{\alpha_1} x_{t-1}) + \varepsilon_t \quad (6)$$

Since α coefficient, which is the cointegrating vector, are known or consistently estimated, the terms in the above equation turn out to be *I* (0). The u_{t-1} term is the magnitude by which y was below or above its long run equilibrium value in the previous period. The coefficient λ (which is expected to be negative) represents the amount of correction of this period (t -1) disequilibrium that happens in the period t. for example if we are using annual data in our time series analysis and λ happens to be 0.5, it means one half of the gap between y_{t-1} and its equilibrium value would tend (all else equal) to be reversed in the period t. this is because the sign is negative.

For more than two variables nonstationary time series analysis the Vector Error Correction Model can be written as:-

$$\Delta y_t = \beta_{y0} + \beta_{yy1}\Delta y_{t-1} + \beta_{yx1}\Delta x_{t-1} + \lambda\,(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + v_t^y, \quad (7)$$

$$\Delta x_t = \beta_{x0} + \beta_{xy1}\Delta y_{t-1} + \beta_{xx1}\Delta x_{t-1} + \lambda\,(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + v_t^x. \quad (8)$$

As in previous example, all the terms in both equations above are $I(0)$ if the variables are cointegrated with a cointegrating vector $(1, -\alpha_0, -\alpha_1)$, or to put it more straight forward, if $y_t - \alpha_0 - \alpha_1 x_t$ is stationary. The λ coefficients are again the error correction coefficients which measure the response of each variable to the degree of deviation from the equilibrium in the past period. It is expected that $\lambda_y < 0$ for the same aforementioned reason i.e. if y_{t-1} is above the equilibrium value with x_{t-1} then the error correction term $(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1})$ is positive and this should – other things constant – downward movement in y in period t. The expected sign of λ_x depends on the sign of α_1. We expect $d\Delta x_t/dx_{t-1} = -\lambda_x\alpha_1 < 0$ for the same reason that we expect $d\Delta y_t/dy_{t-1} = \lambda_y < 0$: if x_{t-1} is above its long run relation to y_t then we expect Δx_t to be negative, all other things remain constant.

3.7 Causality Test

A Granger Causality Test is a statistical hypothesis test used to find out whether a given time series can be used to forecast or predict another. It was developed by Clive Granger (a Novel Lauren, 2003) in 1960s and has been widely used in economics since then.

According to Granger (1969), If variable X Granger causes another variable Y, then the past value of X should contain information that are useful in predicting Y, over and above the information contain in the past value of Y alone. Its mathematical formulation is based on linear regression modelling of stochastic process. More complex extension to non-linear cases that seems to be practically difficult also exists.

In the of two variables as mentioned earlier, the mathematical approach to test whether there exist a causal relationship between then can be written as:

$$Y_t = a_0 + a_1 Y_{t-1} + \ldots.. + a_p Y_{t-p} + b_1 X_{t-1} + \ldots.. + b_p X_{t-p} + u_t \quad (9)$$

$$X_t = c_0 + c_1 X_{t-1} + \ldots.. + c_p X_{t-p} + d_1 Y_{t-1} + \ldots.. + d_p Y_{t-p} + v_t \quad (10)$$

Here we assume that u_t and v_t are uncorrelated. A unidirectional causality exist when from X to Y if the estimated coefficients on the lagged X in the first equation are statistically different from zero as a group and the set of estimated coefficients on the lagged Y are not statistically different from zero. In the same vain, unidirectional relationship from Y to X do exist when the lagged Y in the second equation are statistically different from zero and the lagged X are not statistically different from zero in the first equation.

A bilateral causality do exist when the set of both lagged X and Y are statistically different from zero in both equations. But when the set of lagged X and Y are not statistically different from zero in both equations, we can simply say that no causal relation between the variables (Gujarati, 2012).

4.1. Result Analysis

This chapter is aimed at discussing the result obtained from different tests, using the methodology proposed in the previous chapter. First, the study begins with finding out the order of integration through the stationarity test. Second, the test of cointegration to determine whether there exist any cointegration vector or equation among the variables. Akaike Information Criterion (AIC) is used as a lag selection criterion in this regards. Third, the vector error correction mechanisms, to discover the short run and the long run relationship as well as the speed of adjustment back to equilibrium in the short run. Finally, the granger causality test to see the direction of influence between the variables.

4.2 Order of integration

To find the order of integration between the variable under consideration (GDP, Population, Urbanisation and employment, the study begin with testing for the presence of unit root in the variables by employing a univariate analysis for stationarity. Table 1 below reports the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test of unit root for the variables.

Table 1: Unit Root Test (1980 – 2013)
Kwiatkowski-Phillips-Schmidt-Shin (KPSS)

Variables	Level		First Difference	
	Statistic	Critical (5%)	Statistic	Critical (5%)
GDP	0.649692	0.463000	0.090579	0.146000
Population	0.682464	0.463000	0.212034	0.463000
Urbanisation	0.648938	0.463000	0.101135	0.463000
employment	0.647582	0.463000	0.139658	0.463000
source: Author's calculations using E-views				

Table 1 report that all the four variables (GDP, Population, Urbanisation and employment) are not stationary in their level form. At five percent level of significance, the critical values of all the variables are less than their respective t-statistic which implies the rejection of the null hypothesis of stationarity. This shows that, all the variables in their level form have unit root. However, taking the first difference of the variables and rerunning the test again, all the variables become stationary. In other words, after taking the first difference of all the variables, their critical values become greater than their respective statistic. Thus, the variables are said to be integrated of order one (I (1)), which is the fundamental requirement for employing cointegration test.

4.3 Test of co-integration

Since the all variable are I (1), the next step is to find out whether these variables have a long run relationship. In other words, whether there exists equilibrium in the long run. To determine this, the study adopts johansen cointegration test. Meanwhile, Akaike information Criterion (AIC) is employed as lag selection criterion. Table 2 report the results of both the trace Statistic and maximum Eigen value.

Table 2a: Johansen cointegration test: trace statistic

Hypothesized Number of Cointegration Equations	Eigen Value	Trace statistic	Critical Value (at 5% level)	probability
None*	0.724441	63.63305	47.85613	0.0009
At most 1	0.351100	23.67547	29.79707	0.2145

Source author's calculations

*Denotes the rejection of null hypothesis at 5% level

Table 2a is the Trace statistic part of the johansen test of cointegration. The null hypothesis at none is rejected at 5% level of significance since the probability is 0.009 (less than 5%). Also the critical value at 5%, level which is 47.86 is less than the trace statistic value i.e. 63.63. The null hypothesis of at most 1 cointegrating equation is accepted with the probability accounted for 21.5% (greater than 5%). In the same vain the, the critical value at 5% level of significance which is 29.8 is greater than its corresponding value in trace statistic (i.e., 23.7).

In a nutshell, according to Trace Statistic, there exists one cointegration equation among the variables under study.

Table 2b: Johansen co-integration test: Maximum Eigenvalue Statistic

Hypothesized Number of Cointegration Equations	**Eigen Value**	**Max-Eigen statistic**	**Critical Value (at 5% level)**	**probability**
None*	0.724441	39.95758	27.58434	0.0008
At most 1	0.351100	13.40678	21.13162	0.4155

Source: Author's calculations
*Denotes the rejection of null hypothesis.

Table 2b reports the outcome of johansen cointegration test under maximum Eigen value statistic. The null hypothesis of no cointegration equation is rejected at 5% level, because the probability is significance i.e., 0.8%. Likewise, the critical value of the Max-Eigen value which is 27.58 is less than its corresponding statistic i.e., 39.96. On the other hand, the null hypothesis of at most one cointegration equation is accepted since the probability is almost 42% (greater than 5%), and the critical value of the Max-Eigen statistic is 21.13, which is greater than its corresponding statistic value that stands at 13.40.

Thus, both the Trace Statistic and Maximum Eigen Value suggest that there is at most one cointegration equation among the variables under study. This means that the variables have a long run association ship. This indicated that the first objective of the study is been achieved.

4.4 Vector Error Correction Mechanism

The purpose of running Vector Error Correction Model (VECM) is to find out the dynamic interrelationship among the cointegrated variables. The VECM is a system equation where all variables are solved simultaneously. Since our variables are found to have a long run relationship or cointegrated, the study employed VECM to find out the significance of the error correction term (how long the disequilibrium takes in the short run to get back to the equilibrium), the significance of all the coefficients of the independent variables as well as the coefficients of the lags selected. Finally Wald Test frame work shall be used to test the short run influence of the explanatory variables on the explained variable.

Table 3: Coefficient Estimates from the Vector Error Correction Model

Independent Variables	Coefficient	Std. Error	t- statistic	Probability
ECM1	-0.101738	0.019179	-5.304560	0.0000
D(GDP (-1))	0.124766	0.298670	0.417739	0.6804
D(GDP (-2))	-1.458460	0.283373	-5.146780	0.0000
D(POP (-1))	8.109842	3.383989	2.396533	0.0259
D(POP (-2))	2.423966	3.046219	0.795729	0.4351
D(URB (-1))	19.07812	7.594081	2.512235	0.0202
D(URB (-2))	-21.69909	6.898444	-3.145505	0.0049
D(EMP (-1))	0.163795	0.046374	3.532029	0.0020
D(EMP (-2))	-0.030485	0.053839	-0.566224	0.5772

R-Squared	0.783538	**F-Statistic**	8.446091
D – W stat	2.060739	**Probability**	0.000031

Source: Author's calculation using E-views

Table 3 shows the coefficients estimates from the framework of VECM. The Error correction mechanism (ECM 1) provides a means whereby a proportion of the disequilibrium is corrected in the next period. Thus, an error correction mechanism is a means to reconcile the short-run and long run behaviour. Considering the result in Table 3, the coefficient of ECM1 (which is also known as the speed of adjustment toward equilibrium or coefficient of the cointegrated model), is not only negative but also significance i.e. the coefficient accounted for –0.10 and the probability accounted for 0.00. This implies that it takes 10 months for the short run deviations to correct itself back to equilibrium.

It is also important to mention that apart from DGDP (-1), DPOP (-2) and DEMP (-2) all the remaining coefficients that made up the total explanatory variables in the model, are significant in explaining the variation in the dependent variable because their corresponding probability value is less than 5% each.

The good ness of fit of the explanatory variables in explaining the explained variable accounted by R-squared is 78.3%. This shows that the independent variables explain almost 80% variation in the dependent variables. The Durbin – Watson statistic that capture the present of serial correlation in the residuals is 2.1 which signifies absence of autocorrelation in the model. The F – statistic is also high accounted for 8.45 and its corresponding probability value is 0.000031.

Table 4: Wald Test

Short run influence	Null hypothesis	Chi-square Value	Probability
POP to GDP	No short run influence	6.864828	0.0323
URB to GDP	No short run influence	11.75639	0.0028
EMP to GDP	No short run influence	13.51520	0.0012

source: Author's calculation using E-views

Table 4 reports the results of the short run influence between each and every independent variable with the dependent variable. This is done in line with the second research question which says whether the relationship among the variables in the model is a short run or a long run.

The null hypothesis of no short run influence is rejected in all the three variables (including their lag values), because their respective probability value is less than 5%. Therefore, going by the results in table 4, and the fact that the variables are cointegrated, the study concluded that there are both long run and short run influences on economic growth by population growth, urbanisation and employment respectively, in India during the period of the study. In other words, population growth, urbanisation and employment are individually influencing the economic growth even in the short run. Thus, the study has addressed the second research questions.

4.5 Test of Causality

The third and fourth research questions stated that whether there is causal relationship between the variables and what the directions of the causality are? This is tackled using Granger Test of Causality. The study performs this test using bivariate autoregressive process for the variables. The essence is first, to find whether there exist causal relationships among the variables, second, to find the direction of the causation (if any).

Table 5: Granger Causality Test

Null hypothesis	**Obs**	**F-statistic**	**Probability**
POP does not Granger Cause GDP GDP does not Granger Cause POP	30	2.04580 4.87484	0.1246 0.0061
URB does not Granger Cause GDP GDP does not Granger Cause URB	30	4.02838 4.82031	0.0141 0.0065
EMP does not Granger Cause GDP GDP does not Granger Cause EMP	30	2.13180 5.22760	0.1126 0.0044
POP does not Granger Cause EMP EMP does not Granger Cause POP	30	3.33294 1.86196	0.0291 0.1548
URB does not Granger Cause EMP EMP does not Granger Cause URB	30	4.14798 5.75288	0.0125 0.0027
POP does not Granger Cause URB URB does not Granger Cause POP	30	3.92137 2.72583	0.0157 0.0568

Source: Author's calculation using E-views

As earlier mentioned, the third and fourth objectives of this study are to determine whether there exist a causal relationship between economic growth and population growth in

India during the period under study and the direction of the causality. Table 5 above shows the causal relationship not only between GDP and Population but also between each and every variable in the model.

The null hypothesis of no causal relationship between population growth and economic growth, running from population growth to economic growth could not be rejected at 5% level, since the probability is insignificant i.e., 12.5%. However, the null hypothesis of no causal relationship running from GDP to population growth could be rejected at 5% level, with the probability accounted for 0.61% which is highly significant. Thus, there is unidirectional causality between population growth and economic growth, running from economic growth to population growth in India during the period under study. In other words, an increase in income causes population to grow in India.

The test captured a bidirectional relationship between Urbanisation and GDP. The null hypotheses of no causal relationships in both directions are rejected at 5% level i.e., from Urbanisation to GDP and from GDP to Urbanisation, with probability accounted for 1.41% and 0.65% respectively. This means that growth in GDP leads to the expansion of towns and villages into urban centres through the provisions of infrastructures. On the other way round, the provisions of these infrastructures pave way for economic development of India.

The relationship between GDP and Employment according to Table 5 can said to be a unidirectional causation. The null hypothesis of no causality between the two variables running from Employment to GDP is accepted with the probability accounted for 11.26% which is greater than the required 5% to reject it. This can be related to the fact that, although efforts are being made to generate employments, but low wage or salary attached to significant portion of jobs in India can find it difficult to manifest in the economic growth. However, the null hypothesis of no causality between the variables running from GDP to Employment is rejected with the probability accounted for 0.44%. This shows that economic growth facilitates employment opportunities.

The null hypothesis of Population does not Granger-cause Employment could be rejected with probability accounted for 2.91% which is less than 5%. This implies that Population growth generates more Employment opportunities. This finding goes in line with the Optimistic theory of population which stated that when people are many, the total wage will be relatively small which give firms and industries opportunity to employ more heads. In the long run, the level of unemployment will be kept at minimum level; there will be increase in output per capita due to specialization; advancement in innovation and technology through research and development as a result of less cost of production (since labour is relatively cheap); which will further increase output (Ester Boserupe, Karl Max, Simon Kuznets, Julian Simon etc). On the other hand, the null hypothesis of Employment does not Granger-cause

Population cannot be rejected at 5% level of significance because the probability is about 15.5%. Therefore, the study concludes that there exists a unidirectional causality between Population and Employment, running from Population growth to Employment.

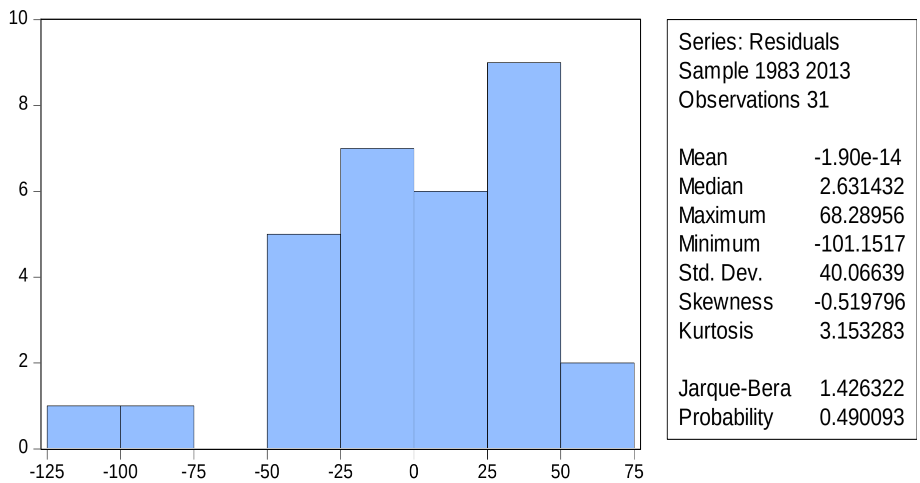
The relationship between Urbanisation and Employment can said to be a bidirectional, based on the results shown in Table 5. The null hypotheses of no causality in both cases are rejected since the probability is less than 5% each. This implies that urbanisation in India increases employment opportunities, which in turn, stimulates the expansions of urban centres.

Lastly, the causal relationship between Population and Urbanisation can said to be a unidirectional at 5% level. The null hypothesis of Population does not Granger-cause Urbanisation could be rejected with probability accounted for 1.57%, which means that Population growth leads to transformation of villages and towns into urban centres. But the null hypothesis of no causality between these variables running from Population growth to Urbanisation could not be rejected, since the probability is greater than 5% i.e., 5.7%. However, at 10% level of significance, the relationship between the variables turns out to be bidirectional causality. This indicated that population growth Granger-cause expansion of urban centres and it also turn round to Granger-cause population growth in India during the period of study.

To ensure consistency, the study employed residuals diagnostic tests which include Normality Test, Serial Correlation Test, and Heteroskedasticity Test.

First, the study checked whether the residuals are normally distributed using Normality Test (Jarque-Bera approach). In this framework, the null hypothesis of "normal distribution of the residuals" is tested against the alternative hypothesis of "the residuals are not normally distributed". The null hypothesis could be accepted if the probability value is greater than 5%.

Table 6: Normality Test of the Residuals



Source: Author's Calculations using E-views

Table 6 indicated that the probability of Jarque-Bera statistic is 49%. Therefore the study accepts the null hypothesis of normal distribution of the residuals.

Second, since the study is dealing with time series data, the possibility of autocorrelation is high. Therefore there is need to test the residuals for autocorrelation. The study employed LM Test of residuals serial autocorrelations adopted by Breusch-Godfrey.

Table 7: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.140741	Probability	0.8696
Observations R-squared	0.452556	Probability	0.7975
Null hypothesis: No Serial Correlation			

Source: Author's Calculation using E-views

Table 7 shows the result of LM test based on Breusch-Godfrey framework which indicated that the null hypothesis of no serial correlations could be accepted at 5% level of significance. The probability of the observed R-squared is about 80% which is more than 5% required to accept the null hypothesis. This indicates that there is no autocorrelation in the variables

Third, the study further employed Heteroskedasticity Test under the framework of Breusch-Pagan-Godfrey. The result is illustrated in table 8 below.

Table 8: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.104901	Probability	0.4121
Observations R-squared	13.14904	Probability	0.3583
Null hypothesis: No Heteroskedasticity			

Source: Author's calculation using E-views

The null hypothesis of no Heteroskedasticity could be accepted since the probability is more than 5% i.e., 36%. Thus, the analysis is not suffering from Heteroskedasticity.

5. Conclusion

The aim of this study is to find additional empirical evidences on the relationship between population growth and economic growth as economists are perambulating between three theories. First, economic growth and population growth are negatively related, which means if population increases, economic growth decreases. Second, economic growth and population growth are positively related, which implies that when population increases economic growth also increases, and third, population growth is neutral to economic growth. The study established an econometric model under the framework of Solow growth model to test the relationship between population growth and economic growth in India, using a time series data from 1980 – 2013. Other variables included in the study includes, rate of urbanization and data on employment in India.

The result of the Johansen test of cointegration shows that the variables are cointegrated and the VECM shows the speed of adjustment toward the long run equilibrium from the deviation in the short run. The short run influence on the dependent variable (GDP) by the independent variables (population, rate of Urbanisation and employment) were tested using a Wald Test which indicated that each independent variable influence the dependent variable in the short run. The study also discovered a unidirectional causality running from GDP to Population growth; a unidirectional causality running from GDP to employment; a unidirectional causality running Population to employment; a bidirectional causality or feedback influence between GDP and rate of urbanisation; bidirectional causality between urbanisation and employment; and finally, bidirectional causality between population and rate of urbanisation.

Conclusively, the relationship between population growth and economic growth is found to be positive in this study. In other words, the variables are found to have long run positive relationship or equilibrium. This results coincides with outcome of other empirical work done by many researchers such as Tsangayo et'al (2014) in Finland, Portugal, and Sweden; Adediran (2012) in Nigeria; Gideon K. et'al (2010) in Kenya; Fumitaka Furuoka and Qaiser Munir (2010) in Singapore; Fumitaka Furuoka (2009) in Thailand; Rohan Kothari (1999) in India; which support the argument raised by optimistic economists.

5.1 Policy Implications

The rationale behind any research is to make an impact in the framework or economy where it is conducted. The fundamental driven force to carry this research came as a result of my residing in India where I witnessed what population growth means. This driven force pushed me to begin to look at theoretical and empirical literature about population in general and that of India in particular and eventually leads to this little contribution to the economy of India.

India was the first country to officially implement family planning program to restrict population growth in early 1950s. Unfortunately (to Indian Government) or fortunately (to those that were born) all its targets were missed. Though in urban centres people are now trying to maintain small family of two to three children, due to this program, many in rural areas keep large family under the traditional or religious umbrella. As a matter of fact, India has gathered momentum in terms of large population. Even if small family will be kept across the country, the population will keep growing.

Thus, the first policy implication suggests by this study is that population should be taken as virtues not vice, since it has long run equilibrium with economic growth. As point out by optimistic economists such as Ester Boserup, Simon Kuznets, and Julian Simon, large population can brings problems in the short run, but in the long run, the economy will be better off than if those problems were never occurred.

Second, the study discovered that there is a feedback influence between rate of Urbanisation and all other variables. This indicated how provision of infrastructure contributes immensely to the economic growth and development. Therefore the study suggests that large amount of fund should be allocated each and every fiscal year in the provision of infrastructures in India in order to minimise the problems of large population growth in the short run and maximise its benefits in the long run. These infrastructures include, education, health care, transportations, communications, banking services, electricity, vocational training for women and school dropout, farm inputs etc.

Third, small and medium scale industries should be given more consideration since government and other formal organisations could not provide jobs enough to keep the rate of unemployment at barest minimum. Therefore, government should further looks into the problems facing by these sectors in areas such as tax, tariff, etc

Fourth, government should also looks into exploitation especially by construction firms on labour in terms of wage. Most of construction firms resort to employ women from villages and pay them a mega amount. Reasonable amount (not necessary large) of wage is significant in improving the living standard of the teaming population of India and keep it productive.

Fifth, zero tolerance to corruption should be employed and maintained in India because many at times, fund allocated to developmental project of improving the living standard of the people are either syphoned and redirected to private purses or embezzled to some other less productive purposes at the detriment of the populace, hiding behind that people are too many to be taken care of by the public fund.

Sixth, inequality and cast system should also be considered. As in many developed countries, the riches are taxed heavily in many ways to improve the living standard of the poor. If this can be adopted fully in India, the population could be taken care of, no matter how large it may be. Furthermore, the concept or assumption of cast system should be relaxed and allow those considered to be low cast to fully participate in the economy at all level and all spheres of life without any restrictions.

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