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Demographic Opportunity and Economic Development: A Comparative Study of India and China

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Abstract: Since a long period of time, the academia and policy makers have tried to understand and explain the drivers of growth of China and India, the emerging economic powers and the fastest growing economies of the world before the onset of Covid pandemic. These two Asian giants are also the most populated and the youngest (in terms of share of young population) nations of the world. Although, both the countries enjoyed the demographic opportunity but why is the China's economic performance significantly ahead than of India? Against this backdrop, the paper attempts to link demographic advantage in terms of high working-age population with economic growth taking the evidences from India and China. The study uses the data from the World Bank Database and applies time series econometrics and population pyramid technique to test the arguments. The study finds that the impact of population policy on demographic indicators was not that perceptible in the case of India and it has not been able to take advantage of its demographic advantage. It should replicate the important lessons learned from its counterpart i.e. China and should make adequate investments in health, education and especially in skill creation.

Keywords: Demographic Dividend, Economic Development, Population Policy, China, India.

Introduction

Across the globe, dynamics of population growth has been a major concern for all the countries as there is strong empirical linkages between the structure of the population and its impact on the economic growth (Bloom and Williamson, 1998; Bloom, Canning and Malaney, 2000; Lin, 2012; Bloom, Canning and Fink, 2010; Ladusingh and Narayana, 2011; National Transfer Accounts (NTA) 2016; Joe, Kumar and Rajpal, 2018; Taketoshi, 2020; Jafrin et al., 2021; Chaurasia, 2021). As the countries pass through the different stages of demographic transition in their process of development, a window of a demographic opportunity opens in the phase of rapidly declining mortality. The result is an increase in the share of young adults in the population leading to a 'youth bulge'. The youth bulge has been used extensively in the demographic analysis and refers to a demographic pattern where a large share of the population comprises of children and young adults (Lin, 2012; Inayatullah, 2007). This bulge is indicative of a large share of the working-age group in the total population which may yield a demographic dividend and hence, a low dependency ratio. The dividend, however, is transient. The lower fertility will eventually reduce the growth rate of this potential labour force along with lower mortality speeding up the growth of elderly population. Most countries in the world are now in the third stage of demographic transition, with low fertility and low mortality. This demographic

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transition has greatly affected the economic development in many countries through the demographic dividend. Based on the cross-sectional analysis of 78 Asian and non-Asian countries, Bloom and Williamson (1998) have shown that growth of the working-age population (Demographic Bonus) has had a powerful positive impact on GDP per capita growth while growth of the total population has had a negative impact.

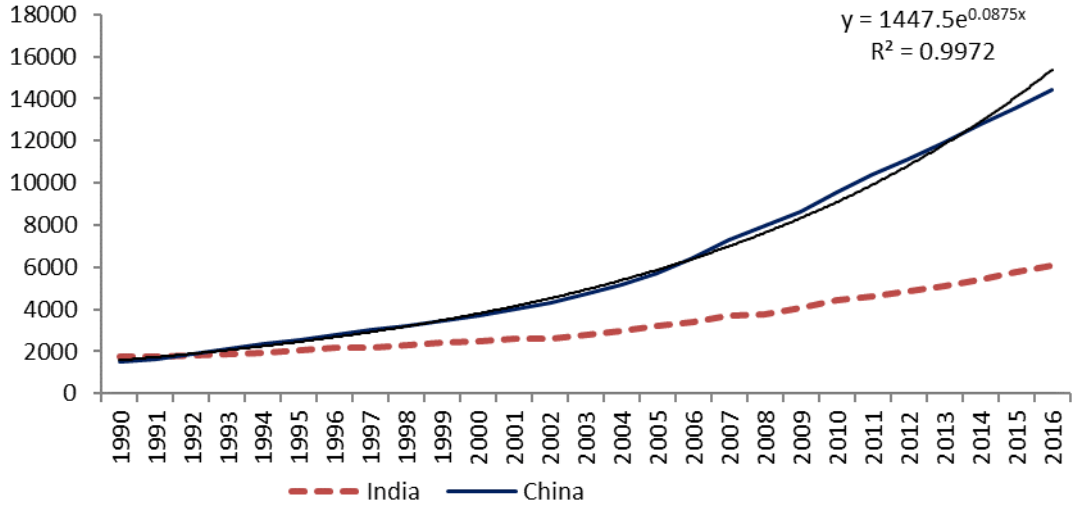
It is also well known that economic growth in the East Asian countries has been hugely benefitted by this demographic gift called demographic dividend, where they have witnessed a decline in the dependent population and increase in working-age population. These evidences create a popular belief that the increase in working-age population will lead to rapid growth of countries (Asian Development Bank, 1997; Bloom and Williamson, 1998; Mason, 2001; Joe, Kumar and Rajpal, 2018; Fang, 2018; Taketoshi, 2020; Jafrin et al., 2021; Chaurasia, 2021). According to Bloom and Canning (2008), "East Asia's macroeconomic performance is tracked very closely by its demographic transition and resulting changes in age structure". In this process, adolescents and youth population are the significant component of the working population which becomes an instrumental for economic growth. Therefore, to reap in the fruits of the development, the productivity of this youth becomes more crucial and hence, the necessary pre-conditions in the form of health, education, skills and productivity of the youth population are imperative to realise the demographic dividend (Asian Development Bank, 1997; Bloom and Williamson, 1998; Mason, 2001; Misra, 2015; Fang, 2018; Taketoshi, 2020; Jafrin et al., 2021).

The proponent of demographic dividend believes that changes in age structure may have a significant impact on economic growth of a nation. It depends on the fact that contribution to production tends to be lower for the young and elderly and higher for the working-age population which implies sources of growth may vary depending on where most of the people fall in the life cycle (Bloom, Canning and Fink, 2010; Ladusingh and Narayana, 2011; National Transfer Accounts (NTA) 2016; Joe, Kumar and Rajpal, 2018). The potential advantage of higher share of working-age population and its contribution to the growth of economy has been shown by Mason and Lee (2006), and Bloom, Canning and Fink (2010) as $Y/N = Y/L \times L/WA \times WA/N$ (Where, Y is the gross domestic product (GDP), L is the total labour force, WA is the working-age population and N is the total population). The per capita GDP is decomposed into three components: first component Y/L is labour productivity; second component L/WA is the employment levels and the third component WA/N reflects the changes in the share of the working-age people in the total population. This shows that with increased share of working-age population, high employment levels can render large growth effects. Converting variables into log form and totally differentiating the identity, it shows the growth rate of income per capita equals the growth of income per worker plus the growth of labour participation plus the growth of the ratio of working-age to total population. Although, Bloom, Canning and Fink (2010) found that faster growth in output per worker accounts for most of the growth in China and India but growth in the working-age share of the total population also contributed modestly.

Since a long period of time, the academia has tried to understand and explain the drivers of growth of China and India, the emerging economic powers of the world, which were also the fastest growing economies of the world before the onset of Covid pandemic. These two Asian giants are the most populated and the youngest (in terms of young population) economies of the

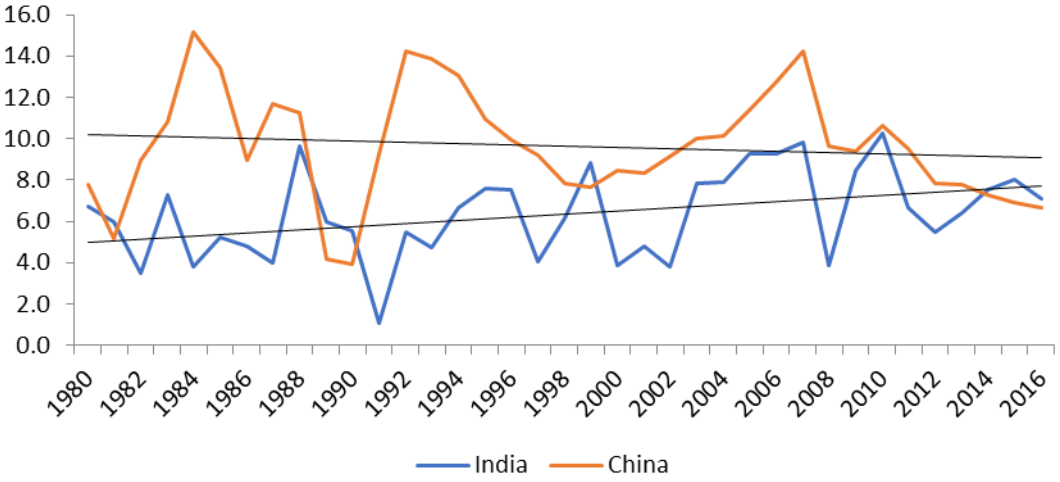
world. Studies suggest that India and China have utilized this demographic opportunity to convert it into high and sustained economic growth (Bloom, 2011; Bloom and Williamson, 1998; Bloom, Canning and Malaney, 2000; Bloom et al., 2006; Bosworth and Collins, 2008; Ladusingh and Narayana, 2011; Joe, Kumar and Rajpal, 2018; Fang, 2018; Taketoshi, 2020; Jafrin et al., 2021). China's take-off began in early 1990s, whereas, India experienced its take-off from 2000s onwards. Beginning with same base in 1990, the World Bank data exhibits that per capita income has risen more than twice in India but registered a remarkable seven-fold rise in China. This is clearly evident as the China's per capita income grew exponentially as compared to India which witnessed more or less a linear growth. At present, the China's per capita income is more than three times that of India (Figure 1). Not only this, China has also been able to reduce poverty to a low level of 4.5 per cent in 2016. However, the corresponding figure for India is 21.9 percent in 2011-12 [World Development Indicators (WDI), 2018].

Figure 1: Trends in Real Per Capita Income



Source: Author's calculations based on the World Bank Data.

Figure 2: GDP growth Rate (constant prices)



Source: Author's calculations based on the World Bank Data.

In the recent years (pre-pandemic times), China's growth was slowing down (but still higher than India) whereas no such trend was evident in the case of India. It can be seen that the GDP growth rates are converging (Figure 2). However, the sources of their economic growth are, in fact, quite different. Bosworth and Collins (2008) noted that China experienced rapid growth mainly on account of its robust industrial sector, booming foreign trade and large foreign direct investment inflows. On the contrary, the growth of India has been mainly driven by the rapid expansion of service-producing industries. Also, the demographic transition experienced by these two nations differs in magnitude and time.

Among other economic growth drivers, higher share of working-age population has been found as an important contributor to the growth of these countries. Studies show that demographic dividend has been instrumental in pushing the economic growth in India and China (Aiyar and Mody, 2011; Bloom, 2011; James, 2008; Bosworth and Collins, 2008; Bloom et al. 2006; Joe, Kumar and Rajpal, 2018; Taketoshi, 2020; Jafrin et al., 2021; Chaurasia, 2021). The link between demographic change and economic growth in Asia, for the period 1965 to 1990 has been studied by Bloom, Canning, and Malaney (2000) and Jafrin et al. (2021) where they noted that demographic transition acted as an accelerator and catalyst for the economic "miracle" in the East Asia and SAARC nations. They revealed that it is the change in age-structure, population density and life expectancy that had a significant impact on growth rates. Mere change in overall growth rate of population is not sufficient to have a positive impact on the economic growth. Kelley and Schmidt (1996) using Barro and KS Models arrived at a quantified analysis that demography has a very favourable impact on economic growth and declining mortality and fertility have notably increased the rate of economic growth. In another study Bloom, Canning, and Sevilla (2003) discussed that the concept of age structure of any country is very important for economic growth because people in different age groups behaves differently with different economic consequences. When the number of working populations is relatively larger than the dependent population then there is a great potential for a major economic outgrowth.

It is also to mention that China has been able to achieve controlled growth of population with its aggressive policy interventions, whereas India is yet to arrest population growth and momentum (Smith and Potts, 2010). Although, researchers differ on effectiveness of the population policy in achieving desired population goals but there is unanimity that it clearly brings out the intentions of the state and guide the socio-economic policy formulations (Smith and Potts, 2010; May, 2012). The role played by the population policies in the demographic and economic transition of China and India is not fully explained by the existing studies.

It is clearly evident from the above-mentioned discussion that, although, both the countries enjoyed the demographic opportunity but China's economic performance is significantly ahead than India. Is it because of the time window of the demographic opportunity different or the policy interventions by the countries? This aspect needs to be looked into for further analysis. Against this backdrop, the main objective of this paper is to analyse the impact of demographic dividend in India and China on the economic growth and development of these two Asian giants. It also seeks to explore the answers to some of the questions like whether these countries have been able to reap the benefits of demographic dividend and convert it into economic development? This paper also attempts to present a brief comparative qualitative analysis of population policy measures for both the countries

The paper is organized in the following manner. After the introduction in the first section, the second section discusses the data and methods. In the third section, population policies of India and China are being analysed to explain how changes in population policy induces demographic changes. The fourth section presents results followed by the discussion in the fifth section. The sixth section concludes the paper.

Data and Methods

Choice of variables

The study follows production function approach to empirically investigate the said relationship taking economic growth as the function of labour force and stock of capital. Different terms have been used to measure the economic progress of a nation in the literature. Researchers primarily used GDP for measuring development of a nation. Researchers also utilized population adjusted GDP i.e. per capita GDP for measuring the economic development of a nation. The study takes both the variables i.e. GDP and per capita GDP to capture level of development, which have been used as a dependent variable. The explanatory variables are labour force and stock of capital. Labour force has been proxied by the working-age population (% share of total population). Age group 15 to 64 years is considered as working population. Few researchers and demographers took 15-59 years as working age-group. However, considering the significant rise in the life expectancy of both the nations, the study undertakes 15-64 years age group as the working-age group. Stock of capital has been measured through gross fixed capital formation. Gross fixed capital formation consists of expenditures on additions to the fixed assets of the economy plus net changes in the level of inventories. The study takes gross fixed capital formation (GFCF) as percent of GDP.

Data

To see the relationship between economic growth and working-age population in the countries selected for the purpose of analysis, we have applied time series econometrics utilising the time series data derived from the World Bank Database of both the countries since 1960. GDP and per capita GDP have been taken in purchasing power parity terms in US$ at constant prices (2011=100). Other explanatory variables- working-age population 15-64 years (% of total population) and GFCF as percent of GDP have also been collected from the World Bank Database – World Development Indicators.

Methods

Augmented Dickey-Fuller (ADF) unit root test is used to check the presence of stationarity and order of integration of variables. Additionally, Philips-Perron unit root test has also been used to confirm the order of integration. The results of unit root tests for the both the countries are given in Table 1 and 2 for India and China respectively. Unit root analysis presents a perplexing picture for both the countries. The ADF unit root tests show that variables are integrated of order one i.e. I(1) in the case of India, whereas, as per Phillips-Perron test, GDP, per capita GDP and GFCF/GDP are I(1) and working-age population (% of total) is I(0). Similarly in the case of China, ADF unit root test suggests that GDP and per capita GDP are I(1) and GFCF/GDP and working-age population (% of total) are I(0) and I(2) respectively. The Philip-Perron test shows GDP, per capita GDP and GFCF/GDP are I(0) whereas working-age

population (% of total) is I(2). Arltova and Fedorova (2016) by a simulation study provide the recommendations which test is suitable to use. For time series of lengths about 50 (T=50), among several tests, ADF test followed by Phillips-Perron test are the most powerful tests for analysing presence of unit root. STATA 13.1 has been used to perform all the econometric analysis in this paper.

Table 1: Test for stationarity and order of integration: India

Variable	**ADF test - Z(t)**		**Philips-Perron Test- Z(t)**	
	At level	**At first difference**	**At level**	**At first difference**
Gross Domestic Product	-0.454	-6.683***	-0.448	-8.311***
Per Capita Gross Domestic Product	0.136	-6.498***	0.157	-8.176***
Working population (% share of total population)	-1.341	-4.478***	-3.885**	-2.981
Gross Fixed Capital Formation/GDP	-2.258	-5.389***	-2.715	-8.471***

Note: Author's calculations based on the World Bank Data. ** p<0.05; *** p<0.01.

Table 2: Test for stationarity and order of integration: China

Variable	**ADF test - Z(t)**		**Philips-Perron Test- Z(t)**
	At level	**At first difference**	**At level**
Gross Domestic Product	-2.017	-5.536***	-5.180***
Per Capita Gross Domestic Product	-2.051	-5.318***	-4.227***
Working-age population (% share of total population)	-2.175	-1.806$^{\$}$	-1.952$^{\&}$
Gross Fixed Capital Formation/GDP	-4.887***	-10.794***	-5.115***

Note: Author's calculations based on the World Bank Data. **$** ADF test statistics at second difference -3.647**. **&** Phillips-Perron test statistics at second difference -7.309***. Note: ** p<0.05; *** p<0.01.

If all the variables are integrated of same order, then variables may be cointegrated (Engle and Granger, 1987). The variables are found to be integrated of order one by the ADF unit root test in the case of India. The Engle-Granger (EG) test for cointegration between GDP and per capita GDP with working-age population (% share of total) has been conducted (Engle and Granger, 1987; Schaffer, 2010; MacKinnon, 1990, 2010). The EG test for cointegration is a two-step residual-based test. The test is performed as follows. First, y is regressed on a constant and x_1, ..., x_k and the residuals are calculated. Then, the first difference of the residuals is regressed on the lagged level of the residuals without a constant. Under the null hypothesis that y and x_1,..., x_k are not cointegrated, the residual should be non-stationary. Rejection of the null is the evidence that the residuals are stationary, i.e., the series are cointegrated. We also used ARDL model (Pesaran and Shin, 1999; Pesaran, Shin and Smith, 2001) based on the unit root test estimates by the Philips-Perron test which showed variables have mixed order of integration but none of them are integrated of order two. For ARDL model, Akaike information criterion (AIC) is used to select the variable lag length and bounds testing approach is used to investigate the presence of long-run relationship (Pesaran, Shin and Smith, 2001).

In the case of China, Granger causality test has been applied after fitting Vector Autoregressive (VAR) model to know whether one variable Granger-causes another (Granger, 1969). A variable x is said to Granger-cause a variable y if, given the past values of y, past values of x are useful for predicting y. As the economic and demographic variables are not integrated of same order and working-age population is I(2), we cannot apply cointegration test or ARDL model to test the long run relationship between working-age population and development in the case of China. The Granger causality Wald test has been applied after running time series VAR regression. The changes in age-structure have also been analysed through age-pyramids. Age-pyramids are widely used tool to analyse change in age-structure for males and females. Age-pyramids have been constructed for both the countries from 1960 to 2016 for every interval of 10 years.

Population Policy and Demographic Changes

Population policy is not only set of quantitative targets portrayed in a formal document rather it also includes implicit actions of the government. May (2012, p. III) says "population policies can be defined as actions taken explicitly or implicitly by the authorities to predict, delay, or manage imbalances between demographic changes, on the one hand, and social, economic, environmental, and political objectives on the other." To influence population growth and distribution, population policies involve a wide range of decisions and actions by governments, both explicit and implicit, which influence individual and family decisions regarding marriage, fertility, working arrangements, and migration (Mosley, 2006). It mainly works through information, laws and regulations, taxes and price controls, direct spending/investments and research channels (Demeny, 2011; May, 2012). Population policies are essential as they provide a directive to the efforts for desirable demographic outcomes which are not possible if left to the individual or self-correction mechanism alone. Here, we would be analysing the population policy interventions of India and China and their impact on demographic changes.

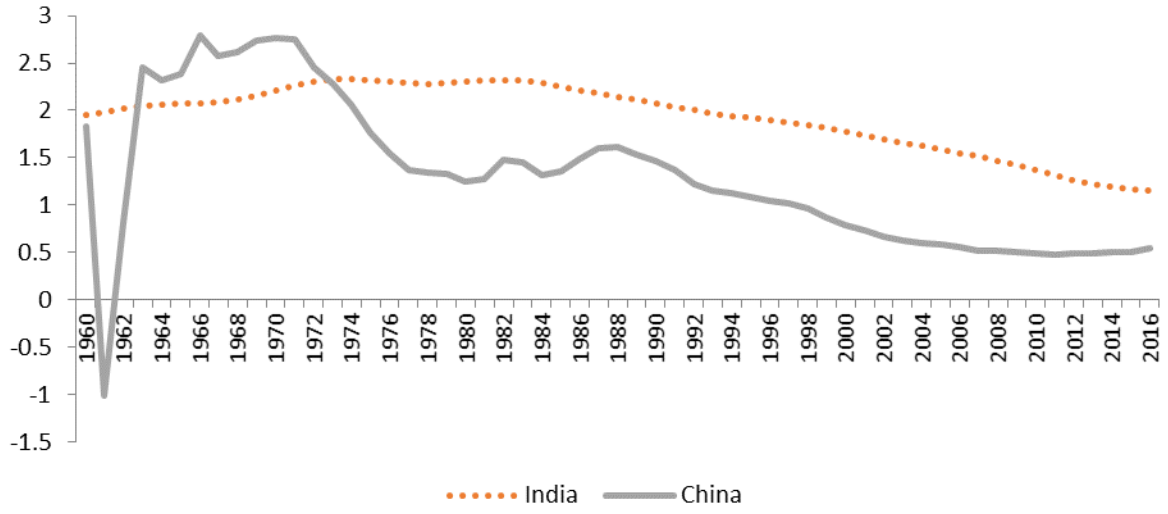
Population Policy in India

When India got independence in 1947 then fertility was high and mortality had started to decline. This was the second stage of demographic transition for India which witnessed increased population growth. The government at that time in the backdrop of available economic resources decided to arrest this population growth rate by providing family planning in its very first Five-Year Plan. However, due to lack of contraceptive techniques and low level of awareness related to consequences of large family size, the efforts of the government could not see the desired results. Continuing its efforts. the government initiated the Family Planning Programme in 1956, the first of its kind in the world. However, the performance was far from satisfactory as most of the demographic targets and deadlines fixed under different programmes were not achieved. Only mortality rates were continuously declining.

The continuing decline in the death rates from 27-30 during the 1940s to 9 during 1996-98 has compensated for the slow decline in the birth rate, which has come down to 26 by 1998 (27 during 1996-98) from about 42-45 during the 1940s and l950s (Visaria, 2002). In the year 2000, the government came out with its ambitious National Population Policy. It had fixed three

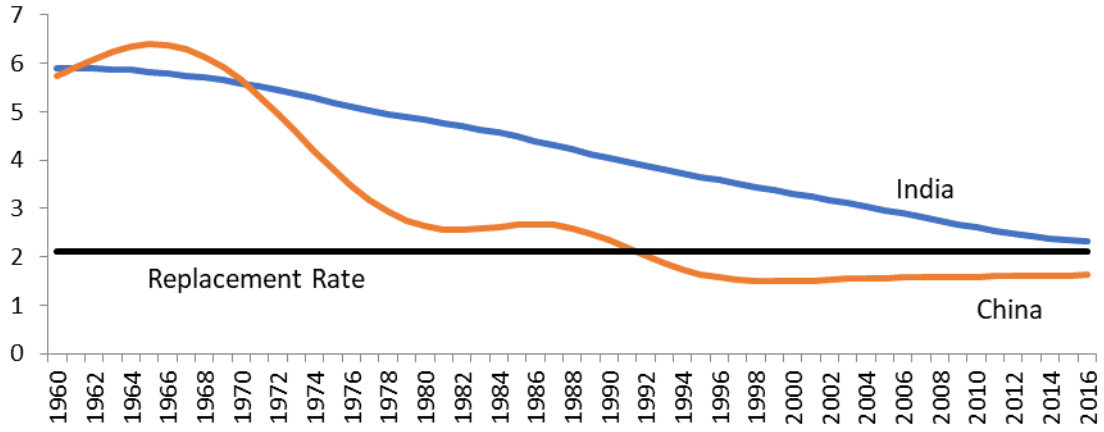
different set of objectives. The immediate objective was to target the unmet need for family planning and health care infrastructure. Its mid-term objective was to achieve a TFR of 2.1 per cent by 2010 and the long-term goal was to attain population stabilisation by 2045. During the nineties, the decline in Crude Birth Rate has been steeper than that in the Crude Death Rate and consequently, the annual population growth rate has fallen below 2 per cent (Figure 3). The total fertility levels declined (Figure 4) from 3.6 to 2.2 during 1991 to 2016 (SRS 2019) mainly on account of investment in human development reflected in improved health, better education statistics and decrease in child mortality in the country. However, India yet to achieve the replacement rate of fertility.

Figure 3: Trends in Population growth



Source: Author's calculations based on the World Bank Data.

Figure 4: Trends in total fertility rate



It has been almost two decades now, when National Population policy was announced. Since then, the government has neither made any efforts to formulate a new population policy nor has taken any significant policy actions to regulate the population growth. In the Indian context, it is important to understand that this ignorance towards population issues is not by

default but has been done willingly and deliberately. Indian population is very sensitive and traditionally rigid towards applying artificial measures to control fertility. The successive governments apprehensions (to lose power) to take any direct policy action to regulate fertility or population has put this important subject at the backseat of policy making. The rapidly rising population especially working-age population has created tremendous pressure on the government to provide job and basic necessities which they are unable to do so. Thus, a big risk lies in the future when this demographic opportunity could turn into demographic burden and the government due to its laid-back attitude and different priorities may end up in losing this dividend.

Population Policy in China

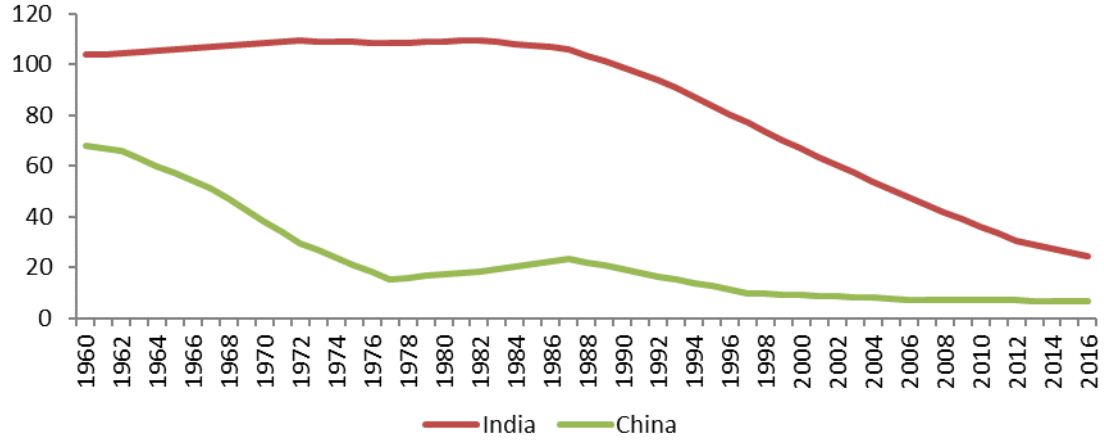
The Chinese Population Policy had a number of milestones. It began with the victory of the Communists in the civil war in 1949 which led to the abolishing of the feudal system and called for equal rights for men and women. The government also encouraged late marriages, recommending age of 23-25 for women and 25-28 for men. Mao Tse Dong, after coming to power in 1949 had favoured a large population. The idea was to have sufficient manpower for their army in anticipation of a counter attack by the Nationalists. However, in 1955 country witnessed a major policy shift with the party focusing on the confinement of the reproduction to improve maternal health and improve status of education of the population. But given the traditional mindset of the people (like in India) the reluctance in the use of contraceptives, the efforts were not very successful. Once again in 1957, government announced ten-year program for family planning in country but due to emphasis on enhancing agriculture and industrial productivity coupled with nuclear war with the United States and Soviet Union, border warfare with India and the Tibetan armed revolt, it was felt that large population is the solution to all these issues.

With persistent efforts of the government, the birth control programme was again on track by 1963 but with the turmoil from 1966 to 1969 in China with regard to its Cultural Revolution, country's growth rate became astonishingly high at 22 percent a year. This massive growth rate incentivised the government who gave the slogan "one is good, two is alright and three is too many," which included delayed marriages, greater space between children and fewer children overall. Contraceptives were now to be distributed free and women could get free hospital care for abortions, IUD insertions, and sterilisations. The results could be seen by the end of the 1970s, as the birth rate had declined from 34 per thousand to 18 per thousand and fertility rate declined from 5.5 in 1953 to 2.9 in 1979 and further to 1.7 in 2004 (Figure 4). In 1980 China's Communist Party began the world's most radical social experiment through one-child policy. Prior to this experiment China already had *Wan, Xi, Shao* (later, longer, fewer) campaign. Yet the Chinese leadership argued that the one child policy was necessary to lift the population from abject poverty (Fong, 2016).

With already below replacement level of fertility, the one child policy has made a significant decline in population growth. However, the reduction in the population growth was beyond the expectation of the government. It created a new problem for China. On one hand the working-age population started stabilizing and on the other, share of aged population started increasing. Along with this the rising demand for labour for economic expansion forced the Chinese government to rethink its approach and revisit its one child population norm policy.

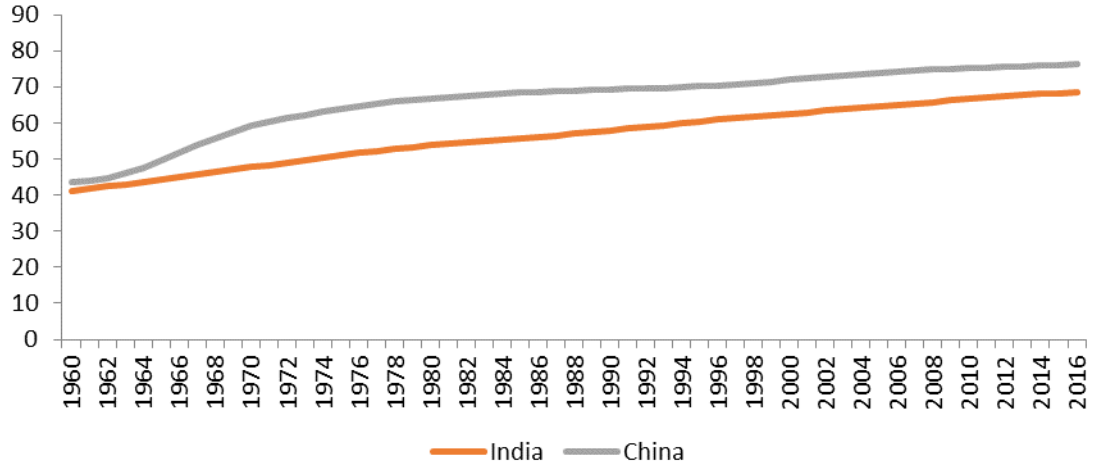
The Chinese government thereby eased its population control programme in 2013 and finally revoked the one-child policy in 2016. The policy though by this time had inculcated reluctance among couples to take-up the two children offer due to the time and financial constraints involved in the case of more than one child. However, coercive one child policy of China along with progress in education, health and income brought significant changes in the population growth as well as age structure of the country. Population growth and fertility rates declined significantly (Figure 4 and 5).

Figure 5: Trends in Adolescent fertility- India and China



Source: Author's calculations based on the World Bank Data.

Figure 6: Trends in Life Expectancy – India and China



Source: Author's calculations based on the World Bank Data.

Thus, it is clearly visible that the approach and outlook adopted by India and China regarding their population differ significantly. India adopted a liberal approach whereas China adopted aggressive approach towards regulation of population growth. As a result, the achievements also differ significantly. China has been able to regulate its demographic growth whereas India is still struggling with it. Nonetheless, the measures taken by the respective

governments in India and China resulted in changing the demographic structure in both the countries with improved life expectancy as evident from Figure 6.

Results

This section is divided into two parts. In the first part, we have discussed the analysis of changing age structure and demographic dividend in India and China through age-pyramids. Econometric analysis is explained in the second part of this section.

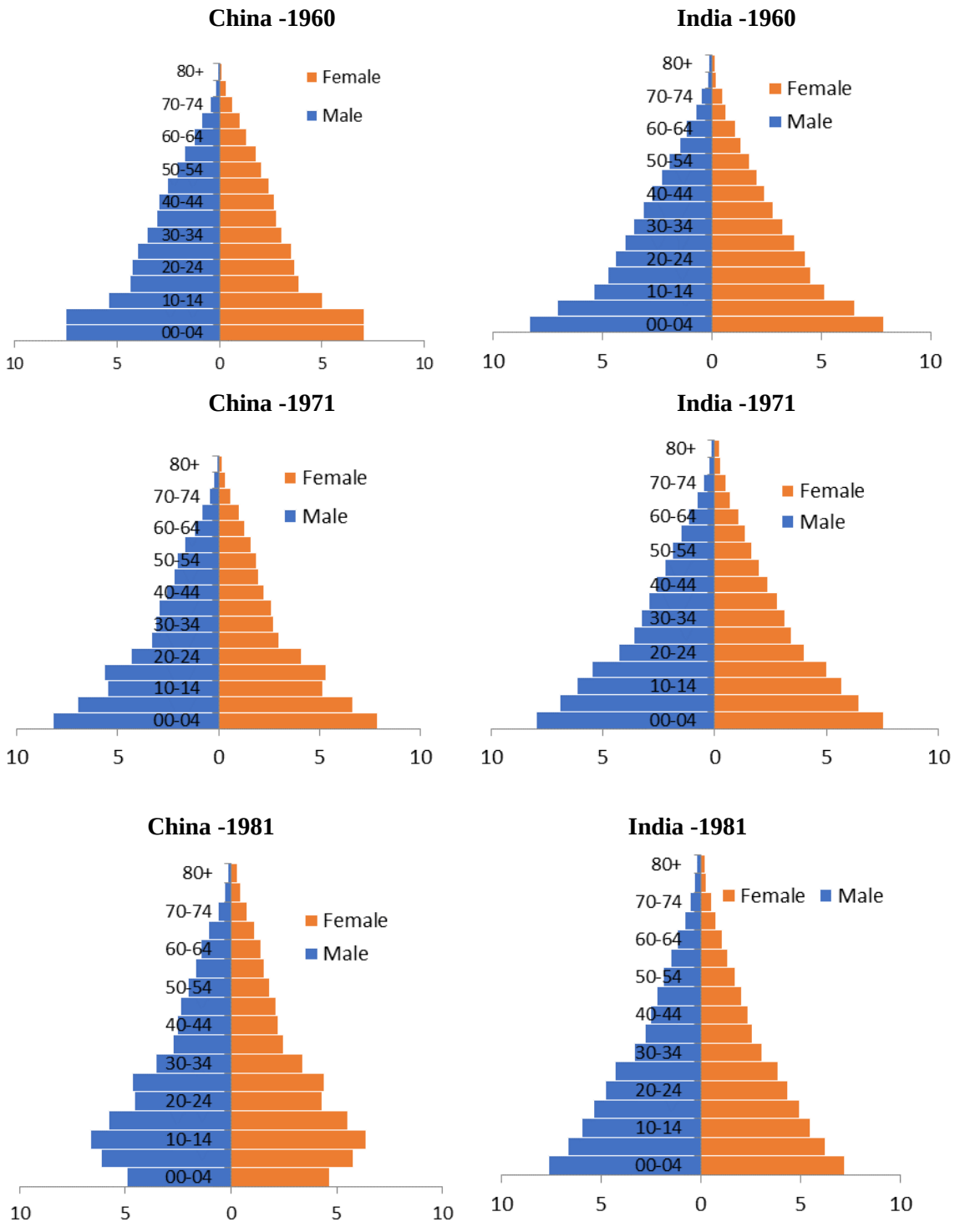
Changes in Age-Structure and Demographic Dividend

Demographic advantage in terms of youth bulge (higher share of working-age population) is the major factor which determines the pace and quantum of economic progress. The population pyramid explains changes in age structure of any country which gets influenced by economic development, fertility, mortality and different stages of demographic transition. At the beginning, the pyramid has a long base, as the median population age is very young. At the second stage, it becomes flatter at its top and the number of young dependents increase. But when the fertility rate decreases, the population growth is kept at check and the median age population becomes higher (Gribble and Bremner, 2012). Changes in age structure of population of India and China is depicted through population pyramids in figure 7 which exhibit the share of population in each age group, separately, for males and females. The pattern of demographic advantage experienced by China and India is distinctly different. During the 1960s and 1970s both the countries had similar age structures as they had a very young population, with more children and fewer elders. This resulted in a typical pyramidal shape of the age distribution of both the countries. In the later years, the base of the population pyramid shrinks faster for China as compared to India as the number of working-age individuals increased in comparison to the increase in children and the elderly. However, bulging of youth population in China started from 1981 as compared to India which experienced the youth bulge from 2001 onwards clearly visible from the shape of the population pyramids.

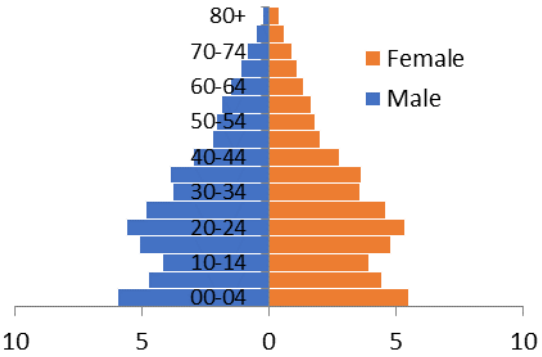
This difference can also be understood from the alternative way i.e. ratio of working-age to non-working-age population (Bloom, 2011). In 1960 and 1970, both the countries have similar working-age to non-working-age population ratio (Figure 8). Since then, it has been low in the case of India than that of China, corresponding to a higher burden of youth dependency (Bloom, 2011). China's demographic advantage of working-age to non-working-age population reached at the highest level in 2010 when there were 2.81 workers per non-working population. It is also notable that demographic advantage seems to be fading as now the aged population is picking up in China. This has happened because of continuous decline in fertility rates even below replacement level.

Indian youth bulge seems to stay longer. As Bloom (2011) said that India's demographic cycle now lags roughly 25 years behind that of neighbouring countries which suggests that next three decades will be a period of catching up for India with respect to per capita income in the East Asia. Would it prove to be a dividend or lost opportunity? It is yet to be decided as India hitherto has not been able to reap its demographic advantage properly.

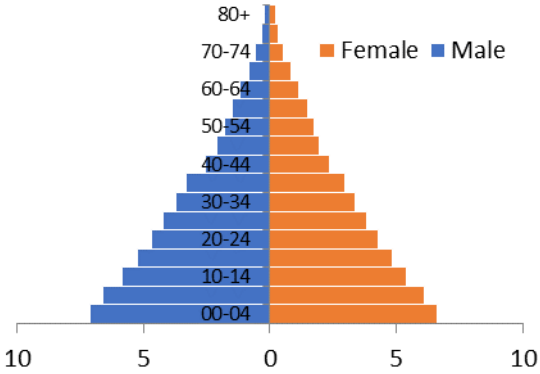
Figure 7: Population Pyramid – China and India (1960 to 2016)



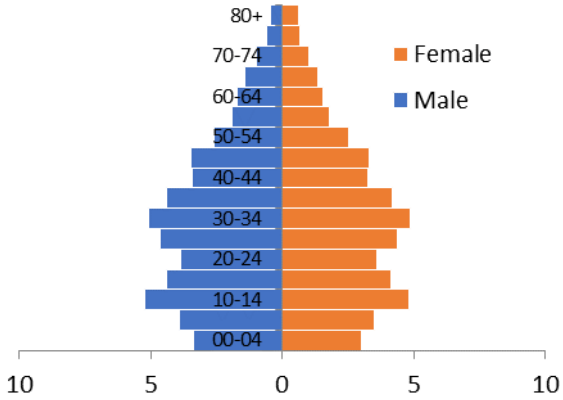
China -1991



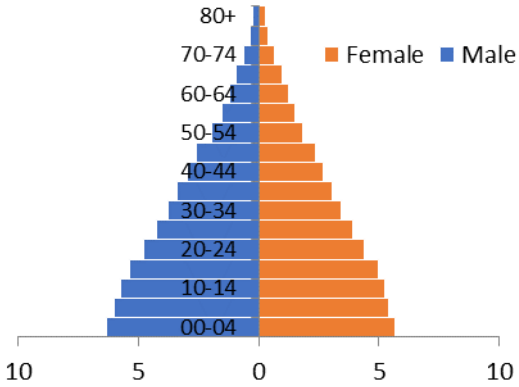
India -1991



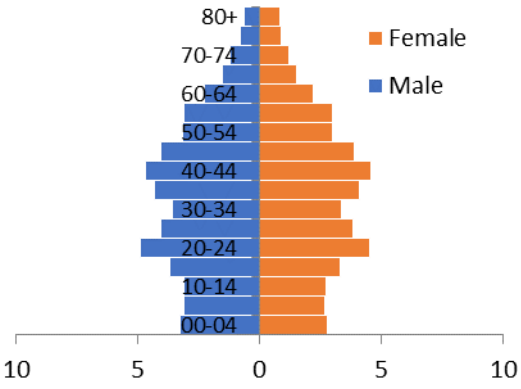
China -2001



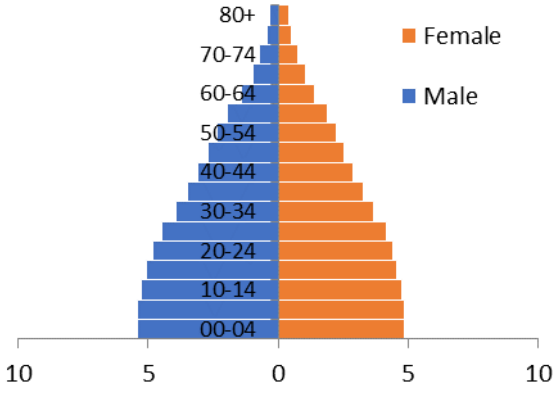
India -2001

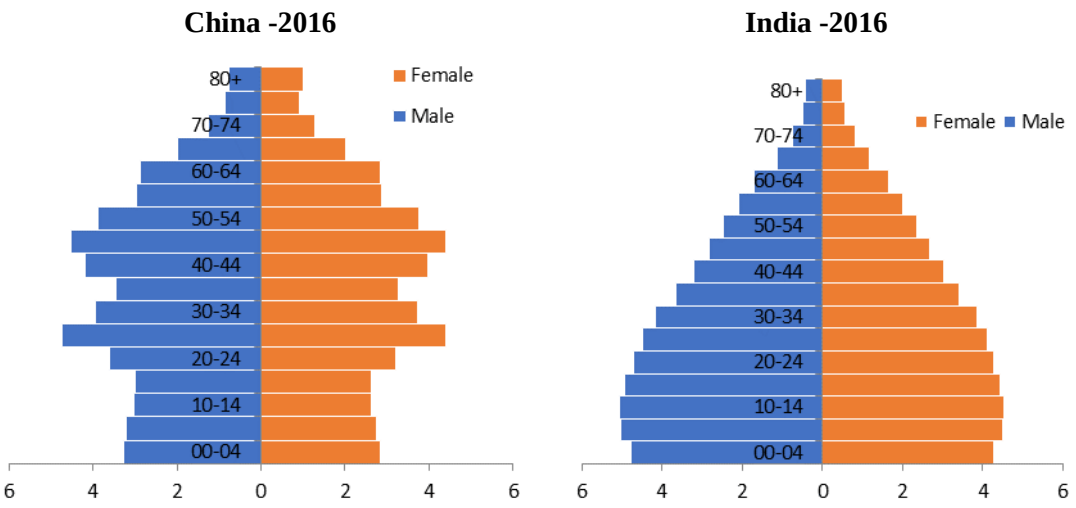


China -2011



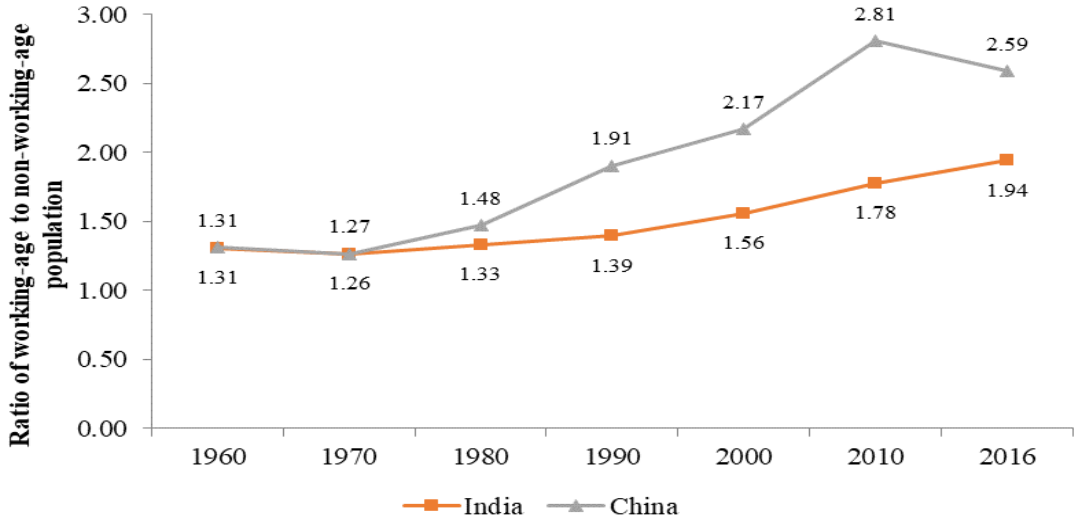
India -2011





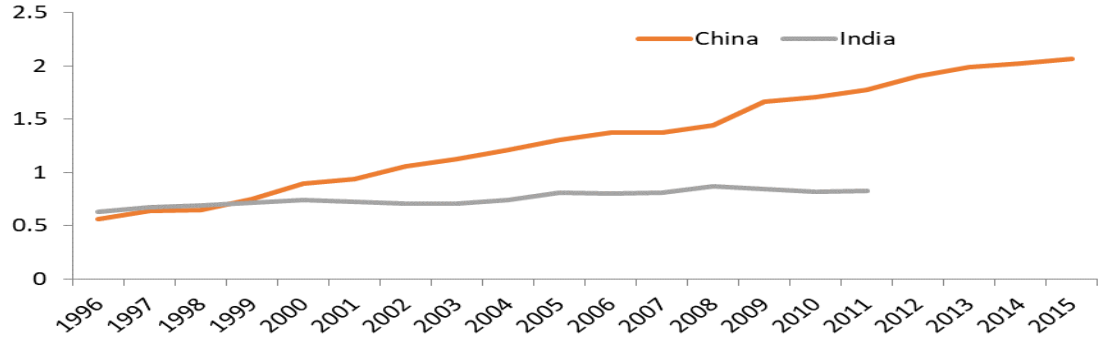
Source: Author's calculations based on the World Bank Data.

Figure 8: Changing age-structure in India and China: 1960 to 2016



Source: Author's calculations based on the World Bank Data.

Figure 9: Research and development expenditure (% of GDP)



Source: Author's calculations based on the World Bank Data.

Econometric Analysis

On the basis of unit root test results discussed in the data and methods section, we have applied Engel-Granger cointegration test to explore the long-run relationship in the case of India. The EG test showed the presence of long run relationship of GDP and per capita GDP with working-age population in India (Table 3). The EG test statistics is statistically significant which showed existence of long run association between working-age population and development indicators. Further, we examined the long-run relationship between economic variables and demographic variables by using ARDL model. The F-statistic of cointegration for both the models is greater than critical values, and confirms the presence of long-run relationship among variables. The models fulfil basic diagnostic tests namely Lagrange multiplier test of no residual serial correlation, Ramsey's model specification test and the test for the absence of heteroscedasticity at five percent level of significance. Long run coefficients of working-age population for GDP (17.621, $p<0.05$) and per capita GDP (11.045, $p<0.01$) are positive and statistically significant too. It shows that one percent increase in working-age population may lead to about seventeen percent increase in GDP and eleven percent increase in per capita GDP. However, GFCF/GDP has positive impact on GDP and per capita GDP but the coefficients are not statistically significant.

In the case of China, as discussed above, we have applied the Granger Causality test to estimate the long-term association and direction of causality between economic growth and demographic dividend. The results are presented in the Table 5. Our results show that GDP, per capita GDP and working-age population Granger causes fixed capital formation. Fixed capital formation also Granger causes working-age population but we failed to reject null hypothesis of working-age population does not Granger cause GDP and per capita GDP in the case of China.

Table 3: Engle-Granger Test of Cointegration

Cointegrating Variables	N (first step/second step)	Test Statistics
GDP and Working-age population (% share of total)	57/55	-3.544**
Per capita GDP and Working-age population (% share of total)	57/55	-3.965**

Note: Author's calculations based on the World Bank Data. ** $p<0.05$. Critical values from MacKinnon (1990, 2010).

Table 4: Long-run coefficients of demographic dividend based on ARDL model, India 1960–2016

Dependent Variable	Log of GDP (3,0,0)	Log of per capita income (1,0,0)
Log of working population share	17.621*	11.045***
Log of gross fixed capital formation	2.097	0.129
Speed of adjustment	-0.02915	-0.1925**
F-test of Cointegration	6.682**	9.830***
Serial correlation LM version (p-value)	0.466(0.494)	0.302(0.5826)
Heteroscedasticity LM version (p-value)	0.058(0.809)	0.280(0.596)
Ramsey RESET test (p-value)	0.39 (0.7594)	0.65(0.587)

Note: Author's calculations based on the World Bank Data. *$p<0.10$. **$p<0.05$. ***$p<0.01$. The models include an intercept. The lag length was selected using AIC.

Table 5: Granger Causality Wald test for estimating long run relationship: China

Dep. Variable	Independent Variable	F- statistics
Log of per capita GDP (first difference)	Log of working population share (second difference)	0.27342
	Log of gross fixed capital formation	0.90052
Log of working population share (second difference)	Log of per capita GDP (first difference)	1.5255
	Log of gross fixed capital formation	1.8794
Log of gross fixed capital formation	Log of per capita GDP (first difference)	14.977***
	Log of working population share (second difference)	4.2519**
Log of GDP (First difference)	Log of working population share (second difference)	0.21711
	Log of gross fixed capital formation	0.17166
Log of working population share (second difference)	Log of GDP (First difference)	1.6564
	Log of gross fixed capital formation	2.5819*
Log of gross fixed capital formation	Log of GDP (First difference)	14.271***
	Log of working population share (second difference)	4.2543**

Source: Author's calculations based on the World Bank Data. *p<0.10. **p<0.05. ***p<0.01.

Discussion

Each nation would like to utilise its demographic advantage for economic benefits but this dividend is not guaranteed (Bloom, 2011). This potential demographic dividend is realisable with certain pre-conditions, the first being to make wider and deeper investments in education, health and skill creation (Fang, 2018; Taketoshi, 2020; Jafrin et al., 2021; Chaurasia, 2021). This opinion is also corroborated in a study by Bhushan (2019) which states that in the long run investing in human capital shall be instrumental in reaping the benefits of demographic dividend. Population policy has been understood as a significant interventionist tool to affect demography and consequent economic progress of the nation. In the case of India, population policy does not seem to be very effective. However, it has brought desirable changes in the case of China. The major decline in fertility (TFR) in China has happened during 1965 to 1980 (a decline of 3.766 points) before adoption of the coveted one child policy. Thereafter, it reached replacement rate of fertility by 1991. As discussed earlier along with the policy activism, it was the Cultural Revolution, awareness and advancements in the field of maternal and child health which caused rapid decline in fertility in China. In India, despite of several measures taken by the government and manifold increase in public expenditure on family planning, the decline in fertility has been very slow. India is yet to reach replacement level of fertility. India may take more than 56 years to achieve reduction in fertility by 3.766 points which China did in 15 years' time period only.

The fertility decline is highly correlated with the educational attainment, maternal and child health care and female labour force participation rate. China had significant improvement in life expectancy and educational attainment during 1965 to 1980. Its life expectancy improved from 49.55 years in 1965 to 66.84 years in 1980, however, India's life expectancy reached to 68.56 years in 2016 from 44.36 years in 1965. Similarly, the female labour force participation[1] rate in China has been significantly high as compared to India. It was more than twice in most of

the years during 1960 to 2016. Female labour force participation rate was 23.60 percent in India and 61.26 percent in China in 2016. The coefficient of correlation between total fertility rate and life expectancy is high and statistically significant too (India: -0.989, $p<0.01$; China: -0.943, $p<0.01$). This further proves our argument that other factors along with population policy played major role in determining the pace of demographic changes in these countries. May (2012, p. X) observed rightly that

> "*It appears that the main challenge for these policies in the twenty-first century will be to link interventions in the area of population to the new issues of economic and human development. These are reducing poverty, promoting fairness, the rollout of secondary and tertiary education, controlling the HIV/Aids epidemic, satisfying the needs of the young, preventing conflicts and violence, and preserving the balance between population and environment*."

Population pyramids showed that demographic transition in terms of age-structure was much faster in the case of China as compared to India. China's transition from higher share of young population to working-age population was swift, whereas, in the case of India, the transition is quite slow. The youth-bulge of China coincides with the episodes of high economic growth. Although, slow transition provides enough window for policy makers to take adequate intervention measures to reap the demographic opportunity when it falls but it also creates confusion as to when real opportunity would arise. This seems to be true in the case of India as social and economic indicators are far behind when compared to China which was experiencing the fruits of demographic advantage. India is experiencing now same stage of ratio of working-age population to non-working-age population what China was experiencing 20 years back. It shows that now India has the relative advantage and would experience the episodes of high economic progress in the coming years.

Our empirical results present some orthodox outcomes. In the case of India, we found existence of long run association between working-age population and development indicators i.e. GDP and per capita GDP, while, there was no statistically significant relationship with GFCF. These findings are in line with the ratio of working-age population to non-working-age population observations. India's youth bulge peak is coinciding with the long episodes of high growth of GDP. This implies that India's demographic advantage is being converted into dividend, however, conversion of opportunity into dividend is slow. The reason is inadequate capital formation. India needs to make greater capital investment to get second order benefits from high working-age population and should learn lessons from China in this context.

In the case of China, we found that working-age population and GFCF is Granger causing each other. This shows that working-age population with adequate capital formation can convert demographic advantage into bigger dividends in terms of high per capita income and economic growth. Working-age population does not find to be Granger cause GDP or per capita GDP may not be very surprising. China has obtained highest level of ratio of working-age population to non-working-age population around 20 years back and now the share of working-age population is declining. This is the reason that our econometric analysis does not found statistically significant evidences about long term association between working-age population and economic development. Studies show that growth drivers of China are total factor

productivity, continuing capital investment and skill generation of young workers (OECD, 2005; Bosworth and Collins, 2008). China encourages capital investment in all sectors especially in industries and services sector. The capital stock along with skilled worker led to higher total factor productivity and thereby higher sustained growth. Thus, demographic advantage of higher working-age population may only be realised if it is coupled with higher capital accumulation and skill training (Wang and Yao, 2003; Joe, Kumar and Rajpal, 2018; Fang, 2018; Taketoshi, 2020; Jafrin et al., 2021; Chaurasia, 2021). The research and development (R&D) expenditure (as % of GDP) of these countries show that China has been investing a significant portion of their GDP in R&D which may be taken as indicator of investment in skill and technological development (Figure 9).

Conclusion

The paper attempted to link demographic advantage in terms of high working-age population with economic growth taking the evidences from India and China. It also critically analyses the population policy of both the nations with reference to their impact on the pace of demographic changes. Whether high working-age population brings higher economic development was the central question which paper attempted to address. We applied time series econometrics and population pyramid technique to test our arguments.

China had an aggressive population policy as compared to India's which was comparatively moderate. However, the impact on demographic indicators was not that perceptible in the case of India. The important lesson from China's experiences is that along with pro-active policy intervention, people's perceptions and attitudinal changes about fewer children and small family size are more important. Our empirical analysis show that advantages of high working-age population is not obvious. China realised its demographic dividend with timely investments in health, education, skill and R&D. It also made adequate investment in capital assets. All these efforts along with higher total factor productivity led to double digit steady growth in China. India has entered late in the growing working-age population era. To realise demographic dividend, it should replicate the important lessons learned from its counterpart i.e. China and should make adequate investments in health, education and especially in skill creation (Medina and Chager, 2015; Drummond, Thakoor and Yu, 2014). Then only we can think of accelerating the growth of economies and accruing sustainable benefits from demographic transition followed by dividend.

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Endnotes

[1] Labour force participation rate, female (% of female population ages 15+) (modeled ILO estimate).

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