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Impact of Ageing Population on Labour Productivity and Economic Growth of India

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Abstract: ***Over the past few decades the age distribution of India's population is shifting towards older workers and this process is going to accelerate in the year ahead. This paper studies the impact of ageing population on labour productivity and economic growth of India. For analyzing the impact of labour productivity the seminal work of James Feyrer is taken as reference. The study examines decadal data from 1991 to 2019 for India, U.S.A., Japan and Europe. We find that elderly participation in labour force has a positive influence on labour productivity which suggests that harmful effect of ageing can be mitigated by more active participation of elderly in the labour force. We also find that there is a positive impact of ageing population in short runs while this impact turns out to be negative in the long run.***

Keywords: Ageing population, Old age dependency ratio, Young population ratio, Economic growth

1.Introduction

According to **International Encyclopedia of public Health, 2008** "Population ageing refers to changes in age composition of a population such that there is an increase in the proportion of older persons." The increased life expectancy coupled with declining labor force is putting more pressure on the Indian economy as the rate of dependency increases. Unlike many developed nations the depth of the problem is severe in India as the retirement system significantly differentiates in formal and informal sector. The elderly working in formal sector only get access to old age security, formal wages, provision like sick leave and retirement between 55 and 65 years. According to a latest survey the total formal employment in the economy is only 9.98 percent which leaves maximum of the population in informal sector. Informal sector employees by contrast lack access to any form of social security such as retirement pension and are also expected to work relatively late in their lives that too at very low wages.

This so called silver tsunami is going to impact the economy negatively and the most feasible way of controlling this is through proper planning and execution of government policies. Although government has implemented policies like Indira Gandhi National Old Age Pension (IGNOAPS) for elderly belonging to below poverty line but the amount allotted is too less to meet even the basic consumption needs of elderly (Kumar and Anand, 2006; Dadekar, 1996, Narayan, 2011). Even the coverage of this policy is very less, less than one third BPL senior citizens benefit from the policy. The inadequacy of these social security measures initiated by government can be reflected by share of GDP spent on these measures. Total amount of public expenditure on different social security measures amount to only about 2 percent of India's GDP. (kryzysmytof et. Al. 2009). Such insufficient resources cannot be allocated properly for a vast labour force. So the only option left with elderly is to depend on their adult children for their livelihood.

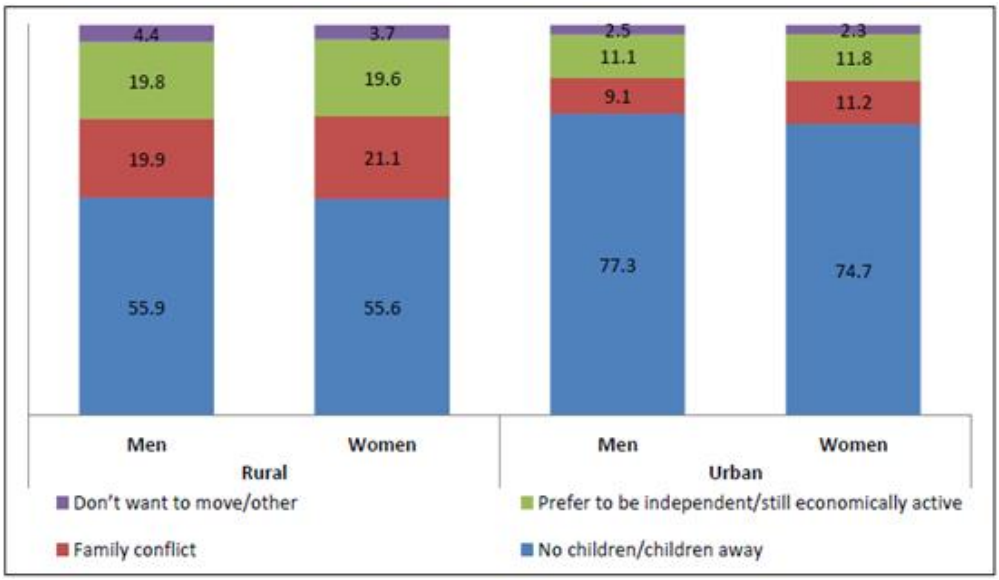

Figure 1: Main reason for living alone or with spouse
Source: National Family Health Survey 2012

Traditionally, India has had a joint family system and as part of such extended family system, it is common for elderly to live with their children. However, as it is visible in figure 1 a significant 22 percent of the elderly are living alone or with their spouses. This figure is on the rise in both rural and urban India. According to few studies it has been shown that with the impact of modernization, urbanization and migration, nuclear families are on rise with the implication that family care for the elderly has been on the decline in India (Dandekar, 1996; Rajan, Mishra and Sarma, 2000; Kumar, 2003). Therefore with the erosion of extended family system and poor social security system for old age, the risk of slipping into poverty is increasing for the elderly.

The factors that influence the labour force participation of elderly vary from country to country according to the stage of development, and variation in historical, socio-economic and demographic conditions. There are several studies which focus on factors that influence the labour force participation of elderly in developed nations but very few have been done on the developing countries like India. This chapter majorly focuses on the trends in the labour force participation rate of elderly in India from 1983 to 2011-12. It also focuses on how different demographic factors and socio-economic factors are correlated with labour force participation decision making at older age. It also assesses the nature and condition of work for the elderly in India.

2.Labour force Participation of Elderly in India

The objective of the study is to illustrate the diverse labour force participation of elderly persons in India on the basis of age, sex and place of residence. The total labour force participation rate of elderly was 42% in 1983 which declined to 37.1% in 2011-12 at all India level.

Table 1: Labour Force Participation of Elderly (age 60 and above) in India, 1983- 2009-10 (in percent)

Round and Year		Rural			Urban		Rural+Urban		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
38th round, 1983									
60+	66.8	22.66	44.85	50.41	13.8	31.26	63.5	20.73	42
60-64	83.18	34.24	59.81	63.93	20.14	41.53	79.31	31.09	55.94
65-69	71.68	23.93	47.2	52.76	13.93	32.71	67.66	21.78	44.1
70-74	54.69	12.92	33.56	38.76	7.89	21.96	51.74	11.86	31.27
75+	28.5	5.26	16.71	24.53	4.51	14.02	27.64	5.09	16.11
43rd round, 1987-88									
60+	67.04	22.03	44.87	48.2	12.3	29.96	63.31	20	41.84
60-64	83.39	31.91	58.14	59.88	18.08	39.19	78.8	29.17	54.42
65-69	71.68	22.31	46.95	51.41	12.61	31.48	67.62	20.28	43.79
70-74	53.18	12.55	33.5	40.03	8.23	23.6	50.68	11.64	31.51
75+	31.12	7.09	19.21	20.9	3.28	11.75	28.89	6.19	17.52
50th round, 1993-94									
60+	70.09	24.13	47.53	44.44	11.35	27.41	64.57	21.17	43.03
60-64	86.14	35.69	62.01	57.39	17.4	37.36	80.25	31.67	56.78
65-69	72.83	24.3	48.23	46.93	11.43	28.12	67.14	21.27	43.64
70-74	59.4	14.01	37.04	35.24	6.83	20.89	54.16	12.39	33.46
75+	27.4	4	16.08	15.19	1.64	8.16	24.32	3.34	13.98
55th Round, 1999-00									
60+	63.18	21.43	42.51	39.48	9.12	23.54	57.86	18.4	38.05
60-64	80.63	32.26	56.4	53.09	13.35	32.59	74.64	27.95	51.09
65-69	70.05	23	46.37	43.49	10.51	25.9	64.06	19.91	41.52
70-74	51.51	10.69	31.7	30.24	5.81	17.43	46.68	9.44	28.26
75+	20.37	2.43	11.88	13.35	1.41	7.1	18.58	2.13	10.56
61st Round, 2004-05									
60+	64.49	25.44	44.82	36.6	10.02	22.79	57.77	21.54	39.39
60-64	82.32	38.17	59.44	47.63	14.64	30.94	73.77	32.58	52.55
65-69	69.77	26.83	48.04	37.56	10.61	23.46	62.24	22.83	42.13
70-74	50.86	12.44	32.51	28.06	7.31	17.09	45.47	11.03	28.57
75+	24.96	4.38	14.78	15.13	2.18	8.23	22.44	3.75	13
66th Round,2009-10									
60+	64.65	22.63	43.73	34.18	7.05	20.16	56.52	18.23	37.26
60-64	82.65	32.36	57	50.14	11.05	29.63	74.21	26.58	49.73
65-69	67.31	23.99	45.91	33.68	7.32	20.14	58.59	19.42	39.03
70-74	50.76	12.92	32.34	22.3	3.69	13.29	42.79	10.36	27.03
75+	24.41	3.59	14.37	10.34	1.25	5.43	20.25	2.78	11.5
68th Round,2011-12									
60+	64.94	21.35	43.11	36.52	7.75	21.8	57	17.42	49.37
60-64	82.2	31.78	56.69	49.44	11.54	29.91	73.37	26.17	58.35
65-69	67.65	21.7	45.07	37.59	7.5	22.54	59.04	17.53	38.53
70-74	50.08	10.81	30.99	27.98	5.94	17.29	44.26	9.53	27.39
75+	26.64	5.4	15.63	11.58	1.34	5.95	21.79	3.98	12.37

Source: Computed from Employment and Unemployment Surveys of NSS of India Rounds 38 (1983), 50 (1993-94), 55 (1999-2000), 61 (2004-05), 66 (2009-10) and 68(2011-12)

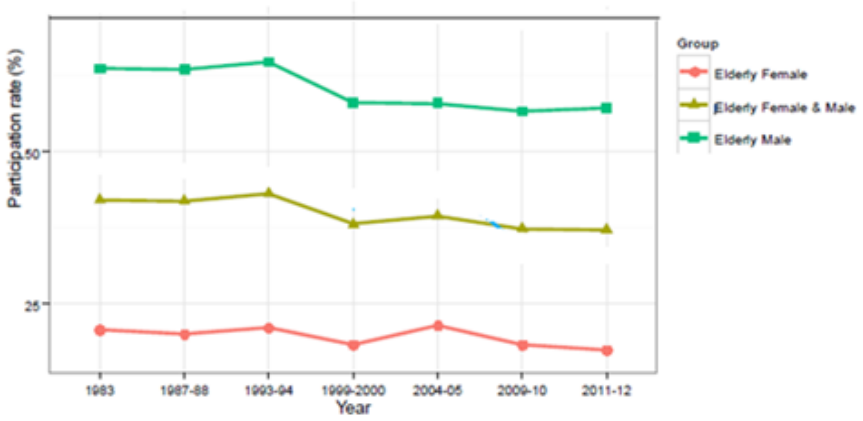

Figure 2: Elderly Labour Force Participation Rates by Gender, India (1983-2012)

Figure 2 depicts the variation in the labour force participation rate of males and females in India with time. As it can be seen in the figure the rate of elderly labour force participation remains constant during the period 1983 to 1993-94 and after that the rate of labour force participation of elderly men reduced. In contrast the labour force participation rate of elderly women remained stable around 20% during 1983 to 2011-12 (Bhalla and Kaur, 2011). After so many years also there is lower female participation in economic activity. Females belonging to the age group 15-59 had much lower participation rate than their male counterparts under the same age group as the rate of participation of females in the age group 15-59 is half the male labour force participation in the same age group (Reddy 2012). This gender difference widens among elderly as the labour force participation rate of elderly men was thrice the participation rate of elderly women. There are many reasons of why this gender difference is more pronounced among elderly. Few of the major reasons are:

- Younger women are more capable of participating in any activity with mass education and modernization of culture.
- Under the changing family scenario where young women participate more in labour force, the elderly women are expected to stay back to look after younger grand children and household chores.
- Previously the rate of fertility rate was high among elderly women due to which the health issues prevail more among elderly women.

Many women may be recorded as not economically active in official statistics but they contribute to household income by usually participating in non-market home based economic activity (klasen and pieters 2013).

3.Impact of Aging Population on Labour Productivity

This study examines decadal data from 1991 to 2019 for India, USA, Japan and Europe. Data source include the World Bank, International labour Organisation and OECD database and other information publicly available on official government websites, as well as reports published by the NSSO. We collected the data for each year of four relevant variables- labour productivity, youth dependency ratio, dependency ratio and percentage of employed persons aged 55-64 years. The sample of three countries is analyzed to compare it with India. The selected sample is of Japan, Europe and USA. As Japan has the world's largest ageing population and Europe is expected to account among the most aged countries in the world by 2030 while USA is a developed nation which has started taking measures for its ageing population. Though we were willing to consider the sample of China too but due to unavailability of sufficient data we excluded it.

Model Specification

We have used the model developed by **James Feyrer**. He carried out one of the first known analyses in relation to the search of a possible relationship between population ageing and labour productivity, so it could be the seminal article in the field of knowledge. In his study Feyrer argued that literature on productivity had neglected the possible influence of population ageing on aggregate productivity, specifically the possible impact of the labour force age structure on productivity. He conducted a longitudinal study between 1960 and 1995 taking into account the age cohort structure of the labour force of the economies under study and their aggregate productivity. He considered two different samples – the first included 87 countries (all the countries for which data were available, excluding oil exporting countries) and the second sample included 19 OECD member countries. In his study he found that there is a strong and significant relationship between the age structure of the labour force and aggregate productivity at the country level. To be specific he found that an increase in the age cohort of the workers between 40 and 50 years old led to improvements in productivity, while cohorts between 15 and 39 led to lower productivity. For cohorts aged 50-59 and over 60, the relationship was also negative.

The proposed regression model takes the labour productivity per person employed as dependent variable (YW). It is converted into Log form and then first

differentiation is applied to estimate the growth rate (ΔlogYW). The explanatory variable or independent variable is taken as the percentage of employed persons between 55 and 64 years of age (w55-64), dependency ratio (OADR) and the youth dependency ratio (YDR). The regression coefficients are β_1, β_2 and β_3 respectively.

$$\Delta logYW_t = \alpha + \beta_1 W55\text{-}64_t + \beta_2 YADR_t + \beta_3 OADR + \mathcal{E}_t$$

The variables are as follows:

YW: labour productivity per person employed.

W55-64: Percentage of people employed between 55and 64 years of age in relation to the total number of people employed.
OADR: Old Age Dependency Ratio calculated as the ratio between the number of persons aged 65 and over and number of persons aged 15 to 64.

YDR: Young Dependency Ratio, calculated as the ratio between the number of persons aged 0 to 14 and the number of persons aged 15 to 64.

Ɛ: Error term.

4.Result and Analysis

This section presents the result of the empirical model specification.

India: The table 2 shows the estimated result of India.

Table 2: Result showing Impact of Aging on Labour Productivity in India

	1991-2000	2001-2010	2011-2019	1991-2019
C	1.39 (.713)	4.8 (.437)	.201 (.472)	0.025 (.91)
W55-64	.707 (.103)	.94 (.438)	7.1 (.123)	.503 (.015)
YDR	-1.37 (.7041)	-4.16 (.395)	-9.65 (.072)	-.720 (.327)
OADR	-1.58 (.66)	-4.61 (.437)	-2.83 (.021)	-.220 (.773)
R^2	.41	.481	.701	.35
DW	2.6	2.6	2.2	2.1
F	1.42	1.85	3.90	4.42
Sig(P)	.324	.23	.08	.01

(Source: Secondary data, compiled and computed by the Researcher)

It can be observed from the above result that both dependency ratios (YDR and OADR) show negative impact on labour productivity in India however old age dependency ratio depicts much significant impact on labour productivity as compared to YDR. So far as the impact of ageing workers is considered, our estimated result clearly shows that ageing workers bring significant positive impact on labour productivity for the period of 1991-2019 and even during the segmented time period also the result exhibits that impact of ageing workers on labour productivity during 2011-19 is more pronounced as compared with the previous time period. Probably, the reason behind it may be that in India about 90 percent workers are engaged in Informal sector where mostly, there is no provision for old age social security so they are bound to work even in their old age.

5.Cross Country Comparison

In order to compare the estimated result of India with USA, Japan and Europe, we have used Ordinary Least Square Method. Their results are reported as under-

USA: The estimated result of USA is presented in Table 3

Table 3: Result showing Impact of Aging on Labour Productivity in USA

	1991-2000	2001-2010	2011-2019	1991-2019
C	-97.20 (0.18)	3.79 (0.20)	542 (0.17)	-59.7 (0.09)
W55-64	2.27 (.118)	-0.771 (.37)	12 (.013)	.713 (.181)
YDR	4.20 (.210)	-1.27 (.278)	-10.68 (0.07)	1.6 (1.97)
OADR	-2.69 (.241)	-1.37 (0.09)	-22.58 (0.03)	.467 (0.08)
R^2	0.45	0.50	0.95	0.17
DW	2.45	2.62	2.25	1.31
F	1.67	2.06	30	1.73
Sig(P)	0.26	0.20	.003	0.18

(Source: Secondary data, compiled and computed by the Researcher)

As shown in table 3 estimated result for USA also suggest similar patterns of dependency ratio as observed in India that is both YDR and OADR show negative impact on labour productivity of USA with OADR having intense and more significant impact on labour productivity as compared to YDR. The result of the aging workers (W55-64) for the period 2001-2010 show negative impact on labour productivity while the picture get reversed for the period 2011-2019. During this period ageing workers positively and significantly affect the labour productivity of USA which may be due to the effective policy measures adopted by the USA government.

Japan: The table 4 presents the estimated result of Japan.

Table 4: Result showing Impact of Aging on Labour Productivity in Japan

	1991-2000	2001-2010	2011-2018	1991-2018
C	2.001 (.246)	4.286 (.013)	2.195 (.487)	1.125 (.390)
W55-64	.195 (.45)	.225 (.48)	-0.09 (.90)	-.09 (.270)
YDR	1.43 (0.45)	-1.01 (.08)	-0.161 (.78)	.843 (.511)
OADR	1.4 (.707)	-1.09 (.016)	-0.373 (.496)	.569 (.486)
R^2	.18	.69	.26	.384
DW	1.3	1.98	2.8	2.070
F	.44	4.5	.48	1.737
Sig(P)	.202	.028	.518	.540

(Source: Secondary data, compiled and computed by the Researcher)

The table 4 presents the result for impact of aging population on labour productivity of Japan. The estimated

result suggests that up to 2000 the entire regression coefficient were positive. In contrast, for the period 2001-2010 dependency ratios indicate negative impact on labour productivity which continues for the period 2011-2019. The ageing workers continue to contribute positively (0.225) till 2010 but thereafter ageing labour force in Japan put deterrent impact however not significantly for the period 2011-2019.

Europe: The following table shows the estimated result of Europe

Table 5: Result showing Impact of Aging on Labour Productivity in Europe

	2004-2019
C	-2.407 (.043)
W55-64	.438 (.154)
YDR	1.067 (.035)
OADR	-1.168 (.014)
R^2	.595
DW	2.763
F	4.901
Sig(P)	.024

(Source: Secondary data, compiled and computed by the Researcher)

We have estimated the similar regression model for Europe for the period 2004-2019 only (due to unavailability of the data from 1991). The result as shown in table 5 suggest that aging workers and young dependency ratio show positive impact on ;labour productivity of Europe whereas OADR show significant negative impact on labour productivity of Europe.

To corroborate we can say that Japan depicts negative impact on labor productivity while India, USA and Europe show significant positive impact on labour productivity. This idea is consistent with Skirbekk's (2008) reflections that competences and skills of the working person can evolve both positively and negatively with age. As it is mentioned by the Aiyer (2016) that the impact of ageing on productivity may be sensitive to the structure of the economy.

In the light of the results of the empirical contrast presented, the negative impact of population ageing on labour productivity constitutes a real socio-economic challenge for Japan. The result reinforce the idea of Aiyer (2016) that the progressive increase in the workforce age can damage their labor productivity and consequently have a significant impact on public services too since population ageing adds pressure on public accounts.

However the positive impact of population ageing on labour productivity in USA, Europe and India can be defended by Acemoglu and Restrepo (2017), who argue that this effect would consist in the fact that the ageing phenomenon would be driving in recent decades the robotization and automation of production processes in certain countries, which in turn would have a positive influence on the productivity of their economies. Although this can be true for developed countries like USA and Europe but not for a developing country like India.

In the context of India positive impact on labor productivity can be due to following reasons:

- One of the main reasons is delayed retirement due to lack of social security to elderly. According to the latest data 92.4 percent workers are engaged in informal sector where they don't get any social security benefits due to which elderly are forced to work in their later stages of life.
- The other reason can be the rising trend of nuclear families which enforces elderly to work on their own for their subsistence living.
- The positive impact on labour productivity can also be due to increase in the participation of females in the labour force.
- Due to lack of enough employment opportunities the rate of migration is also high in India which leaves elderly on their own and they are bound to work for their living.
- The improvement in health status is changing mindset of elderly as now they are more willing to be independent.

6.Impact of Aging Population on the Economic Growth of India

Since different age groups have different productive capacities it's very likely that as population ages the economic structure of the country also gets affected. However some previous studies examining the direct impact of population aging on economic growth have failed to show a negative impact. For example, using a panel dataset for the period 1960-2005, Bloom, Canning and Fink (2008) find that the impact of ageing on growth is negative in short run whereas it is insignificant in the long run. On the other hand some studies examines that the link between population aging and economic growth shows a detrimental growth effect on economy. For example Park and Shin (2012) find that population aging has a negative impact on Total factor productivity, Labour force participation and the saving rate. In case of India there are very few studies which have found a significant impact of ageing population on economic growth. Therefore it is important to systematically reassess the impact of population aging on Indian economic growth by using the recent data.

Empirical Estimation (Partial Adjustment Model)

The study aims to assess if population aging has a detrimental effect on economic growth of India. Data on age structures are collected from OECD data and World Bank's World Development Indicators online data base. We use data for the period from 1995 to 2019.

Following the study of Lee (2013), we adopt the partial-adjustment model to regress the per capita GDP growth rates on a set of independent variables, including demographical variables. In his study Lee assumes that

aggregate output obeys a three-factor Cobb-Douglas production function:

$$Y = AK^{\alpha} H^{\varphi} L^{1-\alpha-\varphi} \quad (1)$$

where Y is gross domestic product (GDP), K is physical capital, H is human capital, L is labour force, and A is the productivity level. Dividing both sides by population, P, and taking the natural logarithm of both sides, they get

$$ln\ y = ln\ A + \alpha ln\ K + \varphi\ ln\ H + (1-\alpha-\varphi)\ ln\ (L/P) - (\alpha+\varphi)\ lnP \quad (2)$$

where y is GDP per capita and k is physical capital per capita and H is Human Capital. Equation (2) suggests that as a country's working-age population increases, it is likely to grow faster.
It is assumed that L is proxied by the working age population, so that

$$In\ y = In\ A + \alpha In\ k + \emptyset\ In\ H + (1-\alpha-\emptyset)\ In\ \left(\frac{P-C-O}{P}\right) - (\alpha+\emptyset)\ In\ P \quad (3)$$

where C is the youth population and O is the old population. Thus, Equation (3) suggests that as a country's share of youth-age or share of old-age increases, the country is likely to grow slower. Following the work of Lee, we estimate the following growth equation.

$$(ln\ y_t - ln\ y_{t-1}) = -\delta\ ln\ y_{t-1} + X_{t-1}\lambda_1 + (X_t - X_{t-1})\ \lambda_2 + \mu_t \quad (4)$$

where δ is the rate of adjustment (or speed of conversion) which is bounded by zero and one, X is a vector of explanatory variables, which are summarized in Equation (3), and μ_t is an error term.

In this partial-adjustment growth model, the λ coefficients on each level variables represents the long-run coefficient (β), while the λ coefficients on the first-difference variables represent the short-run adjustments to contemporaneous changes in the determinants of ln y. Bloom, Canning, and Finlay (2008) also estimate an equation which includes both lagged and first-difference terms of demographic variables. However, their equation includes only the lagged terms of the control variables. Therefore, our equation is more general.

In this study we assume that the productivity of the economy, ln (A), is a function of trade openness.

Then (4) becomes the following empirically testable equation:

$$(ln\ RGDPna_t - ln\ RGDPna_{t-1}) = \delta\ ln\ RGDPo_{t-1} + \beta_1 Pop_{t-1} + \beta_2 YoungSh_{t-1} + \beta_3 OldSh_{t-1} + \beta_4 lnCap_{t-1} + \beta_5 hc_{t-1} + \beta_6 lnTrd_{t-1} + \beta_7(lnPop_t - lnPop_{t-1}) + \beta_8(YoungSh_t - YoungSh_{t-1}) + \beta_9(OldSh_t - OldSh_{t-1}) + \beta_{10}(lnCap_t - lnCap_{t-1}) + \beta_{11}(Hc_t - Hc_{t-1}) + \beta_{12}(lnTrd_t - lnTrd_{t-1}) + \mu$$

Where

$(\ln RGDPna_t - \ln RGDPna_{t-1})$ = Difference of log of real GDP per capita between the period t and t−1
$\ln RGDPo_{t-1}$ = Log of initial level of output-side real GDP per capita
ln Cap = Log of capital stock
Hc = Human Capital Index
ln Pop = Log of total population
YoungSh = Population aged below 15 (youth age) as % of total population
OldSh = Population aged above 65 (old age) as % of total population
ln Trd = Log of trade as % of GDP (World Bank's WDI)

Thus, Equation (4) will be estimated using Ordinary Least Squares (OLS), from the year 1991-2018 for India. The data used is the average of five years using 5 year moving average model. The data of on Human Capital Index was taken from World Bank. However few years data needs to interpolate due to non-availability of data.

7.Empirical Result

The result of the above regression analysis is reported in table 6.6. All the variables are calculated with the five year average of the variables using moving average method so as to avoid fluctuation for the period of 1991-2019.

Table 6: Result showing Effects of Population Aging on Economic Growth of India

Variable	Coefficient	t-Statistic	Prob.
LNCAPLAG	-0.932734	-1.595394	0.1547
LNGDPLAG	-0.226569	-0.679996	0.5184
LNHCLAG	12.58376	1.920203	0.0963
LNPOPLAG	-3.267319	-1.361711	0.2155
LNTRDLAG	0.096998	0.804080	0.4478
OLDHARELAG	-0.207871	-0.365302	0.7257
YOUNGSHLAG	-0.106847	-0.422516	0.6853
HCFIRSTDIF	2.010136	0.346233	0.7393
OLDSHFIRS	0.059473	0.50394	0.9612
POPFIRST	17.88771	0.144239	0.8894
TRDFIRST	0.113994	1.807183	0.1137
YOUNGSHFIRST	-0.289423	-1.159466	0.2843
CAPFIRSTDIFF	1.433960	1.622877	0.1486
C	37.07542	1.913175	0.0973
R-squared	0.978640	F-statistic	24.67055
Durbin-Watson stat	2.147889	Prob(F-statistic)	0.000141

(Source: Secondary data, compiled and computed by the Researcher)

The result of the impact of aging population on economic growth is presented in the table 6. The table clearly indicate that coefficient of the aging on growth is positive while its lag value show negative impact on economic growth. More specifically, a 10 percentage point increase in ageing population leads to decline in economic growth rate by .20 percentage point in the long run while in the short run ageing population show positive impact of .05 percentage point.

However share of young population (0-15) has bigger negative impact in long run as compared to old age share in India. Further it is evident from the result that role of Human Capital play important role in economic growth of India both in short run and long run.

To conclude we can say that even though problem of ageing population ageing has not reached its advanced stage but it is expected to reach at high level in foreseeable future which will put detrimental impact on country's growth rate. Therefore effective measures are essential on the part of government policies and programmes, not only to provide them Socio-Economic and health security but also to transform the ageing population into productive human capital.

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