



DEMOGRAPHIC DETERMINANTS OF ECONOMIC GROWTH IN INDIA: A POLICY- ORIENTED ANALYSIS

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Abstract

This study examines the impact of key demographic factors—healthcare, education, urbanization, investment, and labor dynamics—on India's economic growth from 1991 to 2023. Using World Bank annual data and robust econometric techniques, including IRLS to address outliers, we estimate a model grounded in the Cobb-Douglas framework. Results highlight that increased investment, improved education spending (with a lag), and longer lifespan positively influence GDP growth, while rapid urban growth exerts negative pressure. Inflation and employment ratio changes also show significant effects. Findings align with the demographic dividend theory, emphasizing that strategic investments in healthcare and education can enhance productivity and economic well-being. However, regional disparities and cultural barriers limit equitable benefits. The study offers policy-relevant insights for optimizing resource allocation, underscoring the need for balanced, region-specific strategies to sustain growth while addressing the challenges of population aging and urbanization.

Keywords: India; economic growth; demographic factors; lifespan; sustainable development.

JEL Classifications: O47, J11, I15, I25, R11, C33, O53



Introduction

Primary theme of this study is to examine the effects of various demographic factors on the economic growth rate of the India. Is important to maintain good quality of life which is not the case in India, as healthcare, education and urbanization can lead to a significant boost in an economy increasing labor productivity which is one of the variables in Kobb Douglas production function. More over in recent years India has undergone structural transformations like shift in fertility rate and age structure in the country. Our study aims to be used by policy makers that will decide is each dollar spent on healthcare is worth of investment. India overall is one of the best countries in the sphere of medicine and digital technologies and the main barrier in the well being of the while population is in cultural barriers that make difference between middle and rich call tremendous. Previous studies have found that health care and investment in infrastructure are associated with increase in economic well-being, also they highlight that balanced approach is recommended as better healthcare and life style leads to an increase in labor force participation it also increases the number of aging populations which requires its own theme. Regional specific approach aimed on correct policy structure is the best argues the studies. During our studies we will observer the diverse effects of demographic factors on economic growth.

Literature Review

The literature of demographic economics explores the concept of demographic dividend which suggests that by properly investing in education and healthcare and creating new jobs among young people leads to economic speed-up. The fundamental research about demographic dividends emerged from the work of Bloom, Canning and Fink in 2003. The paper written by Bloom Canning and Fink explores population aging impacts on economic growth by illustrating how life expectancy changes affect national productivity. The authors stressed that population age composition benefits require governments to make educational and healthcare investments to achieve maximum demographic dividend outcomes.



Bloom, Canning, and Finlay (2008) applied the initial framework to Asian countries with India as part of their analysis. This research revealed that demographic youthfulness promotes economic growth yet needs structural reforms to avoid future benefit deterioration when population aging occurs. This research demonstrated that health improvements through higher life expectancy led to increased labor productivity but notes that growing elderly dependency ratios present financial pressures. The authors suggested that emerging nations like India should create policies to boost older worker participation yet continue human capital investment.

This paper by Gupta (2012) performed a systematic study to determine how demographic changes influence GDP per capita growth within India. Through both time series and panel data methods Gupta showed that health outcome improvements which increased life expectancy led to economic expansion. The burden faced by working individuals increased as a result of higher levels of elder dependency thereby generating negative pressure on per capita income. Gupta proposed that public institutions should use their funds to improve education and healthcare while undertaking labor market reforms for generating additional productive jobs. The research by Chatterjee and Singh (2015) studied the relationships that exist between demographic changes and India's labor market operations.

The researchers demonstrated that realizing demographic dividend required substantial populations within the working years to develop both adequate skills and effective workforce employment. Research results showed that areas with superior educational results alongside comprehensive vocational training achieved better economic growth. The research demonstrated that supportive policies especially reforms in social security and active labor market programs are essential to maintain the benefits of having a youthful demographic. The investigation managed to identify policy solutions which would enhance labor market absorption capabilities together with human capital quality improvement. More recently, Ray (2017) employed advanced econometric techniques to examine the broader interplay between demographic variables—including fertility, mortality, and migration—and macroeconomic performance in India. Through his evaluation Ray demonstrated how economic growth since



the 1990s has been powered by demographic shifts in population dynamics yet the resulting benefits show uneven distribution among Indian regions. The policymaker should develop distinct approaches that match the specific demographic along with economic characteristics of individual regions according to Ray. The heterogeneity throughout India's extensive economy becomes important due to his research findings.

Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
date	33	2007	9.67	1991	2023
GDPgrowth	33	6.073	2.881	-5.778	9.69
popGrowth	33	1.54	.412	.79	2.168
investment	33	31.881	5.266	22.716	41.951
educExpend	33	3.806	.414	3.143	4.635
UrbanGrowth	33	2.61	.242	2.134	3.068
EmployRatio	33	52.138	2.605	47.496	55.499
inflation	33	6.299	2.925	1.334	13.752
Inflationconsumerp~u	33	7.086	3.086	3.328	13.87
trade	33	37.073	12.295	16.988	55.794
lifespan	33	65.42	3.737	59.055	70.91
GDPgrowth c	33	0	2.881	-11.851	3.616

Annual records from 1991 to 2023 amount to 33 observations wherein the average year stands at 2007. The thirty-three-year time period delivers a broad perspective on economic and demographic trends throughout three decades. Statistical data shows meaningful differences between essential economic and population characteristics necessary for studying Indian GDP expansion. GDP Growth Economic performance shows moderate variation according to the 6.073% mean value and 2.881% standard deviation of GDP growth. GDP growth rates ranged from a low point of -5.778% negative growth to a maximum value of 9.69% positive growth during the studied period. Population Growth and Investment The annual population expansion rate amounts to 1.54% at a low dispersion level (standard deviation of 0.412%). The average investment rate in GDP amounts to 31.881% and its standard deviation stands at 5.266%. The variable investment shows wide divergence between 22.716% and 41.951%



because it demonstrates substantial differences in financial capital development that impacts economic growth.

Education Expenditure and Urban Growth The data shows that education expenditure remained stable throughout the period since it exhibits limited variability (3.806 μ 0.414 Std. Dev). The data reveals urban growth rates show less variation compared to other variables despite their average of 2.61 and standard deviation of 0.242. **Employment Ratio and Inflation** The employment ratio maintains an average of 52.138 and standard deviation at 2.605 while showing values from 47.5 to 55.5. The participating numbers in the labor market exhibit moderate differences between the given years. Two inflation measures indicate economic instability of developing nations: overall inflation averaged 6.299 (Std. Dev. = 2.925) while consumer price inflation averaged 7.086 (Std. Dev. = 3.086). **Trade and Lifespan** The openness of the economy displays substantial variability through trade which constitutes 37.073% of GDP on average yet shows large standard deviation at 12.295. The health outcome of lifespan shows an average of 65.42 years with a standard deviation of 3.737 as it extends between 59.055 to 70.91 years across its distribution, which demonstrates a positive trend in life expectancy duration.

The constant term in GDP growth displays a mean equilibrium point at 0 which is dispersed by standard deviations equal to 2.881 across its observed values (-11.851 to 3.616).

Correlation matrix

Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) GDPgrowth	1.000							
(2) investment	0.304	1.000						
(3) educExpend	0.050	-0.336	1.000					
(4) UrbanGrowth	-0.067	-0.322	-0.494	1.000				
(5) EmployRatio	0.126	-0.290	-0.388	0.779	1.000			
(6) inflation	-0.103	-0.018	-0.467	0.400	0.158	1.000		
(7) trade	0.191	0.840	-0.011	-0.686	-0.638	-0.168	1.000	
(8) lifespan	0.040	0.521	0.305	-0.844	-0.820	-0.541	0.810	1.000



A correlation matrix provides valuable insight about variable movements regarding one another. The model shows that GDP growth demonstrates a positive association with investment (0.304) while showing moderate strength between the variables. Empirical evidence demonstrates minimal relationship between GDP growth and expenditure on education (0.050) as well as lifespan (0.040), indicating these elements do not share direct linkage to GDP development in simple analysis. These low correlation values do not automatically eliminate possible significant relationships between variables when multiple variables are present in a multivariate model. The analysis reveals that higher investment rates tend to match with longer lifespans (0.521) potentially due to simultaneous health improvements and extended life expectancies that result from better economic development along with effective public health measures. The data reveals that increased investment displays negative relationships with education expenditure measures (-0.336) possibly due to resource allocation conflicts or divergent policy goals.

Moving to **education expenditure**, its moderate negative correlation with urban growth (-0.494) suggests that in periods or regions where urbanization accelerates, there might be less relative spending on education. This could be due to urban areas having different educational funding mechanisms or shifting policy focus toward infrastructure. Education expenditure also has a modest positive correlation with lifespan (0.305), implying that increased education spending may contribute to better health outcomes.

The variable **urban growth** has a strong positive correlation with the employment ratio (0.779). This indicates that faster urbanization is typically associated with a higher employment ratio, perhaps reflecting the economic pull of cities that concentrate labor markets. However, urban growth is strongly negatively correlated with lifespan (-0.844), suggesting that rapid urbanization might be linked to stress, congestion, or environmental challenges that adversely affect health outcomes. Similarly, the employment ratio shows a strong negative relationship with lifespan (-0.820), which could reflect challenges such as overburdened urban infrastructures or labor market pressures that might negatively impact health.



Methodology

The data from World Bank is taken for our topic, as World Bank is considered a credible source for this kind of studies. Timeframe of thirty-three most recent years is taken from 1991 to 2023 “annual data”. Those years has been chosen as they capture India’s structural shift which we aim to analyses and recent years selection ensures that our analysis is up-to-date. Several tests have been conducted to determine the final model. Autocorrelation test of Durbin-Watson which showed that in our data the is no autocorrelation: “d-statistic (8, 31) = 1.881075”. Also, there was no heteroscedasticity problem in our regression:

White's test for H_0 : homoskedasticity

against H_a : unrestricted heteroskedasticity

$\chi^2(30) = 31.00$

$\text{Prob} > \chi^2 = 0.4154$

Cameron & Trivedi's decomposition of IM-test

Moreover, most of our selected variables suffered from stationarity problem that is why Dickey-Fuller test was employed and First and Second order differences have been added to address this issue.

Even though, we found out that the was outliers’ problem in our data which can distort the finding of our regression, so iteratively reweighted last squares (IRLS) model has been employed to account for them.

Our final model is:

$$\begin{aligned} \text{GDPgrowth}_t = & 4.725 + 0.636 * \text{D.investment}_t + 1.369 * \text{L.D.educExpend}_t \\ & - 13.758 * \text{D.UrbanGrowth}_t + 2.169 * \text{D2.EmployRatio}_t + 0.559 * \text{D.inflation}_t \\ & - 0.274 * \text{D.tradet}_t + 4.095 * \text{D.lifespan}_t + \epsilon_t \end{aligned}$$

There GDPgrowth is in percentage growth of GDP form previous year, D.investemnt is the difference of Gross fixed capital formation (% of GDP) while L.D.educExpendi is the lagged difference of Expenditure on education (% of GDP) and D.UrbanGrowht is the first difference of the growth of population in urban areas. D2.EmployRatio is the Second difference of employed population to total labor force. D.Inflation is inflation GDP deflator. D.trade is tarde openness which means $(\text{Export} + \text{Import})/\text{GDP}$ and finally D.lifespan is how much lifespan has increased from previous year. Overall, our model captures key demographic factors.



Empirical result

Robust regression

GDPgrowth	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
D.investment	.636	.092	6.95	0	.446	.827	***
L.D.educExpend	1.369	.796	1.72	.1	-.286	3.024	
D.UrbanGrowth	-13.758	3.869	-3.56	.002	-21.805	-5.712	***
D2.EmployRatio	2.169	1.113	1.95	.065	-.146	4.485	*
D.inflation	.559	.172	3.24	.004	.2	.917	***
D.trade	-.274	.071	-3.86	.001	-.422	-.126	***
D.lifespan	4.095	1.057	3.87	.001	1.896	6.294	***
Constant	4.725	.548	8.62	0	3.585	5.865	***
Mean dependent var	6.550		SD dependent var	1.690			
R-squared	0.760		Number of obs	29			
F-test	9.497		Prob > F	0.000			

*** p<.01, ** p<.05, * p<.1

From the table above R-squared is 0.76 which means our model is able to capture about 76% of the variation in dependent variable which means in GDP growth rate. Investment is found to have statistically significant effect on GDP growth about 0.636 percent, 1% increase from previous year of Gross fixed capital formation of GDP will result in 0.636 % increase in GDP growth rate. This effect is found to be statistically significant at 1 significance level. Lagged education expenditure also has positive effect on GDP growth, but this effect is found to be not statistically significant. One percent increase in education expenditure in past year will result in 1.369 percent increase in GDP growth rate. Urbanization growth has a negative effect on GDP growth and this effect is found 1 percent significance level, 1 percent increase in Urbanization will lead to negative 13.758 percents of GDP growth. This effect could represent the short-term adjustment issue. And study of "Econometric Study of Urbanization and Economic Development" which allayed 22 Indian states showed that urbanization is a consequence rather than reason of GDP growth. Employment

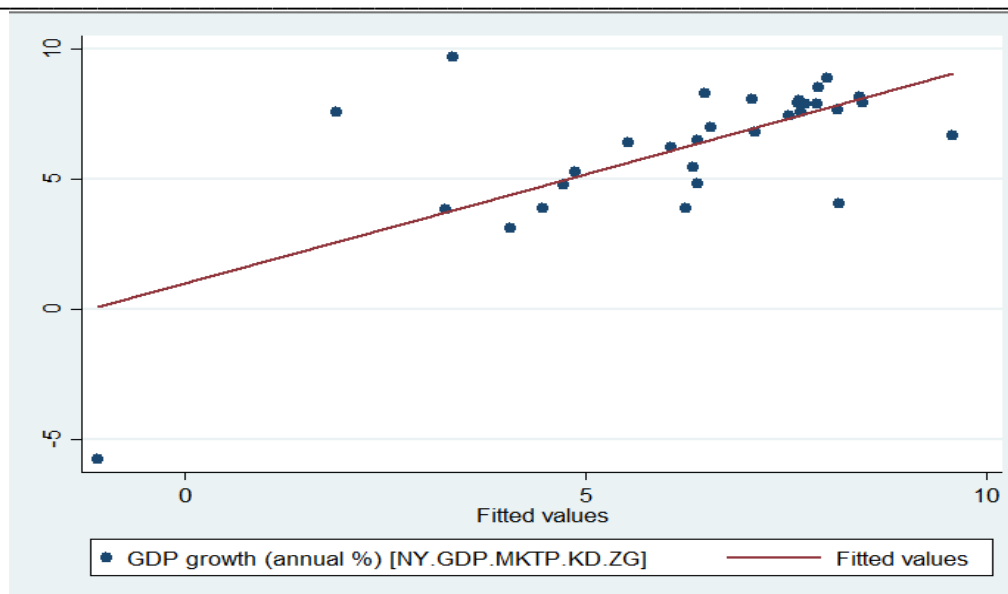


ratio our control variable as expected has a positive statistically significant result 2.169, which implies 1 percent increase in employment will cause 2.169 percent increase in GDP growth rate. Also, inflation is associated with positive GDP growth, which confirms the theory of slight inflation to maintain stable economic growth, this effect is found statistically significant at 1 significance level. trade has a coefficient of -0.274 and found statistically significant this could be due to transportation costs and dynamics in a short-run. Finally, lifespan has a positive effect on GDP growth rate (4.095) percent if average years of people increases by 1 year it will cause around 4 percent increase in GDP growth rate. Constant has a coefficient of 4.725 and found to be statistically significant which means that GDP growth holding other factors constat will increase by 4.725 percents.

Variance inflation factor

	VIF	1/VIF
D.lifespan	3.443	.29
D.inflation	2.56	.391
D2.EmployRatio	1.984	.504
D.trade	1.722	.581
D.UrbanGrowth	1.324	.755
D.educExpend	1.282	.78
D.investment	1.219	.821
Mean VIF	1.933	.

The overall average VIF value reached 1.933 indicating most predictors exist independently of each other. The actual data shows that our results obtain stable regression coefficients because overlapping information between independent variables does not bias the estimates in a significant way. Our confidence in both positive and negative estimated effects rises because multicollinearity artifacts do not obscure genuine relationships in the U.S. economy.



Policy recommendation and Conclusion

From our empirical result it is apparent that Investment in capital should be enhanced especially the ones that enhance performance, infrastructure investment, small business encouragement and improvement in ease of business creation. Secondly, India already has (IIT) and many other well established in the world rating universities in different spheres, it will be better to invest in them even more to boost the labor force and quality of labor. Thirdly, Urbanization should have a negative effect on economic growth rate so better governance in urban areas is encouraged, investments in infrastructure and more affordable housing can mitigate the effect of rapid urbanization in India. Fourthly, investing into healthcare and lifespan as it not only helps to improve productivity and motivation to work it also boost GDP growth. India already at top countries by medicine policies to distribute medical services among population will increase labor force. Also, strengthening trade policies and lowering barriers that are holding back the economy, creating more ports and free zones also looking of potential Tarde opportunities will enhance economy even further. Finally, improving labor market reforms, it is apparent that more labor force leads to more performance and economic growth so, upgrading



worker skills, reduce underemployment, and promote inclusive labor market policies will be essential to harness the full potential of India's labor force.

Overall, that policy recommendation could be applied to enhance economic performance of India. But the policies should be applied with caution as our study also captures most of the effects of demographics cannot be considered as a true representative of population, it is just the study of a sample and it can differ from region of India to another region.

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