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A Study on the Effect of Population Growth on Printing Industry in India

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Abstract
This research work focuses on the population growth and total value of output of the printing industry in India for the period 1950-51 to 2020-21. Printing in India is one of the oldest and modern manufacturing industries with facilities spread across India. It is particularly interesting and relevant to study this relationship, with India becoming the largest country in terms of population and also the fastest growing economy in the world with improvements in literacy, education, and economic wellbeing. This study uses Ordinary Least Square (OSL) method analyse the effect of population growth on the printing industry in India. It revealed a positive relationship of the independent and dependent variables with the population growth having a bearing on the value of output of the printing industry in India.

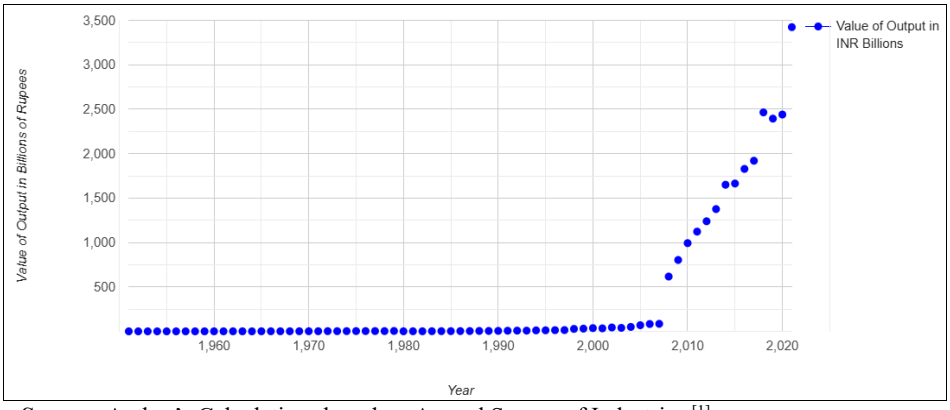
Keywords: Printing, Population, Industry, Value of Output, India, OLS

Introduction

Printing Industry

This paper covers the National Industrial Classification 2004 (NIC 2004) Section D - Manufacturing; Division 22 - Publishing, printing and reproduction of recorded media; Group 222 consisting of Class 2221 and 2222 and comprising 22211 Printing but not publishing of newspapers; 22212 Printing but not publishing of periodicals, books, journals, directories, atlases, maps and sheet music, schedules and pamphlets; 22213 Printing of Bank notes and Currency notes; 22219 Printing and allied activities like screen printing other than textile, n.e.c.; 22221 Engraving, etching and block making etc.; 22222 Book binding on account of others; 22229 Other service activities relating to printing n.e.c; (Ministry of Statistics & Programme Implementation 2023) [19]. However, prior to 2004 the classification and information were available in broader classifications and the concordance as provided by the issuing authority are duly noted (Ministry of Statistics & Programme Implementation 2023) [19].

The printing and reproduction of recorded media industry (18 of NIC-18) has 3255 operating factories with a fixed capital INR 146.8881 billion; working capital INR 79.2054 billion; invested capital 198.858 billion and gross value of plant and machinery INR 145.5783 billion. The industry engages 153914 persons with a total input of INR 304.1133 billion; and produces a total output of INR 424.9223 billion adding gross value of INR 120.809 billion and net value of INR 102.6498 billion. The industry contributes 0.81 percent share in aggregate gross value added to the GDP as on 2020 (National Statistical Office, Government of India, 2022) [23]. This works out in percentage terms to 1.64 of operating factories; 0.40 of fixed capital; 0.90 of working capital; 0.40 of invested capital; 0.41 of gross value of plant and machinery; 0.93 of total persons engaged; 0.41 of total input; 0.47 of total output; 0.81 of gross value added and 0.8 of net value added among all the industries in India (National Statistical Office, Government of India, 2022) [23].



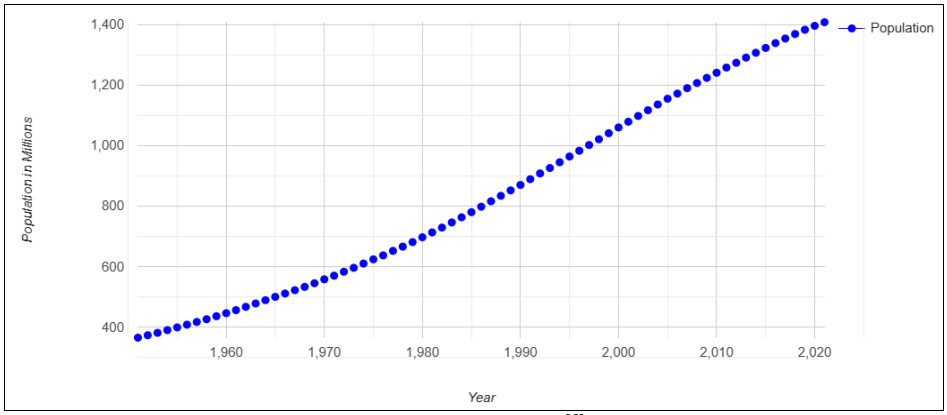
Source: Author's Calculations based on Annual Survey of Industries [1]

Fig 1: Year-wise Value of Total Output of the Printing Industry in India

In the printing industry packaging, offset printing, flexography and commercial digital printing are the major sectors driving the growth [2]. Technological advancements in the digital and offset printing, the expansion of e-commerce; increasing consumption of consumer durables and non-durables, increase in population, rising income levels, changing lifestyles and the growing middle class are contributing to this growth [3]. The industry is growing at a CAGR of 18% for the packaging market between 2015 and FY20. The demand for high quality and customised packaging solutions, short run jobs, on-demand and custom printed materials are the emerging components of the growth. The Make in India initiative by the government encourages domestic manufacturing of printing equipment and materials along with growing export markets are fostering growth in the industry [4]. Factors such as rising consumer spending, manufacturing expansion, and investment in printing technology contribute to the strong growth prospects in India.

Population

The population of India is growing steadily and its estimated current population is 1.451 billion [5]. Population growth often drives demand for the printing industry, especially in emerging economies, as rising populations and increasing incomes lead to greater demand for printed materials in areas like packaging, publishing, and customised goods. The growth of the industry attributes spread of literacy and increase in educational opportunities and a growth in educated population. The readership of newspapers and magazines are up by 15% [6]. However, the relationship of population with the industry is complex, with digital transformation and shifting consumer lifestyles influencing the printing market, making customisation and digital printing crucial the factors in growth. A larger population, particularly in regions with growing middle classes, translates to higher consumption of goods, which in turn drives the need for more printed products and packaging. A growing population and urbanisation often mean a greater need for educational materials, books, and other publications, which benefits the publishing segment of the printing industry. As populations become more urbanised, the organized retail sector expands, increasing the demand for printed promotional materials and product labels.



Source: Author's Calculations based on United Nations [5]

Fig 2: Year-wise Population of India

This study tries to understand the relationship between the growth of population on the total value of output achieved by the printing industry of India using the required econometric tools.

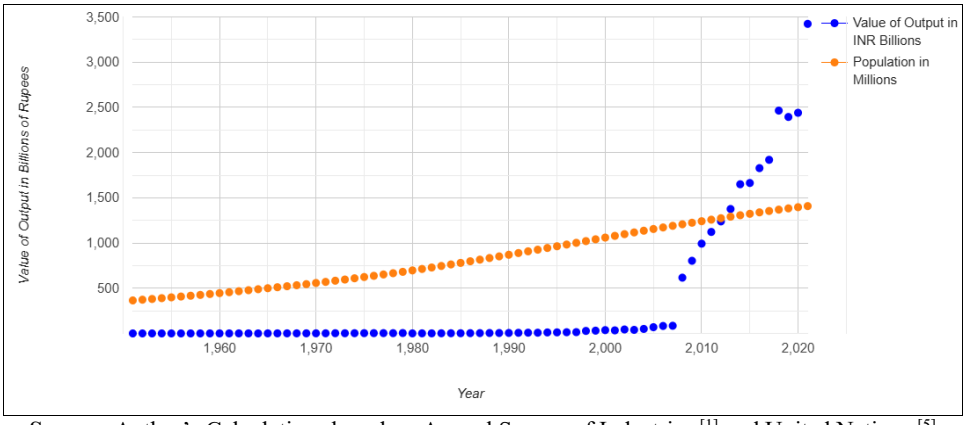
Literature Review

The growth of printing industry depends on the demand for printed products and services, which is driven by many forces including, overall economic growth, advertising expenditures, the Internet, changing consumer behaviour, population growth, and school enrolments. The growth in population, especially that of more educated population, their age and school enrolments form the basis for this growth [7]. The rising literacy rate along with high population growth rate is going to provide a huge customer base for Indian stationery and art materials market in future,

thereby serving as a key growth driver [8]. One of the important drivers for growth of the printing and packaging is the rise of the middle class, which is has grown from 14% to 31% of the population between 2004-05 and 2021-22 and is projected to rise to 63% by 2047 [9].

The population and its growth always formed the subject matter of economic studies. One of the foremost studies on population is Thomas Malthus in 1798 published in An Essay on the Principle of Population. Malthus stated that there is a tendency for the population growth rate to surpass the production growth rate because population increases at a geometrical rate while production increases at an arithmetic rate [10]. He further stated that an unfettered growth of population in a country could plunge the country into acute poverty. Solow's model predicts a negative correlation between population growth rate and per capita income. A higher population growth rate leads to a lower steady-state per capita output in the long term and a higher population growth rate results in a reduced growth of per capita output during the transition to the new steady-state equilibrium in the short term [11]. Romer proposes a positive relation between population and economic growth by considering the population as a source of innovators and scientists and not merely as proxy for labour [12].

Simon argues that population and economic development are related in the long run, and aggregate studies should consider this long-run relationship rather than short-term fluctuations [13]. Michael Kremer's model predicts that, for most of history, population growth rates increase proportionally with population size, a finding supported by empirical tests showing that larger initial populations led to faster technological and population growth over time [14]. In the study on population and economic growth Kuznets linked economic growth to high rates of population growth and structural transformation defining economic growth as a sustained increase in per capita output and goods, driven by technological advancements and institutional changes [15]. Ansley Coale's and Edgar Hoover, argued that slowing population growth enhances economic development in low-income countries [16].



Source: Author's Calculations based on Annual Survey of Industries [1] and United Nations [5]

Fig 3: Year-wise Value of Output of Printing Industry and Population of India

In the paper on population urbanization and economic growth… Hong Yeying studied causal relationship between population urbanization using the least square method (OLS) by fitting the per capita gross domestic product (GDP) as dependent variable and the level of urbanisation as independent variable [17]. Adewole examined the effect of population on economic development in Nigeria adopted ordinary least square method of analysis [18].

Methodology

This study uses quantitative analysis tools to evaluate the relationship between the value of the output of printing industry in India with the population of India during the study period from 1950 to 2021. Ordinary least square (OLS) method is used for this purpose to find out the nature of relationship. The independent variable considered in the study is the population. The data is sourced from the National Sample Survey for the years from 1951-52 to1959-60 and from 1960-61 to 2021-22 Annual Survey of India published by the Government of India. For the year1972-73, the data has been calculated as no direct data was available.

The proposed OLS regression model is: $Y = \alpha + \beta X$. In this equation Y is the total Output of the Printing Industry in India, which is the dependent variable; α is the intercept, β is the coefficient or slope; and the X is the Population of India during the period of study. The statistical analyses were performed using JASP Team (2025). JASP (Version 0.95.3) [Computer software].

Data

The population figures have been sourced from the database of Department of Economic and Social Affairs, Population Division, United Nations [5]. The data for the printing industry is obtained from various publications of Ministry of Statistics & Programme Implementation, National Statistical Office, Government of India and Annual Survey of Industries by the Government of India.

Results and Discussion

The results of the analysis of data on the total output of the printing industry in India and the population of India from 1950-51 to 2020-21 are given in the Table 1. The regression line equation is:

$Y = -1003.2187 + 1.6135X.$
X predicted Y, R2 = .49,

$F(1,69) = 65.84$, $p < .001$. $\beta = 1.61$, $p < .001$, $\alpha = -1003.22$, $p < .001$.

Table 1: Regression Analysis of Total Output of the Printing Industry in India and the Population

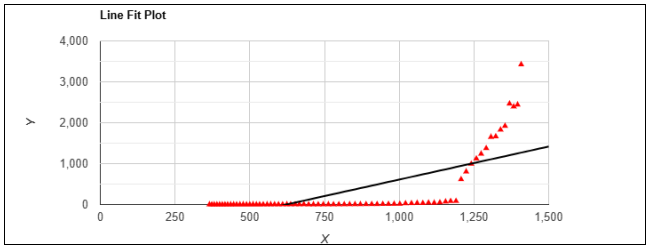
t-statistic	8.114
F Statistic	65.8377 (1.69)
R	0.6988
R-squared	0.4883
p-value	1.237e-11
Shapiro-Wilk p-value	0.0006158
Pearson correlation coefficient (r)	0.6988
Covariance	173855.438

Source: Author's Calculations based on Annual Survey of Industries and United Nations [1]

R-Squared (R^2) equals 0.4883. This means that 48.8% of the variability of value of output of printing industry (Y) is explained by the population (X). Correlation (R) equals 0.6988. This means that there is a strong direct relationship between value of output (X) and change in population (Y). The Standard deviation of the residuals (S_{res}) equals 546.1155. The slope: b_1=1.6135 CI[1.2168, 2.0101] means that when population increases X by 1, the value of output Y increases by 1.6135. The y-intercept: b_0=-1003.2187 CI[-1359.2742, -647.1631] means that when X equals 0, the prediction of Y's value is -1003.2187. The x-intercept equals 621.7823.

The overall regression is right-tailed, F(1,69) = 65.8377, p-value = 1.237e-11. Since p-value < α (0.05), H_0 is rejected. The linear regression model, $Y = b_0 + b1X + \varepsilon$, provides a better fit than the model without the independent variable resulting in $Y = b_0 + \varepsilon$. The slope (b_1): two-tailed, T(69)=8.114, p-value = 1.237e-11. For one predictor, it is the same as the p-value for the overall model. The y-intercept (b_0): two-tailed, T(69) = -5.6209, p-value = 3.727e-7. Hence, b_0 is significantly different from zero.

The linear regression model assumes normality for residual errors. The Shapiro-Wilk p-value equals 0.0006158. It is assumed that the data is not normally distributed. Results of the Pearson correlation indicated that there is a significant large positive relationship between X and Y, (r(69) = .699, p < .001).



Source: Author's Calculations based on Annual Survey of Industries [1] and United Nations [5]

Fig 4: Line Fit Plot Scatter Chart Pearson and Spearman's Rank correlation coefficients for Value of Output of Printing Industry and Population of India

Conclusions

The econometric evidence reveals that population growth exert positive and significant effect on total value of output in India between 1950-51 and 2020-21. Though the study reveals a positive correlation between the value of output and the regression equation does not reveal any negative relationship between value of output and population. This study attempted to establish a direct relationship with population and its growth with the total value of the output in isolation, while keeping other variables including technological change, customer preferences, other economic parameters like capital, labour, raw materials, etc., as constant. These variables shall influence the demand and growth for the services and products of the printing industry. On the other hand, analytical technique examined the significant effect of population on the value of printing industry output in India. The result of model shows that the growth in population and the value of output of the industry has a positive relationship.

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