

GSDP and Per Capita Income Growth in Himachal Pradesh

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Abstract

This present imperial study examines the measurement of long-term growth in the GSDP and per capita income in Himachal Pradesh economy. The study is based on secondary data collected from various reports of economic survey and statistical abstracts of Himachal Pradesh. Data on gross state domestic product (GSDP) and per capita income in rupees (PCIN) at constant prices from 1980-81 to 2015-16 at was analysed. To justify the equation of best fit and measuring the growth rate of secondary sector and its sub sectors eleven different types of growth rate indices were used like simple linear (SLR); log-linear (LLN); hyperbolic (HYP); parabolic (PRB); cubic (CUB); logistic (LGS); gompertz (GOM); modified exponential (MEX); geometric (GEO); log-parabolic (LPB); log-cubic (LCB); were used. AIC values were used to describe the equation of best fit. Gross state domestic product (GSDP) and per capita income in rupees (PCIN) were taken as the indicators of the study. The relative growth rate was used to assess the performance of gross state domestic product GSDP and per capita income in rupees (PCIN). For the robustness of the study the population of the state has also taken as indicator. Findings from the study are expected to be useful in policy making for attaining balanced and sustainable growth for the secondary sector at the state level.

Keywords: GSDP, Population, Per Capita Income, Growth and Himachal Pradesh

I. Introduction

Himachal Pradesh is a small hilly state, performing well when compared to adjoining states like Punjab and Haryana. According to the ministry of statics and program implementation (GOI) for the year 2018-19, the gross state domestic product (GSDP) growth rate of Himachal Pradesh was 7.34 percent, Punjab 6.37 percent, Haryana 8.19 percent and all India 6.81 percent. To understand the fundamentals of any economy the GDP is the best measure. gross state domestic product (GSDP) or GDP is like the backbone of any economy, because it includes three main sectors (i.e. Primary, Secondary, and Tertiary) and other twenty-four sub-sectors from agriculture to services. The gross state domestic product defined as the aggregate of economic values of all goods and services produced within the geographical boundary of the state counted without duplication concerning the specified time, usually one year. GDP at the constant price (Real GDP) is assumed more reliable than current prices (Nominal GDP) because the real gross domestic product is an inflation-adjusted measure.

The overall performance of an economy may be assessed from its gross state domestic product (GSDP) and per capita income in rupees (PCIN) because both of these are the key indicators development and standard of living. The state has displayed the growth in both of these indicators over the period and has increased significantly. The per capita income (PCIN) of state almost higher than the national average. The continuous rise in per capita income (PCIN) states that gross state domestic product (GSDP) growth has been translated in to better healthcare facilities, increased living standard, improved access to education etc. The growth of gross state domestic product (GSDP) and per capita income (PCIN) not only highlights the economic progress but also success of state policies and social welfare.

II. Methodology

The present study is quantitative research and based on secondary data collected from the various reports of economic and statistical department of Himachal Pradesh. The results in the present study have been calculated by applying the following statistical tools:

II.1 Akaike Information Criterion

$$AIC = 2k - 2 \ln(\hat{L})$$

Where:

k is the number of estimated parameters in the model.

$\hat{L}$ is the maximum value of the likelihood function for the model

II.2 Long-term Trend Analysis

For estimating long-term growth paths, traced by each of the components of a particular study variable (say, gross domestic product), an attempt was made to search out the curves of the best fit from amongst the following 11 distinct trend relationship in time variable t :

1. Simple Linear (SLR) : $Y_t = b_0 + b_1t + u_t$
2. Parabolic (PRB) : $Y_t = b_0 + b_1t + b_2t^2 + u_t$
3. Cubic (CUB) : $Y_t = b_0 + b_1t + b_2t^2 + b_3t^3 + u_t$
4. Log-Linear (LLN) : $\ln Y_t = b_0 + b_1t + u_t$
5. Log-Parabolic (LPB) : $\ln Y_t = b_0 + b_1t + b_2t^2 + u_t$
6. Log-Cubic (LCB) : $\ln Y_t = b_0 + b_1t + b_2t^2 + b_3t^3 + u_t$
7. Geometric (GEO) : $Y_t = b_0b_1^te^{u_t}$
8. Hyperbolic (HYP) : $Y_t = \frac{t}{b_0t + b_1 + t_{11}}$
9. Modified Exponential (MEX) : $Y_t = k + b_0b_1^t$
10. Gompertz (GOM) : $Y_t = kb_0^{b_1^t}$
11. Logistics (LGS) : $Y_t = \frac{k}{1 + b_0b_1^t}$

Where u_t stands for disturbance term at time t ; b_0 , b_1 , b_2 and b_3 represents the unknown coefficients which were estimated through the OLS technique.

II.3 Relative Growth Rates

With the help of the best-fit functional form, relative growth rates (RGR _{t}) in the time-series $\{Y_t\}$ in respect of different components of gross domestic product were computed. As per Rudra (1970), $RGR_t = Y_t/Y_1$ where $Y_t = [dy/dt]$ represents the time derivation of Y_t .

For different functional forms, the derived expressions (by Sethi, 2008) for relative growth rates were:

1. SLR : $= \frac{b_1}{b_0 + b_1t}$
2. PRB : $= \frac{b_1 + 2b_2t}{b_0 + b_1t + b_2t^2}$
3. CUB : $= \frac{b_1 + 2b_2t + 3b_3t^2}{b_0 + b_1t + b_2t^2 + b_3t^3}$
4. LLN : $= b_1$
5. LPB : $= b_1 + 2b_2t$
6. LCB : $= b_1 + 2b_2t + 3b_3t^2$
7. GEO : $= \frac{b_1}{t}$
8. HYP : $= \frac{b_1}{(b_1 + b_0t)t}$
9. MEX : $= \frac{(b_0b_1t)\ln b_1}{k + b_0b_1^t}$
10. GOM : $= \ln b_0 \cdot \ln b_1 \cdot b_1^t$
11. LGS : $= \frac{-(b_0b_1^t)\ln b_1}{1 + b_0b_1^t}$

Such growth rates were computed at different points in time so as to examine of consistency, acceleration or deceleration regarding behavioural growth paths traced by the different components. For this purpose, the temporal changes in the relative growth rates were depicted against time graphically.

III.1 Equation of Best Fit for GSDP, PPLN and PCIN

Thirty-six years (1980-81 to 2015-16) data of Himachal Pradesh gross state domestic product was taken at constant prices with base year 2011-12 which was again indexed for the base year 2011-12 and per capita income (PCIN) was calculated by author. To justify the equation of best fit eleven different types of growth rates simple linear (SLR); parabolic (PRB); cubic (CUB); log-linear (LLN); log-parabolic (LPB); log-cubic (LCB); geometric (GEO); hyperbolic (HYP); modified exponential (MEX); gompertz (GOM); logistic (LGS) were tested for state gross domestic product (GSDP) and per capita income (PCIN). The choice for best-fit functional form was made based on the minimum value of Akaike's Information Criterion.

The gross state domestic product (GSDP) found the minimum value of Akaike's Information Criterion 23.6 for the log cubic equation. Therefore, the log cubic growth rate equation was selected for this sector. Population, found the minimum value of Akaike's Information Criterion -43.1 for the cubic equation. So, cubic growth rate equation selected for this population. For per capita income (PCIN), the minimum value of Akaike's Information Criterion was 58.4 for the log-cubic equation. Therefore, the log-cubic growth rate equation was selected for this per capita income (PCIN).

Table 1.

Computed Values of Akaike's Information Criterion (AIC) for GSDP, PPLN and PCIN Eleven Different Functional Forms in respect of the Indexes# on Real GSDP from Various Sectors/ Sub-Sectors of Himachal Pradesh State (1980-81 to 2015-16)

Sector/ Sub-Sector	Functional Form Estimated										
	SLR	PRB	CUB	LLN	LPB	LCB	GEO	HYP	MEX	GOM	LGS
GSDP	183.2	92.9	27.9	119.8	26.0	23.6	215.9	253.9	117.1	124.2	153.2
PPLN	-2.8	-32.0	-43.1	43.5	-41.6	-40.9	101.5	164.8	32.1	30.3	28.7
PCIN	176.7	86.3	60.6	139.3	63.2	58.4	211.0	243.9	116.4	126.9	156.5

Source: Author's Computations

Values of the Indexes for Each of the Aggregates during Different Years were Computed as $100 \times \frac{\text{Value of the Aggregate at a Given Year}}{\text{Value of the Aggregate during 2011 - 12}}$

NC: Not Computable

Out of eleven different types of growth rates equations selected for the line of best fit, only two kinds of growth rates selected on Akaike's information criterion in which log-cubic selected two times cubic was selected one times. While simple linear, geometric, hyperbolic, modified exponential, gompertz, logistic and others were not selected at all.

III.2 Long-Term Trends in GSDP, PPLN and PCIN

For this purpose, eleven different functional forms estimated from the time series on gross state domestic product at constant price (GSDP); population in lakhs (PPLN) and per capita income (PCIN) for the thirty-six years study period in respect of Himachal Pradesh economy. The choice for best-fit functional form was made based on the minimum value of Akaike's Information Criterion and out of eleven functional forms, finally chosen a form of the best-fit, along with the corresponding value of t , R^2 , Adjusted R^2 , F-value for R^2 and AIC.

Table 3 revealed that the long-term growth pattern of gross state domestic product (GSDP) of Himachal Pradesh most appropriately modeled as log-cubic, as it has been associated with the minimum value ($=23.553$) of the Akaike's information criterion (AIC) among the eleven functional forms tried. Further, the equation has a reasonably high value for the line of best-fit ($R^2=0.997$); a low value for adjusted R^2 ($=0.997$) and F-value for R^2 has 3869.000. This indicated the equation of best-fit to the income from gross state domestic product of the Himachal Pradesh economy. The population has modeled adequately as a cubic growth rate equation as it has been associated with the minimum value ($=-43.146$) of the Akaike's information criterion (AIC) among the eleven functional forms tried. Further, the equation has a reasonably high value for the line of best-fit ($R^2=0.998$); a low value for adjusted R^2 ($=0.998$) and F-value for R^2 has 7284.000. This indicated the cubic growth rate as equation of best-fit to the population of Himachal Pradesh economy.

Table 2.

Computation of the Best-Fit Functional Forms for indexed GSDP, PPLN and PCIN (At 2011-12 Constant Prices) in Himachal Pradesh

Sector/ Sub-Sector	Best fit Form	Values of Coefficients	t-Values of the Coefficients	R^2	Adjusted R^2	F-value for R^2	AIC
GSDP	LCB	$\beta_0 = 2.8180$ $\beta_1 = 0.0262$ $\beta_2 = 0.0011$ $\beta_3 = 4.3720 \times 10^{-6}$	109.848*** 4.426*** 2.991** -0.970 ^{NS}	0.997	0.997	3869.000	23.553
PPLN	CUB	$\beta_0 = 60.1400$ $\beta_1 = 1.1900$ $\beta_2 = 0.0135$ $\beta_3 = 3.7280 \times 10^{-4}$	155.345*** 13.310*** 2.424* -3.763***	0.998	0.998	7284.000	-43.146
PCIN	LCB	$\beta_0 = 3.3510$ $\beta_1 = -0.0054$ $\beta_2 = 0.0018$ $\beta_3 = -1.6030 \times 10^{-5}$	76.076*** -0.527 ^{NS} 2.975** -1.421 ^{NS}	0.986	0.985	772.900	58.406

Source: Author's Computations

NS: Non-significant; *: Significant at 10% probability level; **: Significant at 5% probability level; ***: Significant at 1% probability level;

***: Significant at 0.1% probability level.

Per capita income in rupees has most properly modeled as log-cubic equation as it has been associated with the minimum value (=58.406) of the Akaike's information criterion (AIC) among the eleven functional forms tried. Further, the equation has a reasonably high value for the line of best-fit ($R^2=0.986$); a low value for adjusted R^2 (=0.985) and F-value for R^2 has 772.900. This indicated the equation of best-fit to the per capita income of Himachal Pradesh economy.

III.3 Relative Growth Rates in GSDP, PPLN and PCIN of Himachal Pradesh

The relative growth rates were worked out after identifying the most appropriate functional forms in respect of gross state domestic product (GSDP), population (PPLN) and per capita income (PCIN) of Himachal Pradesh economy with the help of the estimated values of the parameters of the equation of best-fit, to all data points for each of indicators. In other words, a precisely investigation has been attempted for a thirty-six-year study period if there is any indication of acceleration, deceleration, or consistency in the growth rates of different sectors and sub-sectors. It may be emphasized, that exponential (EXP) failed to turn out to be the equation of best fit concerning the of gross state domestic product. At the majority of times, either deceleration or acceleration were prevalent in respect of growth in gross state domestic product in the economy of Himachal Pradesh.

Relative growth rates of the gross state domestic product (GSDP), per capita income (PCIN) and per capita income in rupees (PCIN) shown in table 4. The relative growth rate shows the high performance of a sector or sub-sector concerning another sector or sub-sector. If a sector is showing a relatively high growth rate, again and again, we can state it as the driver of growth.

Table 3
Relative Growth Rates in Real GSDP of Service Sector and Sub-Sectors of Himachal Pradesh

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988
GSDP	2.841	3.056	3.267	3.475	3.679	3.878	4.074	4.267	4.455
PPLN	1.981	1.980	1.975	1.966	1.953	1.938	1.919	1.897	1.873
PCIN	-0.164	0.199	0.552	0.986	1.230	1.554	1.896	2.174	2.470
YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997
GSDP	4.640	4.821	4.998	5.171	5.340	5.505	5.667	5.585	5.979
PPLN	1.846	1.817	1.787	1.754	1.720	1.684	1.647	1.608	1.568
PCIN	2.756	3.032	3.299	3.556	3.803	4.041	4.269	4.488	4.697
YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006
GSDP	6.129	6.276	6.418	6.557	6.692	6.823	6.950	7.074	7.193
PPLN	1.527	1.485	1.442	1.398	1.353	1.307	1.260	1.213	1.165
PCIN	4.896	5.086	5.266	5.437	5.597	5.749	5.890	6.022	6.145
YEAR	2007	2008	2009	2010	2011	2012	2013	2014	2015
GSDP	7.309	7.421	7.529	7.633	7.734	7.831	7.923	8.012	8.098
PPLN	1.115	1.065	1.014	0.963	0.910	0.857	0.803	0.747	0.691
PCIN	6.258	6.361	6.455	6.539	6.613	6.678	6.733	6.778	6.814

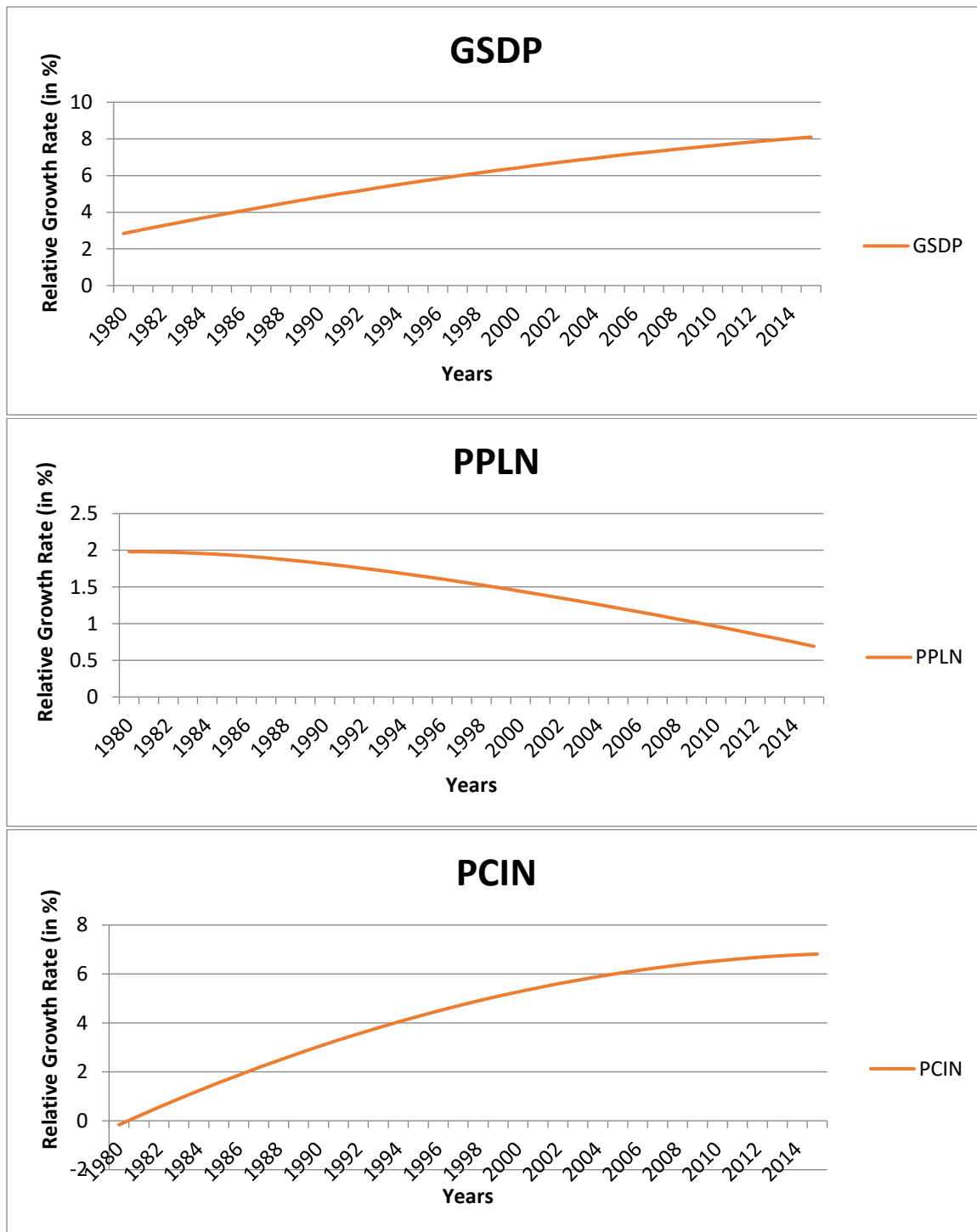
Source: Author's Computations

The gross state domestic product (GSDP) maintained the relatively higher growth rate throughout the study period, followed by per capita income (PCIN). The adverse growth rate has found in per capita income in rupees (PCIN) for the year 1980. The growth rate of both gross state domestic product (GSDP) and per capita income (PCIN) remain in single digit throughout the study period. From the year 1980 to 1986 the gross state domestic product (GSDP) was followed by population (PPLN) growth rate, the per capita income (PCIN) growth rate was lowest in this time. Afterward 1987 gross state domestic product (GSDP) was followed by PCIN in growth rate. The growth rate of population (PPLN) displays declining trend from 1980 to 2015, but after 1987 its growth declined below the growth of per capita income (PCIN), which is a positive sign to the Himachal Pradesh economy toward the path of development and prosperity.

Figure III.1 also represents the relative growth rates in respect of gross state domestic product (GSDP), population (PPLN) and per capita income (PCIN) in the Himachal Pradesh economy. As discernible from the figure, growth rate of GSDP been following an increasing pattern 1980 to 2025. The maximum (i.e. 8.098 percent

per annum) and minimum (i.e. 2.841 percent per annum) values of RGR_t were recorded during 1980 and 2015 respectively, which means it increasing gradually. As regards the per capita income (PCIN), has also displayed an increasing pattern from 1980 to 2015. The maximum (i.e. 6.814 percent per annum) and minimum (i.e. -0.164 percent per annum) values of RGR_t were recorded during 1980 and 2015 respectively. The population (PPLN) following a declining pattern from 1985 to 2015. The maximum (i.e. 1.981 percent per annum) and minimum (i.e. 0.691 percent per annum) values of RGR_t were recorded during 1985 and 2025 respectively.

Figure III.1
Relative Growth Rates in Real GSDP of Different Sectors and Sub-Sectors of Himachal Pradesh



Gross state domestic product has been witnessed a continuously increasing trend up to the whole study period. The population has been following a continuous declining trend up to the whole study period. As far as per capita income is concerned it has been witnessed a continuously increasing trend up to the whole study period.

IV. Conclusion

As regards the long-run growth performance, behavioural growth paths in respect of the gross state domestic product (GSDP), population (PPLN) and per capita income (PCIN) observed for the Himachal Pradesh economy. In which GSDP and per capita income (PCIN) followed third-degree trend path functions; that is log cubic growth rate to be the best representatives in these cases. The population (PPLN) followed cubic growth rate. Specifically speaking, the equations viz., PRB, LLN, and LPB and all others were observed to be of poorer-fit. The gross state domestic product (GSDP) and per capita income (PCIN) registered an increasing rate of growth during the study period. While the population (PPLN) has exhibited declining growth rate during the study period. Afterward 1987 gross state domestic product (GSDP) was followed by per capita income (PCIN) in growth rate. The growth rate of population (PPLN) displays declining trend from 1980 to 2015, but after 1987 its growth declined below the growth of per capita income (PCIN), which is a positive sign to the Himachal Pradesh economy toward the path of development and prosperity.

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