Chapter 6

FACTORS DETERMINING HUMAN DEVELOPMENT
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6.1 Introduction:

This chapter will test the models that have been discussed earlier. We shall examine the relative weightage of different factors that determine human development. This will be done through regressing human development index on different factors that affect human development for example State Net Domestic Product, Social Expenditure and Population. We have assumed in our study that these factors have significant influence on human development.

The data for the purpose of our study has been collected mainly from secondary sources. The different sources are Statistical Abstracts, Govt. of India, Statistical Hand Book, Govt. of Assam, Basic Statistics of North Eastern Region, Ministry of Home Affairs, Govt. of India. We have first examined the
relationship between the economic development of the state and the HDI, and
the first function that we will specify will be as follows –

\[ \text{HDI} = a + b \text{SNDP} \]  

(1)

Where SNDP is the State Net Domestic Product. However, economic
development by itself may not directly benefit the common man, but due to the
operation of Trickle Down Theory, change in economic development may also
change the living condition of the common man in a favourable way.

Therefore, the second function that we shall specify, will be as follows –

\[ \Delta \text{HDI} = a + b \Delta \text{SNDP} \]  

(2)

and \[ \Delta \text{HDI} / \Delta \text{SNDP} > 0 \]

Implying that the change in the level of economic development of the state
bring about a change in the living condition of the common man.

As highlighted above, the capability of the poor people is highly
dependent upon the state who incurs expenditure for the overall improvement in
the living condition of the people. Consequently social expenditure assumes a
crucial role in determining HDI. The next function that we shall specify
therefore will be as follows.

\[ \text{HDI} = a + c \text{SE} \]  

(3)

However, the benefits of social expenditure incurred in a certain period
may not have immediate impact on HDI, during that period itself. The benefits
may be revealed only after a time lag. Therefore, we take one year time lag to
study the relationship between HDI and social expenditure. Hence following would be the next function that we adopt.

\[ \text{HDI} = a + cSE_{t-1} \]  \hspace{1cm} (4)

Where \( SE_{t-1} \) denotes social expenditure incurred in previous year.

Social expenditure in the previous period is expected to be positively correlated to HDI in all societies, so that HDI will be increasing function of \( SE_{t-1} \).

\[ \frac{\partial \text{HDI}}{\partial SE_{t-1}} > 0 \]

It is further postulated that total population plays a pivotal role in determining the living standards and hence in HDI. Higher population is bound to neutralize some of the positive effects of higher social expenditure, since various facilities of a better living condition has to be shared by greater number. HDI is therefore expected to be a decreasing function of the level of population in the state, so that next function that we specify will be as follows –

\[ \text{HDI} = a - dP_{op} \]  \hspace{1cm} (5)

Finally to determine the relative weight of the determinants of HDI we shall test the following function.

\[ \text{HDI} = a + bSNDP + cSE - dP \]  \hspace{1cm} (6)

Since the impact of these variables may not be felt instantaneously, we shall also use a lagged model as follows

\[ \text{HDI} = a + bSNDP_{t-1} + cSE_{t-1} - dP_{t-1} \]  \hspace{1cm} (7)
In the above model, we shall capture the essence of the operation of these determinants over longer period.

Finally to examine the response which may either be positive or negative we shall test the following function in which change in HDI due to change in economic growth, social expenditure and population will be examined. Consequently we shall specify the final equation as

\[ \Delta \text{HDI} = a + b \Delta \text{SNDP} + c \Delta \text{SE} + d \Delta P_{op} \quad (8) \]

All these functions will be tested both for time series as well as cross section data for the state of Assam, by the use of various regression techniques. On the basis of the results obtained, final conclusion will be drawn within the context of our objectives and hypotheses.

The data which have been collected from secondary sources are given in the appendix.

In the tables (as given in appendix) Human Development Index (HDI) is collected from Economic Survey, for the period from 1979-2005 some figures which were not available have been calculated using secondary data following the UNDP method of calculating HDI.

The data on State Net Domestic Product (SNDP) for different years from 1979 to 2001 are collected from North Eastern Councils (NEC) journal. Population data for the same period are collected from Statistical Abstracts, Govt. of India. Population figures for all the years mentioned in the table-1, which were not available in the Statistical Abstract, we have computed the population growth as it was mentioned in the Statistical Abstract that population growth during the year 1970-90 by 26%. After 1990 all figures for population
were given and we required no further calculation. Data on social expenditure for the period of our study were taken from Statistical Abstracts and Journal of North Eastern Council.

We have regressed Human Development Index (HDI) on these three variables viz. SNDP, Population and Social Expenditure separately and than on all the three variables together to see the overall influence of all these variables on Human Development Index (HDI).

6.2 Results of Regression Analysis:

The result of our analysis using model No. 1 reveal that there is no relationship between HDI and the net state domestic product, since the coefficients of the function 'b' is not statistically significant here. The results of the model one is

\[ 321.25 + 7.45 \text{NSDP}, \quad R^2 = 0.265 \]
\[ t = (15.278) \quad (2.006), \quad F = 4.028. \]

Since NSDP is the indicator of the level of economic development of the state, the non-acceptability of this function satisfies our first hypothesis that HDI do not depend on economic development of the state alone, and there must be other more important determinants.

We have next estimated the second model the results of which are as follows –

\[ 299.42 + 0.152 \text{SE}, \quad R^2 = 0.352 \]
\[ t = (11.660) \quad (2.445), \quad F = 5.978. \]
However, what emerges as a surprise is that social expenditure does not seem to have any direct impact on HDI, since the value of $R^2 = 0.352$ is not only low, but the coefficient of the independent variable 0.152 too is insignificant. The reason could perhaps be that the social expenditure has not proved to be very effective in the state, the factors behind which needs to be explored further, or that the benefit of social expenditure takes many years to be fully felt by the beneficiaries. Therefore our hypothesis relating to the positive relationship between social expenditure and HDI, does not hold good atleast in the state of Assam.

We have then tried the next model in which we have taken total population at time $t$ to be determinant of HDI. The results of the estimated equation is as follows –

\[ 51.98 + 1.278 P, \quad R^2 = 0.808 \]
\[ t = (1.154) \quad (6.805), \quad F = 46.303 \]

It is interesting to note that our hypothesis relating to population and HDI works out in the reverse way. The function is acceptable since $R^2$ explains 80 percent of the relationship of the function and as far as the significance of the coefficient is concerned but the positive sign of the coefficient implies that HDI improves with a rise in population. Explanation could be sought in the fact that along with a rise in population literacy rate and health condition instead of deteriorating might have actually improved more than in proportion to the rise in growth rate of population. In other words, it implies that the literacy rate and the percentage of population with better health status might have increased more than the increase in total population. It is also possible that the addition to population might be contributing more for the generation of income. The
combined effect of these positive aspects of population growth might be an improvement in HDI.

We have also tried to capture the simultaneous effect of population and state domestic product on HDI, but could not accept the function as neither $R^2$ is satisfactory nor the coefficients significant as shown in table-6.1. The result of the equation is

$$2.781 + 2.49 \text{ NSDP} + 1.465 \text{ P}, \quad R^2 = 0.824$$

$$t = (0.441) (0.957) (5.625), \quad F = 23.436$$

In view of the important role of social expenditure for improving human development, instead of dropping it altogether from our model, we have combined social expenditure and total population as explanatory variable and tested the next model. The estimated results are as follows –

$$51.928 + 1.40 \text{ SE} + 1.934 \text{ P}, \quad R^2 = 0.897$$

$$t = (-1.049) (2.937) (7.272), \quad F = 43.523$$

We can accept the model, which adopts social expenditure and population as the two explanatory variable for explaining HDI, both an theoretical and statistical grounds, since the value of $R^2$ is not only significant but the co-efficients too are significant and have retained their signs as well. This implies that though taken individually none of the independent variables appear to provide any satisfactory explanation for HDI, but taken simultaneously they do signify variation in HDI explaining as much as 90 percent of the relationship.

We reject the function in which we had accepted NSDP and SE simultaneously, on statistical grounds. The result of the test is follows –
29.94 + 4.382 NSDP + 0.115 SE, $R^2 = 4.24$
\[ t = \begin{pmatrix} 11.242 \\ 1.115 \end{pmatrix} \begin{pmatrix} 1.646 \end{pmatrix}, \quad F = 3.677 \]

The reason for this is not far to seek. Social expenditure is determined by the State Domestic Product and therefore two could be highly correlated. Consequently, used simultaneously, the co-efficients would neither be significant and have high degree of multicollinearity.

We have next estimated the model in which we have used all the independent variables estimated simultaneously in one single equation. The results are as follows

$-116.24 + 4.13 NSDP + 0.164 SE + 2.332 P$, $R^2 = 0.939$
\[ t = \begin{pmatrix} -2.24 \\ 2.473 \end{pmatrix} \begin{pmatrix} 4.098 \end{pmatrix} \begin{pmatrix} 8.692 \end{pmatrix}, \quad F = 45.906 \]

We accept the model in which all the independent variables NSDP, social expenditure and population are adopted simultaneously in a single model. $R^2$ explains 94 percent of the relationship and all the variables are not only statistically significant, but has the required signs also. Therefore, though taken individually the variables may not appear to have much influence on HDI, mainly because of the close inter relationship of the variables, but when seen in a holistic way, they do have a very significant impact on HDI. The reason could be that since they are variables, all of which have relevance in the social sector, their full influence can be worked out only when their operation is taken into account simultaneously. The variables effect each other, which is not surprising in case of such socio-economic variables, before their full impact on HDI can be known. Taken individually economic growth do not affect HDI, as per our hypothesis, but combined with the other variables, NSDP appears to be the best explanatory variable of HDI. The reason could perhaps be that higher NSDP
leads to higher social expenditure and higher population growth increases the economic activities in the society leading to higher NSDP. Therefore high population which is economically active may actually help in raising HDI. This implies that impact of these variables may not be felt instantaneously but may take several years before their full effect on HDI can be realized.

We therefore next adopt lagged models, in which we will be able to examine the effect of these independent variables over a time period of at least one year. As a result we next estimate models with the same variables as mentioned above, with one year lag. The result of the first model in which NSDP has one year lag is as follows

$$329.16 + 8.700 \text{NSDP}_{t-1}, \quad R^2 = 0.240$$

$$t = (14.81) \quad (1.776), \quad F = 3.154$$

The model explains only 24 percent of the relationship, and the coefficient of the variable too is insignificant, due to which the model cannot be accepted for our purpose.

The result of the next model where we have specified population as a lagged variable is as follows

$$313.197 + 0.140 \text{SE}_{t-1}, \quad R^2 = 0.340$$

$$t = (14.368) \quad (2.583), \quad F = 6.672$$

This can be acceptable since about 83 percent of the relationship is explained by this model as revealed by the value of $R^2$. The coefficient of the variable too is satisfactory and is statistically significant also. In other words, both the model where we accept population as well as lagged population as a variable is acceptable. The reason could be that we are not dealing with per
capita value of the variables, which might have decreased due to a rise in population, but the absolute value of population. Therefore it might be that due to a rise in population literacy rate rises, economic activity rises, raising the NSDP of the state, all of which work together to raise the value of HDI, the results of which become much more significant over a period of time.

However, the model in which we take social expenditure as a lagged model is not acceptable on statistical grounds though it is acceptable on theoretical grounds. In a similar manner, the model in which we have accepted lagged values of NSDP and population simultaneously too is not acceptable on statistical grounds.

The next model in which both the NSDP and social expenditure are taken as lagged values, too can not be accepted. Since neither the value of $R^2$ is satisfactory, nor the values of coefficient is significant or high. In a similar manner the model with lagged values of the variable of population and social expenditure is not acceptable on theoretical grounds, since the positive value of social expenditure become negative indicating the presence of multi-collinearity. However, for socio-economic variables it is not surprising as there may be many factors explaining interrelationship among such variables. For similar reasons the model in which we have included lagged values of all the independent variables NSDP, population and social expenditure is not acceptable though value of $R^2$ is as high as 0.890. Taking an overall view, it is revealed that none of the values of lagged variables can be accepted as satisfactory except lagged value of population indicating a positive effect of population on HDI, though not exactly in the manner in which we had specified the relationship.
We have next adopted models in which we had used extent of change of all the independent as well as the dependent variables, the results of which are reported in Table No.-6.3. None of the models could be accepted as satisfactory, either on theoretical or statistical grounds. This implies that though normally effect of socio-economic variables works over a period of time, yet in Assam, the variables do not work out exactly in a similar manner, the reasons for which needs to be explored further.

Though the levels of human development is determined by multiplicity of factors, in our study we have assumed state net domestic product, social expenditure and population as the three main important factors governing human development. It is not possible to include all the complex factors in a single study. It is a micro level study to examine the macro development process. So it is not possible to bring all the factors effecting human development in a micro framework of study.

According to our study human development index for the state of Assam is lower than all India average which is an issue which needs to be addressed on an urgent basis for the overall development of the state. In the six districts that we have studied, we find that human development in most of the districts is very low except Jorhat and Kamrup districts. From secondary sources of data it is also evident that the level of human development in different districts are lower than that of other advanced Indian states. This lower level of human development in the state if not taken care of immediately may have serious adverse affect for long run economic development. Infact, economic development may not be sustainable if human development is allowed to be at such low levels.
So for improving and enhancing economic development, levels of human development both at the state level and district level must be improved. This also suggests that the state has to put greater emphasis on the social sector and not merely on economic sector alone. Policies in social sector have to be sharp and focussed, catering to the specific problems of the districts and the region. Alongwith higher level of financial allocation, greater effort at the implementation level is called for.

Three variables viz. Net State Domestic Product (NSDP), Social Expenditure and population taken together on which Human Development Index is regressed suggest that efforts must be made not only to increase NSDP in the state but to focus greater attention to ensure that the benefits of growth percolates down to the common man. This can be done through improving agriculture and setting suitable industries in the state on the one hand and enhancing service sector on the other. All these measures will increase the income earning capacity of the people, particularly in rural areas. Social expenditure, specifically on health and education for the targeted groups must be increased to improve the level of human development which has direct impact on human development index. However, this may act as a serious problem for the state since the state was passing through acute financial crisis till recently, though the position has improved marginally in recent times. Therefore, restructuring of public finance assumes crucial importance in this context.

The relation between population growth and human development is complex. Many economists argue that population growth is an obstacle to economic development and human development. Population growth necessarily arrests development by lowering down the land-man and capital-labour ratios.
Population growth has adverse impact on agricultural productivity, negative impact on capital formation and shortage of food grains.

The most important way in which the population growth retards human development is through its adverse impact on per capita income and standard of living. Rapid growth of population in the developing countries makes it difficult to raise the level of per capita income and the standard of living of the masses. As noted above, the pressure of population on land increases leading, in turn, to low agricultural productivity and large-scale disguised unemployment. Naturally, these result in low per capita income and low standard of living. The dependency burden in the developing countries is greater than in the developed countries since the working force in the former is required to support almost twice as many children as they do in latter countries. This also results in a lower standard of living in the developing countries. A higher dependency burden can also worsen income distribution because a higher proportion of the population is at the young, low-earning end of the spectrum.

The rapidly increasing population results in large-scale unemployment and under employment. Because of the failure of the secondary and tertiary sectors to expand employment opportunities at a fast rate, more and more people fall back in agriculture. The pressure on agriculture increases leading to the problem of disguised unemployment. In labour surplus economy, disguised unemployment takes serious proportions with the result that the marginal productivity of labour falls to very low levels and many even touch zero.

The relationship of population growth and human development is direct as it is evidenced from our regression analysis, thus there is a possibility of falling human development index with growing population. But from table (as
given in appendix), we see that as population is growing year after, the human
development index is also increasing giving an opposite relationship to that
which we have assumed in our regression analysis. This may be due to positive
influence of SNDP and SE which outweigh the negative impact of population
growth on HDI and there is an overall increase in the value of HDI with
growing population, if HDI is to show an increase, two steps must be taken.
First, the increased SNDP must trickle down to reach all the sections of society,
leading to an more equitable distribution of increased income and second, social
expenditure must be done in such a way that, its benefit reach to all the layers of
the society instead of restricting the beneficiaries to some pockets only. If these
steps are taken very carefully then with growing population also HDI value will
increase and thus there will be an overall socio-economic development and
improvement in the quality of life of the people in the state. Most of the
researchers point out that when SNDP and SE increases but HDI remains
stagnant, the cause of not improving HDI lies in non-trickling down of the
benefits to the majority.

However, though traditionally viewed population growth hampers
economic growth and may thereby lower human development, but recent
development experience of some successful nations reveal that, large
population if put to right use for the development of the economy, and
sufficient care is taken for their health and education simultaneously, can
actually raise human development, instead of lowering the quality of life, as in
the traditional view. This is also evident from the experience in our own
country, in the state of Kerala. Though the state has the highest density of
population in the whole country yet human development index in the state is
one of the highest in the whole country. Therefore, absolute level of population
by itself may not be the problem, if the quality of the population is superior to a sparsely populated. For similar reasons, we come across states of north east like Arunachal Pradesh where though population is spares, yet HDI is low, though per capita indicator reveal a satisfactory value, which again is due to low density of population. This once again proves that per capita indicator of economic progress is redundant for representing the quality of life of the people in general. This highlights the significance of the social sector because it is only the greater emphasis of this sector, that leads to the improvement of the quality of life.

Many statistical investigations carried out in the western countries have shown that output has increased at a much higher rate than can be explained by physical inputs (like labour and capital). The reason is that the quality of human beings as a protective source has been consistently improving due to improvement in education and skills, availability of health services etc. Therefore, side by side with physical capital formation, human capital formation has also been playing a useful role in economic development. The earlier economists also recognized, this role of human capital and explicitly included human beings, or their acquired abilities and skills, as component of capital. The economists who considered human beings as capital are Smith, Say, Engel, Sidwick, Walras and Fisher. Several modern economists argued that investment in education is undertaken primarily for return and should be regarded as investment in human capital which enhances human capital formation. Important economists who put forward this idea are Gary S. Becker, T.W. Schultz, Frederic Harbinson and Charles A. Myers. All the issues relating to population discussed above are relevant for Assam’s Economy as Assam is also facing population problem. It is therefore revealed that, that though
approaches to the study of human development and human resource development is totally different, yet in the ultimate analysis, when we examine the total outcome the two are highly interrelated, and one remains incomplete without the other.

6.3 HDI Ranking Versus Income Rankings:

As it is clear from table-6.4, Canada with a HDI value of 0.935 has the first rank, Norway second and the USA third. Canada has a rank of only 9 in terms of real GDP per capita (ppp $). This shows that it lags behind 8 countries as far as per capita income is concerned, it is the best country as far as the well-being of the people, it ranks second after Canada. USA has the second position in terms of per capita income, and third in terms of HDI. Among the developing countries, Malaysia with HDI value of 0.772 had 61st rank in 1998. However, in terms of per capita income, its rank is as high as 51st in 1998. India ranks 128th in terms of HDI and 121st in terms of per capita income. China with a rank of 99th in terms of HDI is ranks 106th in terms of the GDP per capita (ppp $).

Table 6.1
HDI Ranking of Selected Developed and Developing Countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>HDI Rank 1998</th>
<th>HDI value</th>
<th>Real GDP (ppp$) per capita 1998</th>
<th>GDP Rank minus HDI Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed countries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>1</td>
<td>0.935</td>
<td>23,582</td>
<td>8</td>
</tr>
<tr>
<td>Norway</td>
<td>2</td>
<td>0.934</td>
<td>26,342</td>
<td>1</td>
</tr>
<tr>
<td>USA</td>
<td>3</td>
<td>0.929</td>
<td>29,605</td>
<td>-1</td>
</tr>
<tr>
<td>Developing Countries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td>61</td>
<td>0.772</td>
<td>8,137</td>
<td>-10</td>
</tr>
<tr>
<td>India</td>
<td>128</td>
<td>0.563</td>
<td>2,077</td>
<td>-7</td>
</tr>
<tr>
<td>China</td>
<td>99</td>
<td>0.706</td>
<td>3,105</td>
<td>7</td>
</tr>
</tbody>
</table>

- A positive figure indicates that the HDI rank in better than the real GDP per capita (ppp$) rank, a negative the opposite.

There are significant differences in HDI and per capita income rankings for many countries. In fact, a comparison of the HDI rankings and per capita income rankings for 174 countries as presented in HDR-2000 shows that there are no differences in the ranks for only 7 countries. The differences are substantial in case of number of countries. For example, the ranks differ by 20 or more than 20 in the case of as many as 34 countries. For 11 countries, the ranks differ by 30 or more than 30. Eleven countries have an HDI rank at least 20 place higher than GDP rank. For 21 countries the GDP rank is atleast 20 places higher than HDI rank.

All these figures and comparisons have been highlighted here to once again draw attention to the fact that, though per capita income decreases alongwith an increase in population, with no substantial increase of GDP, this tendency naturally has adverse effect on quality of life. However, if the growing population is provided with adequate level of education and good health facilities, rising population may have favourable impact on HDI. It is due to this reason that some of the over populated nations of the world, are low in ranks as far as per capital GDP is concerned, but performs much better with respect to HDI ranking. However, such a conclusion implies that high population growth has to be matched by high growth rate of the economy. High growth rate in turn can support higher expenditure on health and education.

In case of Assam however, such has not been the development experience. There is no evidence of higher population matched by higher growth rate of the economy. In fact, economic growth has remained stagnant and has even witnessed a negative growth. However, in case of this state, stagnant growth rate has been attempted to be compensated by central assistance of various nature and form. But such experience has an implied
warning signal. This is because such positive relationship between high population growth and HDI rise can only be a temporary phenomenon in the absence of support of economic growth generated within the state itself. In the face of a steady rise in the population growth, since the state records one of the highest growth rate of population, it may be extremely difficult for the state to maintain an increase in HDI, if serious efforts are not undertaken immediately to expedite its rate of economic development. When numerous scope & facilities are available during the current phase of globalisation and liberalisation for economic development, the entire future of the state both with respect to its economic development & human development depends to what extent the political economy of the state can successfully meet the future challenge.

6.4 Links between Economic Growth and Human Development:

It is therefore evident that no extent of human development is possible without economic development. Emphasis on human development and construction of Human Development Index, has been the most important contribution of the development economists to economic literature in recent years. It has shifted the focus from the ‘quantity of growth’ to the ‘structure and quality of growth’. We now realize that success in economic growth must ultimately be judged by what it does to our lives – the quality of life we can enjoy and the liberties we can exercise. In general, economic growth can not be disassociated from the ‘end’ of promoting human capabilities and of enhancing well-being and freedom. Governments are now becoming increasingly aware that, unless they take corrective actions, economic growth can become lopsided and flawed.
Avoiding the pitfalls of growth requires fostering of strong links between economic growth and human development. This can be accomplished in following ways –

1. Provision of remunerative employment to people

2. More equitable distribution of income and economic opportunities.

3. Access to protective assets.

4. Investment in education, health and skills and providing basic services to all.

Thus to relate economic development and human development via growth in NSDP, in case of Assam also the above steps must be taken into consideration to enhance human development status of the state.

As it is obvious from our study that State Net Domestic Product has been increasing continuously from 1979 to 2001 for the state of Assam except for the years 1994 and 1999. As SNDP of the state increased, the HDI value is also increasing gradually, showing a positive relationship of these two variables (SNDP and HDI) though not as much as warranted by the growth of SNDP. Similar relationship is also supported by our regression analysis. Thus we can conclude that SNDP has a positive influence on HDI and as SNDP increases, there is a possibility of increasing HDI. This generalisation is true as it is revealed from our regression analysis.

Social expenditure (SE) also show an increasing trend with exception in the year 1989 and 1991. As both SE and HDI are increasing together, we can say that increasing social expenditure will lead to improvement in human
development, provided social expenditure is made with accountability. The end result will depend not only on allocation of social expenditure, but also its expenditure in the right direction by the government.

Thus our regression analysis is very useful to reveal the influence of different factors on HDI and the results are very important for adopting future socio-economic policies of the state. If the factors highlighted above are taken into account while formulating socio-economic policies, this will go a long way in enhancing the level of human development in the state of Assam which is an urgent area of concern for the policy makers of the state. The government should also free its funds from other wasteful heads and concentrate on developing the human support system. In addition introduction of more participatory type of initiatives and decentralisation could ensure much better outcomes.
### Table – 6.2

#### Regression Results for General Model

<table>
<thead>
<tr>
<th>Equation</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>$R^2$</th>
<th>F</th>
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<td></td>
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<td></td>
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<td>HDI = a + bNSDP − dP&lt;sub&gt;op&lt;/sub&gt;</td>
<td>23.781</td>
<td>2.49</td>
<td></td>
<td>1.465</td>
<td>0.824</td>
<td>23.436</td>
</tr>
<tr>
<td>t=</td>
<td>(0.441)</td>
<td>(0.957)</td>
<td></td>
<td>(5.625)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDI = a + cSE − dP&lt;sub&gt;op&lt;/sub&gt;</td>
<td>-51.928</td>
<td></td>
<td>1.40</td>
<td>1.934</td>
<td>0.897</td>
<td>43.523</td>
</tr>
<tr>
<td>t=</td>
<td>(-1.049)</td>
<td></td>
<td>(2.937)</td>
<td>(7.272)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDI = a + bNSDP + cSE</td>
<td>29.94</td>
<td>4.382</td>
<td>0.115</td>
<td></td>
<td>4.24</td>
<td>3.677</td>
</tr>
<tr>
<td>t=</td>
<td>(11.242)</td>
<td>(1.115)</td>
<td>(1.645)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDI=a+bNSDP+cSE- dP&lt;sub&gt;op&lt;/sub&gt;</td>
<td>-116.24</td>
<td>4.13</td>
<td>0.164</td>
<td>2.332</td>
<td>0.939</td>
<td>45.906</td>
</tr>
<tr>
<td>t=</td>
<td>(-2.42)</td>
<td>(2.473)</td>
<td>(4.098)</td>
<td>(8.692)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table – 6.3

Regression Results for Lagged Model

<table>
<thead>
<tr>
<th>Model Description</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>R²</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDI = a + bNSDP&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>329.16</td>
<td>8.700</td>
<td>-</td>
<td>-</td>
<td>0.240</td>
<td>3.154</td>
</tr>
<tr>
<td>t = (14.81)</td>
<td></td>
<td>(1.776)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDI = a + cSE&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>313.197</td>
<td>-</td>
<td>0.140</td>
<td>-</td>
<td>0.340</td>
<td>6.672</td>
</tr>
<tr>
<td>t = (14.368)</td>
<td></td>
<td></td>
<td>(2.583)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDI = a - dPop&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>82.490</td>
<td>-</td>
<td>-</td>
<td>1.203</td>
<td>0.830</td>
<td>48.97</td>
</tr>
<tr>
<td>t = (2.039)</td>
<td></td>
<td></td>
<td></td>
<td>(6.998)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDI = a + bNSDP&lt;sub&gt;t-1&lt;/sub&gt; - dPop&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>74.76</td>
<td>1.23</td>
<td>-</td>
<td>1.256</td>
<td>0.797</td>
<td>22.54</td>
</tr>
<tr>
<td>t = (1.618)</td>
<td></td>
<td>(-.413)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDI = a + bNSDP&lt;sub&gt;t-1&lt;/sub&gt; + cSE&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>303.28</td>
<td>4.85</td>
<td>0.115</td>
<td>-</td>
<td>0.462</td>
<td>3.860</td>
</tr>
<tr>
<td>t = (12.711)</td>
<td></td>
<td>(2.014)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDI = a + cSE&lt;sub&gt;t-1&lt;/sub&gt; - dPop&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>10.073</td>
<td>-</td>
<td>-9.06</td>
<td>1.651</td>
<td>0.882</td>
<td>33.55</td>
</tr>
<tr>
<td>t = (0.197)</td>
<td></td>
<td></td>
<td>(2.976)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDI = a + bNSDP&lt;sub&gt;t-1&lt;/sub&gt; + cSE&lt;sub&gt;t-1&lt;/sub&gt; - dPop&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-7.652</td>
<td>-2.07</td>
<td>-9.65</td>
<td>1.77</td>
<td>0.890</td>
<td>21.659</td>
</tr>
<tr>
<td>t = (-1.35)</td>
<td></td>
<td>(-0.794)</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
### Table – 6.4

**Regression Results for Change Model**

<table>
<thead>
<tr>
<th>Model</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>$R^2$</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta \text{HDI} = a + b \Delta \text{NSDP}$</td>
<td>1.321</td>
<td>-4.85</td>
<td>-</td>
<td>-</td>
<td>-0.1</td>
<td>0</td>
</tr>
<tr>
<td>t=</td>
<td>(3.136)</td>
<td>(-0.22)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \text{HDI} = a + c \Delta \text{SE}$</td>
<td>1.311</td>
<td>-</td>
<td>1.58</td>
<td>-</td>
<td>0.041</td>
<td>0.423</td>
</tr>
<tr>
<td>t=</td>
<td>(3.581)</td>
<td></td>
<td>(-0.650)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \text{HDI} = a - d \Delta \text{Pop}$</td>
<td>1.007</td>
<td>-</td>
<td>-</td>
<td>3.14</td>
<td>0.052</td>
<td>0.545</td>
</tr>
<tr>
<td>t=</td>
<td>(1.798)</td>
<td></td>
<td></td>
<td>(0.739)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \text{HDI} = a + b \Delta \text{NSDP} - d \Delta \text{Pop}$</td>
<td>9.86</td>
<td>1.794</td>
<td>-</td>
<td>3.19</td>
<td>0.052</td>
<td>0.249</td>
</tr>
<tr>
<td>t=</td>
<td>(1.539)</td>
<td>(0.079)</td>
<td></td>
<td>(0.705)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \text{HDI} = a + b \Delta \text{NSDP} + c \Delta \text{SE}$</td>
<td>1.429</td>
<td>-4.96</td>
<td>1.74</td>
<td>-</td>
<td>.045</td>
<td>0.241</td>
</tr>
<tr>
<td>t=</td>
<td>(3.078)</td>
<td>(-0.211)</td>
<td>(-0.653)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \text{HDI} = a + c \Delta \text{SE} - d \Delta \text{Pop}$</td>
<td>8.39</td>
<td>-</td>
<td>-3.41</td>
<td>6.259</td>
<td>0.190</td>
<td>1.059</td>
</tr>
<tr>
<td>t=</td>
<td>(1.494)</td>
<td></td>
<td>(-1.242)</td>
<td>(1.291)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \text{HDI} = a + b \Delta \text{NSDP} + c \Delta \text{SE} - d \Delta \text{Pop}$</td>
<td>8.88</td>
<td>-5.22</td>
<td>-3.59</td>
<td>6.27</td>
<td>0.196</td>
<td>0.649</td>
</tr>
<tr>
<td>t=</td>
<td>(1.406)</td>
<td>(-0.228)</td>
<td>(-1.194)</td>
<td>(1.223)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
References:


Chatterjee, Biswajit et al. (2001) : Insearch of a District Development Index, State Institute of Panchayat and Rural Development, Kalyani.


