CHAPTER- VI

A Comparative Study among the Tea Estates in Terai Region of West Bengal

6.1: Impact of Welfare, Health, and Safety on Productivity of the Tea Workers: Ownership Pattern Wise

For the purpose of getting a clearer picture of the impact of welfare, health, and safety on the productivity of the workers, it is necessary to conduct a comparative study on the tea estates which fall under different types of ownership category. To establish the relationship among the four variables as per the ownership pattern, we have conducted regression analysis one by one, starting with partnership tea estates, followed by proprietorship, and public tea estates respectively.

6.1.1: Regression Analysis: Partnership Tea Estates

Before going into the depth of regression analysis in view of partnership tea estates, considering the four variables, namely welfare expenses, health expenses, safety expenses, and labour productivity, we have conducted descriptive statistics, followed by unit root test.

6.1.1.1: Descriptive Statistics Results

During the study period, the variables viz. health, safety, welfare, and productivity of the tea workers are found to be very stable and not much varying from their mean values. The low value of the standard deviation of all the three variables, as observed from the table- 6.1, in this regard also confirms the stability.

Table: 6.1

Descriptive Statistics Results: Partnership Tea Estates

	LOG (PRODUCTIVITY)	LOG (WELFARE_ EXPENSES)	LOG (HEALTH_ EXPENSES)	LOG (SAFETY_ EXPENSES)
Mean	7.959088	16.50145	15.00561	13.92257
Median	7.958388	16.50710	15.01311	13.92315
Maximum	8.005752	16.66124	15.16602	14.09157
Minimum	7.917401	16.33793	14.83744	13.76672
Std. Dev.	**0.026986**	**0.100981**	**0.102759**	**0.107008**
Skewness	0.132066	0.042254	-0.13386	0.072697
Kurtosis	1.897496	1.980515	1.816750	1.769879
Jarque-Bera	1.071067	0.872076	1.226461	1.278615
Probability	**0.585357**	**0.646593**	**0.541598**	**0.527658**
Sum	159.1818	330.0289	300.1122	278.4515
Sum Sq. Dev.	0.013837	0.193747	0.200628	0.217562
Observations	20	20	20	20

Source: *Computed by the author*

It is also visible from the table- 6.1 that in the case of all the four variables, p values of Jarque-Bera statistics are greater than 0.05. Therefore, we can assert that all the variables approximately conform to the normality; and it is also observed that the results of median of various variables are more or less equal to the respective mean values.

6.1.1.2: Unit Root Test Results

Unit root test has been conducted to see whether the time series variables are non-stationary and possesses a unit root. The null hypothesis, here, is the series are non-stationary, and the alternative hypothesis is series are stationary.

Table: 6.2

Unit Root Test Results: Partnership Tea Estates

Variables	Level			First Difference			Second Difference		
	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	None
L_Productivity	2.567371 0.9999	0.010103 0.9930	2.588233 0.9957	-2.549140 0.1213	-3.391196 0.0840	-0.189040 0.6041	**-6.111052 0.0001**	-5.887700 0.0010	-6.213986 0.0000
L_Welfare_ Expenses	-0.484236 0.8742	-3.325903 0.0921	2.677583 0.9966	-6.030454 0.0001	-5.845545 0.0010	-4.158514 0.0003	**-5.425754 0.0006**	-5.090705 0.0049	-5.623752 0.0000
L_Health_ Expenses	-0.391834 0.8912	-4.445234 0.0118	2.751805 0.9970	-7.945864 0.0000	-7.697192 0.0000	-6.326227 0.0000	**-5.827815 0.0003**	-5.608057 0.0024	-5.980839 0.0000
L_Safety_ Expenses	-0.450279 0.8800	-4.412206 0.0126	2.520389 0.9950	-6.916054 0.0000	-6.697501 0.0002	-5.612010 0.0000	**-4.250818 0.0058**	-3.177715 0.1283	-4.433817 0.0002

Source: *Computed by the author*

We can see the detail of the ADF test result in table- 6.2. Here, at the 2^{nd} difference with intercept, the probability values of t-statistics of all the variables viz. productivity, welfare, health, and safety are significant; meaning that all the variables are stationary at the 2^{nd} difference with intercept only.

6.1.1.3: Relation between Welfare, Health, Safety, and Labour Productivity: Multiple Regression Model Considering the Partnership Tea Estates

While conducting multiple regression, considering the variables welfare, health, safety, and labour productivity, we have got the following regression model in the context of partnership tea estates. This model has basically come out from the log estimation of the above-mentioned variables, where productivity is a dependent variable and welfare, health, and safety expenses are the explanatory variables.

Table: 6.3

Result of Multiple Regression Model: Partnership Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1998 – 2017				
Included observations: 20				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	3.856632	0.161508	23.87888	**0.0000**
LOG_WELFARE_EXPENSES	0.134918	0.033868	3.983671	**0.0011**
LOG_HEALTH_EXPENSES	0.059841	0.026482	2.259719	**0.0381**
LOG_SAFETY_EXPENSES	0.070258	0.026033	2.69876	**0.0158**
R-squared	**0.982192**	Mean dependent var		7.959088
Adjusted R-squared	0.978853	S.D. dependent var		0.026986
S.E. of regression	0.003924	Akaike info criterion		-8.06637
Sum squared resid	0.000246	Schwarz criterion		-7.86723
Log-likelihood	84.66371	Hannan-Quinn criter.		-8.0275
F-statistic	**294.1561**	Durbin-Watson stat		1.699439
Prob(F-statistic)	**0.0000**			

Source: *Computed by the author*

From table- 6.3, the following multiple regression equation can be formed.

$$Log\ (y) = 3.856632 + 0.134918 \log (x_1) + 0.059841 \log (x_2) + 0.070258 \log (x_3)$$

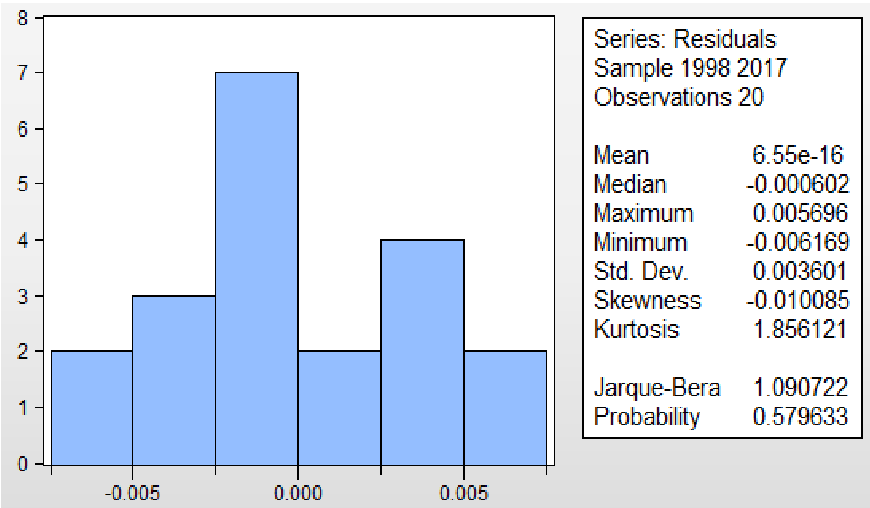
--- (Equation – 6.1)

Where, R^2= 0.982192, F= 294.1561*, DW= 1.699439, y =labour productivity, x_1 = welfare expenses, x_2 = health expenses, x_3 = safety expenses, *=significant at 5% level.

A quick glance at the results of the table- 6.3 reveals that the coefficients, in equation-6.1, are statistically significant and the fit is moderately tight. But, before making any estimation and also forecasting, normality needs to be tested to see whether the residuals are normally distributed or not.

Figure: 6.1

Result of Jarque-Bera Statistics of Multiple Regression : Partnership Tea Estates



Source: *Computed by the author*

From figure-6.1, we get the result of Jarque-Bera Statistics. Here, the null hypothesis is the residuals are normally distributed. Looking at the probability of Jarque- Bera statistics, we can easily accept the null hypothesis because of the insignificance of its probability value. So, we can assert that the residuals are normally distributed. But, as we know that the presence of heteroscedasticity restricts us from making any estimation, before doing so, we have also looked into the matter of heteroskedasticity in the residuals of our equation.

Table: 6.4

Breusch-Pagan-Godfrey Heteroskedasticity Test of Multiple Regression : Partnership Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	1.487353	Prob. F(3,16)		**0.2558**
Obs*R-squared	4.3613	Prob. Chi-Square(3)		**0.225**
Scaled explained SS	1.194816	Prob. Chi-Square(3)		**0.7542**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1998 - 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00047	0.000464	-1.02221	0.3219
LOG_WELFARE_EXPENSES	2.47E-05	9.73E-05	0.253619	0.803
LOG_HEALTH_EXPENSES	0.000115	7.61E-05	1.518085	0.1485
LOG_SAFETY_EXPENSES	-0.00012	7.48E-05	-1.58807	0.1318
R-squared	0.218065	Mean dependent var		1.23E-05
Adjusted R-squared	0.071452	S.D. dependent var		1.17E-05
S.E. of regression	1.13E-05	Akaike info criterion		-19.772
Sum squared resid	2.03E-09	Schwarz criterion		-19.5728
Log-likelihood	201.7195	Hannan-Quinn criter.		-19.7331
F-statistic	1.487353	Durbin-Watson stat		2.440984
Prob(F-statistic)	0.255786			

Source: *Computed by the author*

The table- 6.4 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. It is known to us that homoscedasticity is one of the prerequisites for an accurate regression model. Here the null hypothesis is the residuals are homoskedastic. We can easily accept the null hypothesis looking at the probability values the as probability values are greater than 0.05. So, it proves that the problem of heteroscedasticity is not there in this equation. But, another problem which often restricts us for making estimation is the existence of serial correlation. So, before making estimation we will also have to check whether there is any existence of serial correlation in this equation.

Table: 6.5

Breusch-Godfrey Serial Correlation LM Test of

Multiple Regression : Partnership Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.138028	Prob. F(2,14)	**0.8722**
Obs*R-squared	0.386741	Prob. Chi-Square(2)	**0.8242**

Source: *Computed by the author*

The table- 6.5 gives us the Breusch-Godfrey Serial Correlation LM Test result. Here the null hypothesis is the residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from serial correlation. As we have tested all the prerequisites of multiple regression, we can now proceed further for making estimation using the equation- 6.1.

Log (labour productivity) = 3.856632 + 0.134918 log (welfare expenses) + 0.059841 log (health expenses) + 0.070258log (safety expenses)

---- (Equation – 6.2)

6.1.1.4: <u>Impact of Welfare on Productivity of the Tea Workers: Simple Regression Model Considering Partnership Tea Estates</u>

We have also tested the impact of welfare, health, and safety, separately, on labour productivity to observe how the above-mentioned variables create impact, individually, on labour productivity. Firstly, simple regression has been analysed taking labour productivity as the dependent variable and welfare as an independent variable.

Table: 6.6

Result of Simple Regression Model Considering Welfare and Productivity: Partnership Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1998 2017				
Included observations: 20				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	3.626747	0.194028	18.69186	**0.0000**
LOG_WELFARE_EXPENSES	0.262543	0.011758	22.32881	**0.0000**
R-squared	0.965155	Mean dependent var		7.959088
Adjusted R-squared	0.963219	S.D. dependent var		0.026986
S.E. of regression	0.005176	Akaike info criterion		-7.595119
Sum squared resid	0.000482	Schwarz criterion		-7.495545
Log-likelihood	77.95119	Hannan-Quinn criter.		-7.575681
F-statistic	**498.5757**	Durbin-Watson stat		1.761075
Prob(F-statistic)	**0.0000**			

Source: *Computed by the author*

From the above table, the following regression equation can be formed:

$$\mathbf{Log\ (y) = 3.626747 + 0.262543\ log\ (x_1)}$$

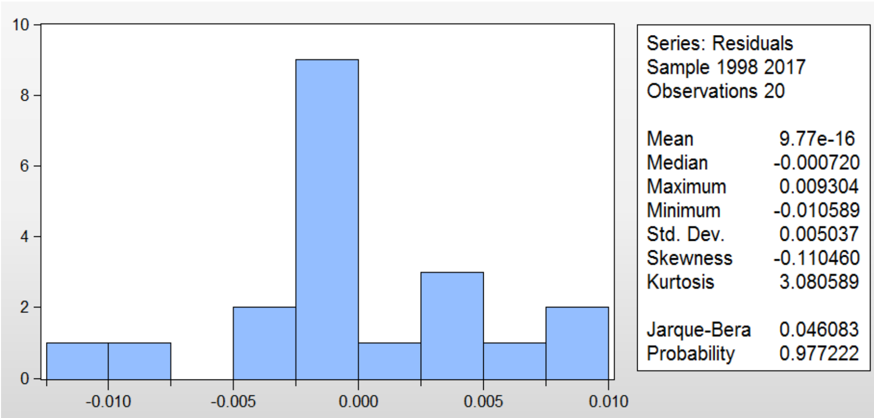
----- (Equation- 6.3)

Where, R^2= 0.965155, F= 498.5757*, DW= 1.761075, y =labour productivity, x_1 = welfare expenses, *=significant at 5% level.

A quick look at the results of the table- 6.6 reveals that the coefficients, in the equation- 6.3, are statistically significant and the fit is moderately tight. But, before making estimation and forecasting, normality has been tested to check if residuals are normally distributed.

Figure: 6.2

Jarque-Bera Statistics Result of Simple Regression Model Considering Welfare and Productivity: Partnership Tea Estates



Source: *Computed by the author*

From the figure- 6.2 we get the result of Jarque-Bera Statistics. The null hypothesis is residuals are normally distributed. Here, from the probability of Jarque- Bera Statistics we can accept the null hypothesis because the probability value is insignificant. So, we can come to the conclusion that the residuals are normally distributed. But, before making an estimation, we need to look into the matter of heteroskedasticity in the residuals of our equation.

Table: 6.7
Breusch-Pagan-Godfrey Heteroskedasticity Test Result of Simple Regression Model Considering Welfare and Productivity: Partnership Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.106526	Prob. F(1,18)		**0.7479**
Obs*R-squared	0.117666	Prob. Chi-Square(1)		**0.7316**
Scaled explained SS	0.09915	Prob. Chi-Square(1)		**0.7529**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1998 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000423	0.00137	-0.308782	0.761
LOG_WELFARE_EXPENSES	2.71E-05	8.30E-05	0.326383	0.7479
R-squared	0.005883	Mean dependent var		2.41E-05
Adjusted R-squared	-0.049345	S.D. dependent var		3.57E-05
S.E. of regression	3.65E-05	Akaike info criterion		-17.50136
Sum squared resid	2.40E-08	Schwarz criterion		-17.40179
Log-likelihood	177.0136	Hannan-Quinn criter.		-17.48193
F-statistic	0.106526	Durbin-Watson stat		2.452391
Prob(F-statistic)	0.747899			

Source: *Computed by the author*

Table- 6.7 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. It is known to us that homoscedasticity is one of the prerequisites for an accurate regression model. Here the null hypothesis is residuals are homoskedastic. We can easily accept the null hypothesis looking at the probability values as the probability values are greater than 0.05. So, it proves that the problem of heteroscedasticity does not exist the equation- 6.3. But, as we know that another problem which often restricts us for making estimation is the existence of serial correlation. So, before making an estimation, we will have to check whether there is any existence of serial correlation in this equation.

Table: 6.8

Breusch-Godfrey Serial Correlation LM Test Result of Simple Regression Model Considering Welfare and Productivity: Partnership Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.10845	Prob. F(2,16)	**0.8979**
Obs*R-squared	0.267499	Prob. Chi-Square(2)	**0.8748**

Source: *Computed by the author*

Table- 6.8 gives us the Breusch-Godfrey Serial Correlation LM Test result. Here, the null hypothesis is the residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from serial correlation. As we have tested all the prerequisites of regression, we can proceed further for estimation using equation- 6.3.

Log (labour productivity) = 3.626747+ 0.262543 log (welfare expenses)

---- (Equation- 6.4)

From equation- 6.4 we can assert that 1% increase in welfare expenditure per year in partnership farm leads to 0.262543% increase in labour productivity per year during the period of 1998 – 2017, which is significant at 5% level.

6.1.1.5: Impact of Health on Productivity of the Tea Workers: Simple Regression Model Considering the Partnership Tea Estates

Now let us analyse simple regression, taking labour productivity as the dependent variable, and health as an independent variable, in the context of partnership tea estates.

Table: 6.9
Result of Simple Regression Model Considering Health and Productivity: Partnership Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1998 - 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.188741	0.270184	15.50328	**0.0000**
LOG_HEALTH_EXPENSES	0.251263	0.018005	13.95504	**0.0000**
R-squared	0.915391	Mean dependent var		7.959088
Adjusted R-squared	0.91069	S.D. dependent var		0.026986
S.E. of regression	0.008065	Akaike info criterion		-6.707982
Sum squared resid	0.001171	Schwarz criterion		-6.608408
Log-likelihood	69.07982	Hannan-Quinn criter.		-6.688544
F-statistic	**194.743**	Durbin-Watson stat		2.04481
Prob(F-statistic)	**0.0000**			

Source: *Computed by the author*

From table- 6.9, the following regression equation can be formed:

$$Log\ (y) = 4.188741 + 0.251263\ log\ (x_2)$$

---- *(Equation- 6.5)*

Where, R^2= 0.915391, F= 194.743*, DW= 2.04481, y =labour productivity, x_2 = Health expenses, *=significant at 5% level.

The glimpses of the results of the table- 6.9 reveal that the coefficients, in the equation- 6.5, are statistically significant and the fit is moderately tight. But, before estimation, we have also looked into the matter of heteroskedasticity in the residuals of our equation.

Table: 6.10

Breusch-Pagan-Godfrey Heteroskedasticity Test Result of Simple Regression Model Considering Health and Productivity: Partnership Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.005016	Prob. F(1,18)		**0.9443**
Obs*R-squared	0.005572	Prob. Chi-Square(1)		**0.9405**
Scaled explained SS	0.010645	Prob. Chi-Square(1)		**0.9178**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1998 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00026	0.004489	-0.05778	0.9546
LOG_HEALTH_EXPENSES	2.12E-05	0.000299	0.070823	0.9443
R-squared	0.000279	Mean dependent var		5.85E-05
Adjusted R-squared	-0.05526	S.D. dependent var		0.00013
S.E. of regression	0.000134	Akaike info criterion		-14.9028
Sum squared resid	3.23E-07	Schwarz criterion		-14.8033
Log-likelihood	151.0282	Hannan-Quinn criter.		-14.8834
F-statistic	0.005016	Durbin-Watson stat		2.323895
Prob(F-statistic)	0.94432			

Source: *Computed by the author*

Table- 6.10 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. It is known to us that homoscedasticity is one of the prerequisites for an accurate regression model. Here the null hypothesis is residuals are homoskedastic. We can easily accept the null hypothesis looking at the probability values, as the probability values are greater than 0.05. So, it proves that the equation-6.5 does not suffer from the problem of heteroscedasticity. But, another problem which often restricts us for making estimation is the existence of serial correlation. So, before making an estimation, it is necessary to check the existence of serial correlation in this equation.

Table: 6.11

Breusch-Godfrey Serial Correlation LM Test Result of Simple Regression Model Considering Health and Productivity: Partnership Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.334958	Prob. F(2,16)	**0.7203**
Obs*R-squared	0.803743	Prob. Chi-Square(2)	**0.6691**

Source: *Computed by the author*

Table- 6.11 displays the Breusch-Godfrey Serial Correlation LM test result. Here the null hypothesis is residuals are not serially correlated. If we look at the probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from serial correlation. As we have tested all the prerequisites of conducting a regression analysis, we can proceed further for estimation using the equation-6.6.

Log (labor productivity) = 4.188741 + 0.251263 log (health expenses)

---- *(Equation- 6.6)*

So, we can assert from the equation- 6.6 that 1% increase in health expenditure per year in partnership farm leads to 0.25126 % increase in labour productivity per year during the period of 1998 – 2017, which is significant at 5% level.

6.1.1.6: Impact of Safety on Productivity of the Tea Workers: Simple Regression Model Considering the Partnership Tea Estates

This time let us analyse simple regression taking labour productivity as the dependent variable and safety as an independent variable, in the context of partnership tea estates.

Table: 6.12

Result of Simple Regression Model Considering Safety and Productivity: Partnership Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1998 2017				
Included observations: 20				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	4.578895	0.223912	20.4495	**0.0000**
LOG_SAFETY_EXPENSES	0.242785	0.016082	15.09648	**0.0000**
R-squared	**0.926801**	Mean dependent var		7.959088
Adjusted R-squared	0.922734	S.D. dependent var		0.026986
S.E. of regression	0.007501	Akaike info criterion		-6.85284
Sum squared resid	0.001013	Schwarz criterion		-6.75326
Log-likelihood	70.52837	Hannan-Quinn criter.		-6.8334
F-statistic	**227.9037**	Durbin-Watson stat		1.908197
Prob(F-statistic)	**0.0000**			

Source: *Computed by the author*

From table- 6.12, the following regression equation can be formed.

$$Log (y) = 4.578895 + 0.242785 \log (x_3)$$

----- (Equation- 6.7)

Where, R2= 0.926801, F= 227.9037*, DW= 1.908197, y =labour productivity, x_3 = Safety expenses, *=significant at 5% level.

the results of the table- 6.12 reveals that the coefficients, in the equation- 6.7, are statistically significant and the fit is moderately tight. But, before making an estimation, the matter of heteroskedasticity in the residuals of our equation needs to be taken care of.

Table: 6.13

Breusch-Pagan-Godfrey Heteroskedasticity Test Result of Simple Regression Model Considering Safety and Productivity: Partnership Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.071764	Prob. F(1,18)		**0.7918**
Obs*R-squared	0.079421	Prob. Chi-Square(1)		**0.7781**
Scaled explained SS	0.163088	Prob. Chi-Square(1)		**0.6863**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1998 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.00101	0.003581	0.282023	0.7811
LOG_SAFETY_EXPENSES	-6.89E-05	0.000257	-0.26789	0.7918
R-squared	0.003971	Mean dependent var		5.06E-05
Adjusted R-squared	-0.05136	S.D. dependent var		0.000117
S.E. of regression	0.00012	Akaike info criterion		-15.1241
Sum squared resid	2.59E-07	Schwarz criterion		-15.0246
Log-likelihood	153.2413	Hannan-Quinn criter.		-15.1047
F-statistic	0.071764	Durbin-Watson stat		2.22977
Prob(F-statistic)	0.791832			

Source: *Computed by the author*

Table- 6.13 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. As the probability values are greater than 0.05, we can assert that the problem of heteroscedasticity is not there in the equation- 6.7. Now, we will have to check whether there is any existence of serial correlation in this equation.

Table: 6.14

Breusch-Godfrey Serial Correlation LM Test Result of Simple Regression Model Considering Safety and Productivity: Partnership Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.01949	Prob. F(2,16)	**0.9807**
Obs*R-squared	0.048605	Prob. Chi-Square(2)	**0.976**

Source: *Computed by the author*

The table- 6.14 gives us Breusch-Godfrey Serial Correlation LM Test result. Here the null hypothesis is the residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from the problem of serial correlation. As we have tested all the prerequisites of regression, we can proceed further for estimation using the equation- 6.7.

Log (labour productivity) = 4.578895+ 0.242785 log (safety expenses)

---- *(Equation- 6.8)*

From the equation- 6.8, we can assert that 1% increase in safety expenditure per year in partnership tea estates leads to 0.242785 % increase in labour productivity per year during the period of 1998 – 2017, which is significant at 5% level.

Now, in the same way, we have conducted multiple regression and simple regression on the proprietorship tea estates. Let us take a look.

6.1.2: Regression Analysis: Proprietorship Tea Estates

Before going into the depth of regression analysis in the context of the proprietorship tea estates, taking the four variables, namely welfare expenses, health expenses, safety expenses, and labour productivity, we have conducted descriptive statistics, followed by unit root test.

6.1.2.1: Descriptive Statistics Results

During the study period, the variables, viz. health, safety, welfare, and productivity of the tea workers, in the context of proprietorship tea estates, are found to be very stable and not much varying from their mean values. The low value of the standard deviation of all the three variables, as we can see in the table- 6.15, also confirms the stability.

Table: 6.15

Descriptive Statistics Results : Proprietorship Tea Estates

	LOG_ PRODUCTIVITY	LOG_ WELFARE_ EXPENSES	LOG_ HEALTH_ EXPENSES	LOG_ SAFETY_ EXPENSES
Mean	8.072020	16.53329	15.07325	14.01419
Median	8.071363	16.53863	15.07996	14.01429
Maximum	8.113772	16.68833	15.22365	14.16911
Minimum	8.034835	16.37516	14.91663	13.87250
Std. Dev.	**0.024109**	**0.097828**	**0.096009**	**0.097692**
Skewness	0.135766	0.046777	-0.12601	0.083091
Kurtosis	1.898702	1.980062	1.815591	1.771624
Jarque-Bera	1.072156	0.874189	1.221946	1.280437
Probability	**0.585038**	**0.645910**	**0.542822**	**0.527177**
Sum	161.4404	330.6659	301.4650	280.2839
Sum Sq. Dev.	0.011044	0.181835	0.175138	0.181331
Observations	20	20	20	20

Source: *Computed by the author*

It is also visible from the table- 6.15 that in the case of all the four variables, probability values of Jarque-Bera statistics are greater than 0.05. Therefore, we can assert that all the variables approximately conform to the normality; and it is also observed that the results of median of various variables are more or less equal to the respective mean values.

6.1.2.2: Unit Root Test Results

Unit root test has been conducted to see whether the time series variables, in the context of proprietorship tea estates, are non-stationary and possesses a unit root. The null hypothesis here is the series are non-stationary and the alternative hypothesis is series are stationary.

Table: 6.16

Unit Root Test Results : Proprietorship Tea Estates

Variables	Level			First Difference			Second Difference		
	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	None
L_Productivity	2.639422 0.9999	0.046530 0.9937	2.551031 0.9953	-2.513657 0.1288	-3.384472 0.0850	-0.177334 0.6083	**-6.109028** **0.0001**	-5.885988 0.0011	-6.207065 0.0000
L_Welfare_ Expenses	-0.477316 0.8756	-3.322908 0.0926	2.678268 0.9966	-6.028134 0.0001	-5.844096 0.0010	-4.156470 0.0003	**-5.419762** **0.0006**	-5.085827 0.0049	-5.617716 0.0000
L_Health_ Expenses	-0.376117 0.8940	-4.454077 0.0116	2.759555 0.9970	-7.952353 0.0000	-7.704583 0.0000	-6.324362 0.0000	**-5.802537** **0.0004**	-5.580778 0.0025	-5.953610 0.0000
L_Safety_ Expenses	-0.433793 0.8832	-4.397657 0.0130	2.524579 0.9950	-6.915082 0.0000	-6.697257 0.0002	-5.607602 0.0000	**-4.251355** **0.0058**	-3.177923 0.1282	-4.434968 0.0002

Source: *Computed by the author*

We can see the detail of the ADF test result in table- 6.16. Here, at the 2^{nd} difference with intercept, the probability values of the t-statistics of all the variables viz. productivity, welfare, health, and safety are significant; meaning that all the variables are stationary at the 2^{nd} difference with intercept only.

6.1.2.3: <u>Relation between Welfare, Health, Safety, and Labour Productivity: Multiple Regression Model Considering the Proprietorship Tea Estates</u>

If we concentrate on the relation between welfare, health, safety, and labour productivity, in the context of proprietorship tea estates, we get the following regression model; and this model has come out from log estimation of the variables above mentioned, where productivity is the dependent variable, and welfare, health, and safety expenses are the explanatory variables.

Table: 6.17

Result of Multiple Regression Model: Proprietorship Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1 20				
Included observations: 20				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	4.18965	0.141225	29.66646	**0.0000**
LOG_WELFARE_EXPENSES	0.123925	0.031215	3.970116	**0.0011**
LOG_HEALTH_EXPENSES	0.057498	0.0253	2.272647	**0.0372**
LOG_SAFETY_EXPENSES	0.068986	0.025426	2.713253	**0.0153**
R-squared	0.982277	Mean dependent var		8.07202
Adjusted R-squared	0.978954	S.D. dependent var		0.024109
S.E. of regression	0.003498	Akaike info criterion		-8.2966
Sum squared resid	0.000196	Schwarz criterion		-8.09746
Log-likelihood	86.96604	Hannan-Quinn criter.		-8.25773
F-statistic	295.5881	Durbin-Watson stat		1.699154
Prob(F-statistic)	0.0000			

Source: *Computed by the author*

From table 6.17, the following regression equation can be formed.

$$Log\ (y) = 4.189650 + 0.123925 \log (x_1) + 0.057498 \log (x_2) + 0.068986 \log (x_3)$$

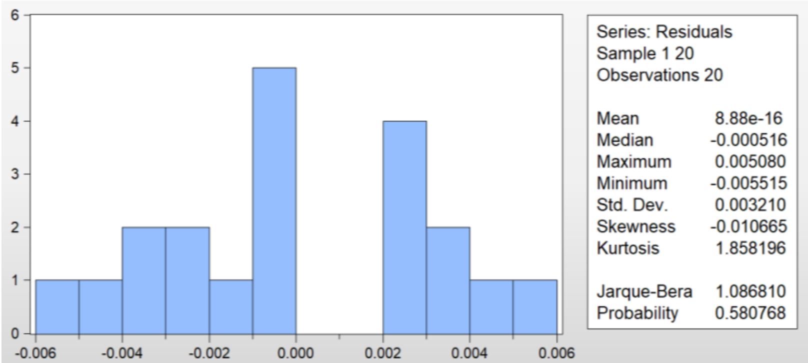
---- (Equation – 6.9)

Where, y =labour productivity, x_1 = welfare expenses, x_2 = health expenses, x_3 = safety expenses, *= significant at 5% level.

A quick glance at the results of the table- 6.17 reveals that the coefficients, in equation-6.9, are statistically significant and the fit is moderately tight. But, before making any estimation and also forecasting, normality should be tested to see whether the residuals are normally distributed or not.

Figure: 6.3

Jarque-Bera Statistics Result of Multiple Regression Model: Proprietorship Tea Estates



Source: *Computed by the author*

From figure-6.3, we get the result of Jarque-Bera Statistics. Here, the null hypothesis is the residuals are normally distributed. Looking at the probability value of Jarque- Bera statistics, we can easily accept the null hypothesis because of its insignificance. So, we can assert that the residuals are normally distributed. But, as we know that the presence of heteroscedasticity restricts us from making any estimation, before doing so, we have also looked into the matter of heteroskedasticity in the residuals of our equation.

Table: 6.18
Breusch-Pagan-Godfrey Heteroskedasticity Test Result of Multiple Regression Model: Proprietorship Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	1.445912	Prob. F(3,16)		**0.2666**
Obs*R-squared	4.265703	Prob. Chi-Square(3)		**0.2342**
Scaled explained SS	1.171459	Prob. Chi-Square(3)		**0.7599**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1 20				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00036	0.000363	-0.98059	0.3414
LOG_WELFARE_EXPENSES	1.88E-05	8.02E-05	0.234527	0.8176
LOG_HEALTH_EXPENSES	9.78E-05	6.50E-05	1.504099	0.152
LOG_SAFETY_EXPENSES	-0.0001	6.54E-05	-1.55013	0.1407
R-squared	0.213285	Mean dependent var		9.79E-06
Adjusted R-squared	0.065776	S.D. dependent var		9.30E-06
S.E. of regression	8.99E-06	Akaike info criterion		-20.2239
Sum squared resid	1.29E-09	Schwarz criterion		-20.0248
Log-likelihood	206.239	Hannan-Quinn criter.		-20.185
F-statistic	1.445912	Durbin-Watson stat		2.452558
Prob(F-statistic)	0.266611			

Source: *Computed by the author*

Table- 6.18 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. It is known to us that homoscedasticity is one of the prerequisites for an accurate regression model. Here the null hypothesis is the residuals are homoskedastic. We can easily accept the null hypothesis looking at the probability values as probability values are greater than 0.05. So, it proves that the problem of heteroscedasticity is not there in this equation. But, as we know that another problem which often restricts us for making estimation is the existence of serial correlation. So, before making an estimation, we need to check whether there is any existence of serial correlation in this equation.

Table: 6.19

Breusch-Godfrey Serial Correlation LM Test result of Multiple Regression Model: Proprietorship Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.142488	Prob. F(2,14)	**0.8684**
Obs*R-squared	0.398987	Prob. Chi-Square(2)	**0.8191**

Source: *Computed by the author*

The table- 6.19 displays the Breusch-Godfrey Serial Correlation LM test result. Here the null hypothesis is residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from serial correlation. As we have tested all the prerequisites of conducting a multiple regression, we can proceed further for making an estimation using the equation-6.9.

Log (labour productivity) = 4.189650 + 0.123925 log (welfare expenses) + 0.057498 log (health expenses) + 0.068986 log (safety expenses)

---- (Equation- 6.10)

6.1.2.4: Impact of Welfare on Productivity of the Tea Workers: Simple Regression Model Considering the Proprietorship Tea Estates

We have also tested the impact of welfare, health, and safety, separately, on labour productivity of the workers, in the context of the proprietorship tea estates to observe how the above-mentioned variables create impact, separately, on labour productivity. Firstly, simple regression has been analysed taking labour productivity as the dependent variable, and welfare as an independent variable.

Table: 6.20

Result of Simple Regression Model Considering Welfare and Productivity: Proprietorship Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1 20				
Included observations: 20				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	4.069050	0.17926	22.69916	**0.0000**
LOG_WELFARE_EXPENSES	0.242116	0.010842	22.33091	**0.0000**
R-squared	0.965161	Mean dependent var		8.07202
Adjusted R-squared	0.963226	S.D. dependent var		0.024109
S.E. of regression	0.004623	Akaike info criterion		-7.82076
Sum squared resid	0.000385	Schwarz criterion		-7.72119
Log-likelihood	80.20763	Hannan-Quinn criter.		-7.80133
F-statistic	498.6695	Durbin-Watson stat		1.760429
Prob(F-statistic)	0.0000			

Source: *Computed by the author*

From the table- 6.20, the following regression equation can be formed:

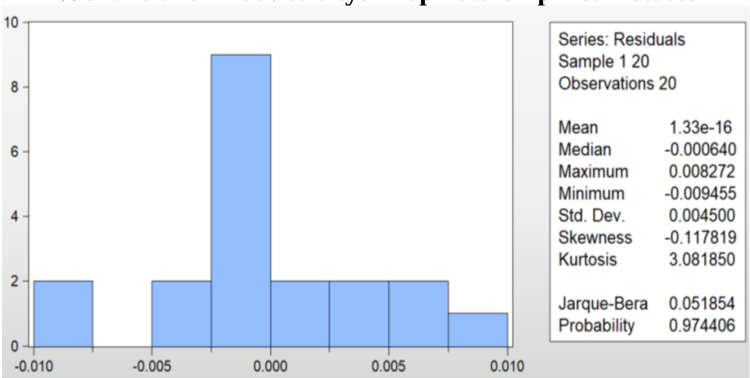
$$Log\ (y) = 4.069050 + 0.242116 \log (x_1)$$

---- *(Equation- 6.11)*

Where, R^2= 0.965161, F= 498.6695*, DW= 1.760429, y = labour productivity, x_1 = welfare expenses, *= significant at 5% level.

A quick glance at the results of the table- 6.20 reveals that the coefficients, in equation-6.11, are statistically significant and the fit is moderately tight. But, before making any estimation and also forecasting, normality has been tested to check whether the residuals are normally distributed or not.

Figure: 6.4
Jarque-Bera Statistics Result of Simple Regression Model Considering Welfare and Productivity: Proprietorship Tea Estates



Source: *Computed by the author*

From figure- 6.4, we get the result of Jarque-Bera Statistics. Here, the null hypothesis is the residuals are normally distributed. Here, from the probability of Jarque- Bera Statistics we can accept the null hypothesis because the probability value is insignificant. So, we can assert that the residuals are normally distributed. But, before estimation, we have also looked into the matter of heteroskedasticity in the residuals of the equation- 6.11.

Table: 6.21
Breusch-Pagan-Godfrey Heteroskedasticity Test Result of Simple Regression Model Considering Welfare and Productivity: Proprietorship Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.119861	Prob. F(1,18)		**0.7332**
Obs*R-squared	0.132298	Prob. Chi-Square(1)		**0.7161**
Scaled explained SS	0.111547	Prob. Chi-Square(1)		**0.7384**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1 20				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00037	0.001131	-0.32919	0.7458
LOG_WELFARE_EXPENSES	2.37E-05	6.84E-05	0.34621	0.7332
R-squared	0.006615	Mean dependent var		1.92E-05
Adjusted R-squared	-0.04857	S.D. dependent var		2.85E-05
S.E. of regression	2.92E-05	Akaike info criterion		-17.9528
Sum squared resid	1.53E-08	Schwarz criterion		-17.8532
Log likelihood	181.5278	Hannan-Quinn criter.		-17.9334
F-statistic	0.119861	Durbin-Watson stat		2.453063
Prob(F-statistic)	0.733199			

Source: *Computed by the author*

Table- 6.21 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. We know that homoscedasticity is one of the prerequisites for an accurate regression model. Here the null hypothesis is residuals are homoskedastic. We can easily accept the null hypothesis looking at the probability values as the probability values are greater than 0.05. So, it proves that the problem of heteroscedasticity does not exist in this equation. Now, let us check whether there is any existence of serial correlation in this equation.

Table: 6.22

Breusch-Godfrey Serial Correlation LM Test Result of Simple Regression Model Considering Welfare and Productivity: Proprietorship Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.109101	Prob. F(2,16)	**0.8973**
Obs*R-squared	0.269083	Prob. Chi-Square(2)	**0.8741**

Source: *Computed by the author*

The table- 6.22 gives us the Breusch-Godfrey Serial Correlation LM Test result. Here the null hypothesis is residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from serial correlation. As we have tested all the prerequisites of conducting a regression analysis, we can proceed further for making estimation using the equation- 6.11.

Log (labor productivity) = 4.069050 + 0.242116 log (welfare expenses)

---- (Equation- 6.12)

From the equation- 6.12, we can assert that 1% increase in welfare expenditure per year in proprietorship tea estates lead to 0.242116 % increase in labour productivity per year during the period of 1998 – 2017, which is significant at 5% level

6.1.2.5: Impact of Health on Productivity of the Tea Workers: Simple Regression Model Considering Proprietorship Tea Estates

Now, this is the time to analyse simple regression taking labour productivity as the dependent variable and health as an independent variable, in the context of proprietorship tea estates.

Table: 6.23

Result of Simple Regression Model Considering Health and Productivity: Proprietorship Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1 20				
Included observations: 20				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	4.449772	0.258886	17.18818	**0.0000**
LOG_HEALTH_EXPENSES	0.24031	0.017175	13.99197	**0.0000**
R-squared	0.915799	Mean dependent var		8.07202
Adjusted R-squared	0.911122	S.D. dependent var		0.024109
S.E. of regression	0.007188	Akaike info criterion		-6.93829
Sum squared resid	0.00093	Schwarz criterion		-6.83871
Log-likelihood	71.38285	Hannan-Quinn criter.		-6.91885
F-statistic	195.7752	Durbin-Watson stat		2.050053
Prob(F-statistic)	0.0000			

Source: *Computed by the author*

From the table- 6.23, the following regression equation can be formed:

$$Log(y) = 4.449772 + 0.240310 \log(x_2)$$

---- *(Equation- 6.13)*

Where, R^2 = 0.915799, F= 195.7752*, DW= 2.050053, y =labour productivity, x_2 = Health expenses, *=significant at 5% level.

A quick glance at the results of the table- 6.23 reveals that the coefficients, in equation- 6.13, are statistically significant and the fit is moderately tight. But, before making any estimation and also forecasting, normality has been tested to see whether the residuals are normally distributed or not.

Table: 6.24

Breusch-Pagan-Godfrey Heteroskedasticity Test Result of Simple Regression Model Considering Health and Productivity: Proprietorship Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.00676	Prob. F(1,18)		**0.9354**
Obs*R-squared	0.007509	Prob. Chi-Square(1)		**0.9309**
Scaled explained SS	0.014435	Prob. Chi-Square(1)		**0.9044**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1 20				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00027	0.003845	-0.07013	0.9449
LOG_HEALTH_EXPENSES	2.10E-05	0.000255	0.082222	0.9354
R-squared	0.000375	Mean dependent var		4.65E-05
Adjusted R-squared	-0.05516	S.D. dependent var		0.000104
S.E. of regression	0.000107	Akaike info criterion		-15.3574
Sum squared resid	2.05E-07	Schwarz criterion		-15.2578
Log-likelihood	155.5736	Hannan-Quinn criter.		-15.3379
F-statistic	0.00676	Durbin-Watson stat		2.322757
Prob(F-statistic)	0.935378			

Source: *Computed by the author*

The table- 6.24 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. It is known to us that homoscedasticity is one of the prerequisites for an accurate regression model. Here the null hypothesis is residuals are homoskedastic. We can easily accept the null hypothesis looking at the probability values as the probability values are greater than 0.05. So, it proves that the problem of heteroscedasticity does not exist in this equation. But, another problem which often restricts us for making estimation is the existence of serial correlation. So, before making estimation we have checked whether there is any existence of serial correlation in this equation.

Table: 6.25

Breusch-Godfrey Serial Correlation LM Test Result of Simple Regression Model Considering Health and Productivity: Proprietorship Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.335563	Prob. F(2,16)	**0.7198**
Obs*R-squared	0.805135	Prob. Chi-Square(2)	**0.6686**

Source: *Computed by the author*

The table- 6.25 gives us the Breusch-Godfrey Serial Correlation LM Test result. Here, the null hypothesis is the residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from serial correlation. As we have tested all the prerequisites of conducting a regression analysis, we can now proceed further for making estimation using the equation- 6.13.

Log (labour productivity) = 4.449772 + 0.240310 log (health expenses)

---- (Equation- 6.14)

From equation- 6.14 we can assert that 1% increase in health expenditure per year in proprietorship tea estates leads to 0.240310 % increase in labour productivity per year during the period of 1998 – 2017, which is significant at 5% level.

6.1.2.6: Impact of Safety on Productivity of the Tea Workers: Simple Regression Model Considering Proprietorship Tea Estates

Now, let us analyse simple regression taking labour productivity as the dependent variable and safety as an independent variable in the context of proprietorship tea estates.

Table: 6.26

Result of Simple Regression Model Considering Safety and Productivity: Proprietorship Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1 20				
Included observations: 20				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	4.742052	0.220213	21.53394	0.0000
LOG_SAFETY_EXPENSES	0.237614	0.015713	15.12193	0.0000
R-squared	0.927029	Mean dependent var		8.07202
Adjusted R-squared	0.922975	S.D. dependent var		0.024109
S.E. of regression	0.006691	Akaike info criterion		-7.081422
Sum squared resid	0.000806	Schwarz criterion		-6.981849
Log-likelihood	72.81422	Hannan-Quinn criter.		-7.061985
F-statistic	228.6728	Durbin-Watson stat		1.907854
Prob(F-statistic)	0.0000			

Source: *Computed by the author*

From the table- 6.26, the following regression equation can be formed.

$$Log\ (y) = 4.742052 + 0.237614\ log\ (x_3)$$

---- *(Equation – 6.15)*

Where, R^2= 0.927029, F= 228.6728, y =labour productivity, x_3 = Safety expenses, *=significant at 5% level.

A quick glance at the results reveals that the coefficients, in equation-6.15, are statistically significant and the fit is moderately tight. But, before making any estimation, we have also looked into the matter of heteroskedasticity in the residuals of the equation- 6.15.

Table: 6.27

Breusch-Pagan-Godfrey Heteroskedasticity Test Result of Simple Regression Model Considering Safety and Productivity: Proprietorship Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.05204	Prob. F(1,18)		**0.8221**
Obs*R-squared	0.057656	Prob. Chi-Square(1)		**0.8102**
Scaled explained SS	0.117746	Prob. Chi-Square(1)		**0.7315**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1 20				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000755	0.003134	0.240973	0.8123
LOG_SAFETY_EXPENSES	-5.10E-05	0.000224	-0.22812	0.8221
R-squared	0.002883	Mean dependent var		4.03E-05
Adjusted R-squared	-0.05251	S.D. dependent var		9.28E-05
S.E. of regression	9.52E-05	Akaike info criterion		-15.5857
Sum squared resid	1.63E-07	Schwarz criterion		-15.4861
Log-likelihood	157.857	Hannan-Quinn criter.		-15.5663
F-statistic	0.05204	Durbin-Watson stat		2.236229
Prob(F-statistic)	0.822122			

Source: *Computed by the author*

Table- 6.27 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. We know that homoscedasticity is necessary for an accurate regression model. Here, the null hypothesis is residuals are homoskedastic. We can easily accept the null hypothesis, looking at the probability values as the probability values are greater than 0.05. So, it proves that the problem of heteroscedasticity does not exist in this equation. But, we will have to check whether there is any existence of serial correlation in this equation, before making any estimation.

Table: 6.28
Breusch-Godfrey Serial Correlation LM Test Result of Simple Regression Model Considering Welfare and Productivity: Proprietorship Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.018966	Prob. F(2,16)	**0.9812**
Obs*R-squared	0.047303	Prob. Chi-Square(2)	**0.9766**

Source: *Computed by the author*

Table- 6.28 gives us the Breusch-Godfrey Serial Correlation LM Test result. Here, the null hypothesis is residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from serial correlation. As we have tested all the prerequisites of conducting a regression analysis, we can proceed further for estimation using equation- 6.15.

Log (labor productivity) = 4.742052+ 0.237614 log (safety expenses)

---- (Equation – 6.16)

From equation- 6.16 we can assert that 1% increase in safety expenditure per year in proprietorship tea estates leads to 0.237614 % increase in labour productivity per year during the period of 1998 – 2017, which is significant at 5% level.

6.1.3: Regression analysis- Public Tea estates

Before going into the depth of regression analysis in view of public tea estates, considering the four variables, namely welfare expenses, health expenses, safety expenses, and labour productivity, we have conducted the descriptive statistics, followed by a unit root test.

6.1.3.1: Descriptive Statistics Results

During the study period, the variables viz. health, safety, welfare, and productivity of the tea workers, in the context of the public tea estates, are found to be very stable and not much varying from their mean values. The low value of the standard deviation of all the three variables, as observed from table- 6.29, in this regard also confirms the stability.

Table: 6.29

Descriptive Statistics Results : Public Tea Estates

	LOG_ PRODUCTIVITY	LOG_WELFARE _EXPENSES	LOG_HEALTH_ EXPENSES	LOG_SAFETY_E XPENSES
Mean	**8.254715**	**16.61145**	**15.26875**	**14.24767**
Median	**8.254129**	**16.61607**	**15.27364**	**14.24700**
Maximum	8.289578	16.75536	15.39348	14.37159
Minimum	8.223796	16.46575	15.14107	14.13635
Std. Dev.	0.020089	0.090500	0.078906	0.077449
Skewness	0.140938	0.057273	-0.106057	0.105694
Kurtosis	1.900444	1.979159	1.813400	1.776227
Jarque-Bera	1.073731	0.879365	1.210843	1.285255
Probability	**0.584578**	**0.644241**	**0.545844**	**0.525909**
Sum	165.0943	332.2291	305.3750	284.9533
Sum Sq. Dev.	0.007668	0.155614	0.118298	0.113970
Observations	20	20	20	20

Source: *Computed by the author*

It is also visible from the table- 6.29 that in the case of all the four variables, probability values of Jarque-Bera statistics are greater than 0.05. Therefore, we can assert that all the variables approximately conform to the normality and it is also observed that the results of median of various variables are more or less equal to the respective mean values.

6.1.3.2: <u>Unit Root Test Results</u>

Unit root test has been conducted, in view of public tea estates, to see whether the time series variables are non-stationary and possesses a unit root. The null hypothesis, here, is the series are non-stationary, and the alternative hypothesis is series are stationary.

Table: 6.30

Unit Root Test Results : Public Tea Estates

Variables	Level			First Difference			Second Difference		
	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	None
L_Productivity	2.740187 1.0000	0.096528 0.9945	2.499652 0.9948	-2.464449 0.1398	-3.374872 0.0864	-0.160908 0.6142	**-6.106147 0.0001**	-5.883570 0.0011	-6.197142 0.0000
L_Welfare_ Expenses	-0.461282 0.8789	-3.315136 0.0938	2.679646 0.9966	-6.022736 0.0001	-5.840899 0.0010	-4.151894 0.0003	**-5.406027 0.0006**	-5.074629 0.0050	-5.603869 0.0000
L_Health_ Expenses	-0.335855 0.9011	-4.474137 0.0112	2.778446 0.9971	-7.967690 0.0000	-7.722954 0.0000	-6.319287 0.0000	**-5.739560 0.0004**	-5.512909 0.0028	-5.885691 0.0000
L_Safety_ Expenses	-0.398335 0.8900	-4.364036 0.0138	2.531949 0.9951	-6.912570 0.0000	-6.696947 0.0002	-5.599224 0.0000	**-4.252825 0.0058**	-3.178254 0.1282	-4.437778 0.0002

Source: *Computed by the author*

We can see the detail of the ADF test result in table- 6.30. Here, at the 2^{nd} difference with intercept, the probability values of t-statistics of all the variables viz. productivity, welfare, health, and safety are significant; meaning that all the variables are stationary at the 2^{nd} difference with intercept only.

6.1.3.3: <u>Relation between Welfare, Health, Safety, and Labour Productivity: Multiple Regression Model Considering Public Tea Estates</u>

While conducting multiple regression, considering the variables welfare, health, safety, and labour productivity, in the context of public tea estates, we get the following regression model. This model has basically come out from the log estimation of the above-mentioned variables, where productivity is a dependent variable and welfare, health, and safety expenses are explanatory variables.

Table: 6.31

Result of Multiple Regression Model: Public Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1998 - 2017				
Included observations: 20				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	4.476056	0.129189	34.64735	0.0000
LOG_WELFARE_EXPENSES	0.110604	0.028016	3.947824	0.0012
LOG_HEALTH_EXPENSES	0.059154	0.025558	2.314466	0.0343
LOG_SAFETY_EXPENSES	0.072866	0.026537	2.745855	0.0144
R-squared	0.982543	Mean dependent var		8.254715
Adjusted R-squared	0.97927	S.D. dependent var		0.020089
S.E. of regression	0.002892	Akaike info criterion		-8.67658
Sum squared resid	0.000134	Schwarz criterion		-8.47743
Log-likelihood	90.7658	Hannan-Quinn criter.		-8.63771
F-statistic	300.1851	Durbin-Watson stat		1.707132
Prob(F-statistic)	0.0000			

Source: *Computed by the author*

From table- 6.31, the following regression equation can be formed

$$\boldsymbol{Log\ (y) = 4.476056 + 0.110604\ log\ (x_1) + 0.059154\ log\ (x_2) + 0.072866\ log\ (x_3)}$$

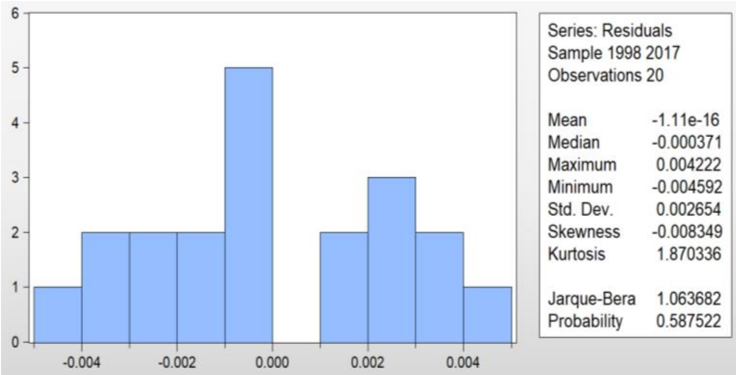
----- ***(Equation- 6.17)***

Where, R^2= 0.982543, F= 300.1851*, DW= 1.707132, y = labour productivity, x_1 = welfare expenses, x_2 = health expenses, x_3 = safety expenses *=significant at 5% level.

A quick glance at the results of the table- 6.31 reveals that the coefficients, in equation- 6.17, are statistically significant and the fit is moderately tight. But, before making any estimation and also forecasting, normality needs to be tested to see whether the residuals are normally distributed or not.

Figure: 6.5

Result of Jarque-Bera Statistics of Multiple Regression : Public Tea Estates



Source: *Computed by author*

From figure- 6.5, we get the result of Jarque-Bera Statistics. Here, the null hypothesis is the residuals are normally distributed. Looking at the probability of Jarque- Bera statistics, we can easily accept the null hypothesis because of the insignificance of its probability value. So, we can assert that the residuals are normally distributed. But, as we know that the presence of heteroscedasticity restricts us from making any estimation, before doing so, we have also looked into the matter of heteroskedasticity in the residuals of our equation.

Table: 6.32

Breusch-Pagan-Godfrey Heteroskedasticity Test of Multiple Regression : Public Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	1.327978	Prob. F(3,16)		**0.3001**
Obs*R-squared	3.987136	Prob. Chi-Square(3)		**0.2629**
Scaled explained SS	1.110448	Prob. Chi-Square(3)		**0.7746**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1998 - 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00022	0.000279	-0.78637	0.4431
LOG_WELFARE_EXPENSES	1.13E-05	6.05E-05	0.187391	0.8537
LOG_HEALTH_EXPENSES	8.06E-05	5.52E-05	1.461131	0.1633
LOG_SAFETY_EXPENSES	-8.38E-05	5.73E-05	-1.46189	0.1631
R-squared	0.199357	Mean dependent var		6.69E-06
Adjusted R-squared	0.049236	S.D. dependent var		6.41E-06
S.E. of regression	6.25E-06	Akaike info criterion		-20.9523
Sum squared resid	6.24E-10	Schwarz criterion		-20.7531
Log-likelihood	213.5225	Hannan-Quinn criter.		-20.9134
F-statistic	1.327978	Durbin-Watson stat		2.476498
Prob(F-statistic)	0.300137			

Source: *Computed by author*

The table- 6.32 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. It is known to us that homoscedasticity is one of the prerequisites for an accurate regression model. Here, the null hypothesis is residuals are homoskedastic. We can easily accept the null hypothesis looking at the probability values, as the probability values are greater than 0.05. So, it proves that the problem of heteroscedasticity is not there in this equation. But, another problem which often restricts us for making estimation is the existence of serial correlation. So, before making estimation we will also have to check whether there is any existence of serial correlation in this equation.

Table: 6.33

Breusch-Godfrey Serial Correlation LM Test of Multiple Regression : Public Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.147426	Prob. F(2,14)	0.8642
Obs*R-squared	0.412529	Prob. Chi-Square(2)	0.8136

Source: *Computed by the author*

The table- 6.33 gives us the Breusch-Godfrey Serial Correlation LM Test result. Here the null hypothesis is, the residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from serial correlation. As we have tested all the prerequisites of conducting a multiple regression analysis, we can now proceed further for making estimation using the equation- 6.17.

Log (labour productivity) = 4.476056 + 0.110604 log (welfare expenses) + 0.059154 log (health expenses) + 0.072866 log (safety expenses)

---- (Equation – 6.18)

6.1.3.4: Impact of Welfare on Productivity of the Tea Workers: Simple Regression Model Considering the Public Tea Estates

We have also tested the impact of welfare, health, and safety, separately, on labour productivity, in view of public tea estates, to observe how the above-mentioned variables create impact, individually, on labour productivity. Firstly, simple regression has been analysed taking labour productivity as the dependent variable and welfare as an independent variable.

Table: 6.34

Result of Simple Regression Model Considering Welfare and Productivity: Public Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1998 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.631905	0.162031	28.58648	**0.0000**
LOG_WELFARE_EXPENSES	0.218091	0.009754	22.35901	**0.0000**
R-squared	**0.965246**	Mean dependent var		8.254715
Adjusted R-squared	0.963315	S.D. dependent var		0.020089
S.E. of regression	0.003848	Akaike info criterion		-8.18801
Sum squared resid	0.000266	Schwarz criterion		-8.08843
Log-likelihood	83.88007	Hannan-Quinn criter.		-8.16857
F-statistic	499.9255	Durbin-Watson stat		1.76257
Prob(F-statistic)	**0.0000**			

Source: *Computed by the author*

From table- 6.34, the following regression equation can be formed.

$$Log\ (y) = 4.631905 + 0.218091\ log\ (x_1)$$

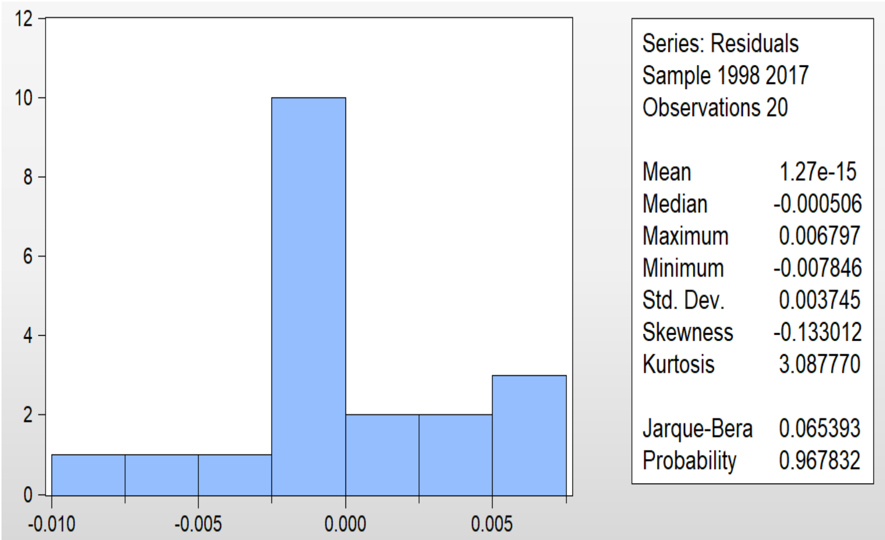
---- (Equation- 6.19)

Where, R^2= 0.965246, F= 499.9255, DW= 1.76257, y = labour productivity, x_1 = welfare expenses, *=significant at 5% level.

A quick look at the results of the table- 6.34 reveals that the coefficients, in equation- 6.19, are statistically significant and the fit is moderately tight. But, before making any estimation and also forecasting, normality must be tested to check whether the residuals are normally distributed or not.

Figure: 6.6

Jarque-Bera Statistics Result of Simple Regression Model Considering Welfare and Productivity: Public Tea Estates



Source: *Computed by the author*

From figure- 6.6, we get the result of Jarque-Bera Statistics. Here, the null hypothesis is the residuals are normally distributed. Looking at the probability value of Jarque- Bera statistics, we can easily accept the null hypothesis because of the insignificance. So, we can assert that the residuals are normally distributed. But, as we know that the presence of heteroscedasticity restricts us from making any estimation, before doing so, we have also looked into the matter of heteroskedasticity in the residuals of our equation.

Table: 6.35

Breusch-Pagan-Godfrey Heteroskedasticity Test Result of Simple Regression Model Considering Welfare and Productivity: Public Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.149016	Prob. F(1,18)		**0.7040**
Obs*R-squared	0.164214	Prob. Chi-Square(1)		**0.6853**
Scaled explained SS	0.138851	Prob. Chi-Square(1)		**0.7094**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1998 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00032	0.000851	-0.37037	0.7154
LOG_WELFARE_EXPENSES	1.98E-05	5.12E-05	0.386026	0.704
R-squared	0.008211	Mean dependent var		1.33E-05
Adjusted R-squared	-0.04689	S.D. dependent var		1.98E-05
S.E. of regression	2.02E-05	Akaike info criterion		-18.686
Sum squared resid	7.35E-09	Schwarz criterion		-18.5865
Log-likelihood	188.8604	Hannan-Quinn criter.		-18.6666
F-statistic	0.149016	Durbin-Watson stat		2.450717
Prob(F-statistic)	0.704002			

Source: *Computed by the author*

The table- 6.35 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. It is known to us that homoscedasticity is one of the prerequisites for an accurate regression model. Here, the null hypothesis is residuals are homoskedastic. We can easily accept the null hypothesis looking at the probability values the as probability values are greater than 0.05. So, it proves that the problem of heteroscedasticity does not exist in this equation. But, we will also have to check whether there is any existence of serial correlation in this equation.

Table: 6.36

Breusch-Godfrey Serial Correlation LM Test Result of Simple Regression Model Considering Welfare and Productivity: Public Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.109175	Prob. F(2,16)	**0.8972**
Obs*R-squared	0.269263	Prob. Chi-Square(2)	**0.874**

Source: *Computed by the author*

The table- 6.36 gives us the Breusch-Godfrey Serial Correlation LM Test result. Here, the null hypothesis is the residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from serial correlation. As we have tested all the prerequisites of conducting a regression analysis, we can now proceed further for making estimation using the equation- 6.19.

Log (labour productivity) = 4.631905 + 0.218091 log (welfare expenses)

---- (Equation- 6.20)

From equation- 6.20 we can assert that 1% increase in welfare expenditure per year in public tea estates lead to 0.218091% increase in labour productivity per year during the period of 1998 – 2017, which is significant at 5% level

6.1.3.5: Impact of Health on Productivity of the Tea Workers: Simple Regression Model Considering Public Tea Estates

Now, let us analyse simple regression taking labour productivity as the dependent variable and health as an independent variable, in the ontext of the public tea estates.

Table: 6.37

Result of Simple Regression Model Considering Health and Productivity: Public Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1998 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.532166	0.263987	17.16811	**0.0000**
LOG_HEALTH_EXPENSES	0.243802	0.017289	14.10141	**0.0000**
R-squared	0.916993	Mean dependent var		8.254715
Adjusted R-squared	0.912382	S.D. dependent var		0.020089
S.E. of regression	0.005947	Akaike info criterion		-7.31738
Sum squared resid	0.000637	Schwarz criterion		-7.21781
Log-likelihood	75.1738	Hannan-Quinn criter.		-7.29794
F-statistic	198.8498	Durbin-Watson stat		2.068498
Prob(F-statistic)	0.000			

Source: *Computed by the author*

From table- 6.37, the following regression equation can be formed.

$$Log(y) = 4.532166 + 0.243802 \log (x_2)$$

---- (*Equation- 6.21*)

Where, R^2= 0.916993, F= 198.8498*, DW= 2.068498, y = labour productivity, x_2 = Health expenses, *=significant at 5% level.

A quick glance at the results of the table- 6.37 reveals that the coefficients, in equation- 6.21, are statistically significant and the fit is moderately tight. But, before making an estimation, we have also looked into the matter of heteroskedasticity in the residuals of our equation.

Table: 6.38

Breusch-Pagan-Godfrey Heteroskedasticity Test Result of Simple Regression Model Considering Health and Productivity: Public Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.010064	Prob. F(1,18)		**0.9212**
Obs*R-squared	0.011176	Prob. Chi-Square(1)		**0.9158**
Scaled explained SS	0.021808	Prob. Chi-Square(1)		**0.8826**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1998 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000296	0.003268	-0.090582	0.9288
LOG_HEALTH_EXPENSES	2.15E-05	0.000214	0.100322	0.9212
R-squared	0.000559	Mean dependent var		3.18E-05
Adjusted R-squared	-0.054966	S.D. dependent var		7.17E-05
S.E. of regression	7.36E-05	Akaike info criterion		-16.10087
Sum squared resid	9.75E-08	Schwarz criterion		-16.0013
Log-likelihood	163.0087	Hannan-Quinn criter.		-16.08143
F-statistic	0.010064	Durbin-Watson stat		2.32028
Prob(F-statistic)	0.921198			

Source: *Computed by the author*

The table- 6.38 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. It is known to us that homoscedasticity is one of the prerequisites for an accurate regression model. Here, the null hypothesis is the residuals are homoskedastic. We can easily accept the null hypothesis looking at the probability values as the probability values are greater than 0.05. So, it proves that the problem of heteroscedasticity is not there in this equation. But, we need also to check whether there is any existence of serial correlation in this equation.

Table: 6.39

Breusch-Godfrey Serial Correlation LM Test Result of Simple Regression Model Considering Health and Productivity: Public Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.333105	Prob. F(2,16)	**0.7215**
Obs*R-squared	0.799474	Prob. Chi-Square(2)	**0.6705**

Source: *Computed by the author*

The table- 6.39 gives us the Breusch-Godfrey Serial Correlation LM Test result. Here the null hypothesis is the residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from serial correlation. As we have tested all the prerequisites of conducting a regression analysis, we can now proceed further for making estimation using the equation- 6.21.

Log (labour productivity) = 4.532166+ 0.243802 log (health expenses)

---- (Equation- 6.22)

From equation- 6.22 we can assert that 1% increase in health expenditure per year in public tea estates leads to 0.243802 % increase in labour productivity per year during the period of 1998 – 2017, which is significant at 5% level.

6.1.3.6: Impact of Safety on Productivity of the Tea Workers: Simple Regression Model Considering Public Tea Estates

Now let us analyse simple regression taking labour productivity as the dependent variable and safety as an independent variable, in the context of public tea estates.

Table: 6.40

Result of Simple Regression Model Considering Safety and Productivity: Public Tea Estates

Dependent Variable: LOG_PRODUCTIVITY				
Method: Least Squares				
Sample: 1998 - 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.695646	0.234628	20.01314	**0.0000**
LOG_SAFETY_EXPENSES	0.2498	0.016468	15.16919	**0.0000**
R-squared	**0.92745**	Mean dependent var		8.254715
Adjusted R-squared	0.923419	S.D. dependent var		0.020089
S.E. of regression	0.005559	Akaike info criterion		-7.45202
Sum squared resid	0.000556	Schwarz criterion		-7.35245
Log-likelihood	76.52024	Hannan-Quinn criter.		-7.43259
F-statistic	230.1042	Durbin-Watson stat		1.907376
Prob(F-statistic)	**0.0000**			

Source: *Computed by the author*

From table- 6.40, the following regression equation can be formed.

$$Log(y) = 4.695646 + 0.249800 \log(x_3)$$

---- (Equation- 6.23)

Where, R2= 0.92745, F= 230.1042, DW= 1.907376, y=labour productivity, x_3 = Safety expenses, *=significant at 5% level.

A quick look at the results of the table- 6.40 reveals that the coefficients, in equation-6.23, are statistically significant and the fit is moderately tight. But, before making any estimation and also forecasting, normality needs to be tested to see whether the residuals are normally distributed or not.

Table: 6.41

Breusch-Pagan-Godfrey Heteroskedasticity Test Result of Simple Regression Model Considering Safety and Productivity: Public Tea Estates

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.022143	Prob. F(1,18)		**0.8834**
Obs*R-squared	0.024574	Prob. Chi-Square(1)		**0.8754**
Scaled explained SS	0.049719	Prob. Chi-Square(1)		**0.8236**
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Date: 09/11/18 Time: 19:25				
Sample: 1998 2017				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000439	0.002764	0.158868	0.8755
LOG_SAFETY_EXPENSES	-2.89E-05	0.000194	-0.14881	0.8834
R-squared	0.001229	Mean dependent var		2.78E-05
Adjusted R-squared	-0.05426	S.D. dependent var		6.38E-05
S.E. of regression	6.55E-05	Akaike info criterion		-16.3346
Sum squared resid	7.72E-08	Schwarz criterion		-16.235
Log likelihood	165.3457	Hannan-Quinn criter.		-16.3151
F-statistic	0.022143	Durbin-Watson stat		2.249531
Prob(F-statistic)	0.883361			

Source: *Computed by the author*

The table- 6.41 shows us Breusch-Pagan-Godfrey Heteroskedasticity result. It is known to us that homoscedasticity is one of the prerequisites for an accurate regression model. Here the null hypothesis is residuals are homoskedastic. We can easily accept the null hypothesis looking at the probability values as the probability values are greater than 0.05. So, it proves that the problem of heteroscedasticity is not there in this equation. But, as we know, another problem which often restricts us for making estimation is the existence of serial correlation.

So, before making estimation we will also have to check whether there is any existence of serial correlation in this equation.

Table: 6.42

Breusch-Godfrey Serial Correlation LM Test Result of Simple Regression Model Considering Safety and Productivity: Public Tea Estates

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.017528	Prob. F(2,16)	0.9826
Obs*R-squared	0.043724	Prob. Chi-Square(2)	0.9784

Source: *Computed by the author*

The table- 6.42 gives us the Breusch-Godfrey Serial Correlation LM Test result. Here the null hypothesis is the residuals are not serially correlated. If we look at probability values, the values are much greater than 0.05. So, we will have to accept the null hypothesis; that means the equation is free from any serial correlation. As we have tested all the prerequisites of multiple regression, we can now proceed further for making estimation using the equation- 6.23.

Log (labour productivity) = 4.695646+ 0.249800 log (safety expenses)

---- (Equation- 6.24)

From equation- 6.24 we can assert that 1% increase in safety expenditure per year in public tea estates leads to 0.249800 % increase in labour productivity per year during the period of 1998 – 2017, which is significant at 5% level.