ISSN: 0975-833X

Available online at http://www.journalcra.com

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

International Journal of Current Research
Vol. 13, Issue, 12, pp.19932-19938, December, 2021

DOI: https://doi.org/10.24941/ijcr.42667.12.2021

RESEARCH ARTICLE

THE EMPIRICAL ANALYSIS OF RELATIONSHIP BETWEEN GNI, NNI AND EXPORTS OF INDIA

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ARTICLE INFO

Article History:
Received 15th September, 2021
Received in revised form
18th October, 2021
Accepted 20th November, 2021
Published online 29th December, 2021

Keywords:

Economic Growth,
Exports GNI, NNI,
Regression Model.

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ABSTRACT

It has been made endeavors to explain the variation in exports via regression model in the present paper. These variations are explained by G.N.I. and N.N.I. in India from 2005-06 to 2019-20, using some statistical tools like Multiple Regression, R Squared, adjusted R Squared, Standard Error, ANOVA and t-test. In this paper, on account of empirical analysis the results found that the relationship between value of GNI and value of exports is positive. The greater the GNI, the higher the value of exports. The coefficient of 0.109320617 indicates, on average, an additional one crore increase in GNI the value of exports raised by Rs.0.1093 crore or Rs.10.93 Lakhs. Similarly, the relationship between value of NNI and value of exports is also positive. Similarly, larger the NNI, the higher the value of exports. The coefficient of 0.122317 indicates, on average, an additional one crore increase in NNI the value of exports rose by Rs. 0.122317 crore or Rs.12.23 Lakhs.

Citation: Dr. Ajab Singh. *"The Empirical Analysis of Relationship between GNI, NNI and Exports of India", 2021. International Journal of Current Research, 13, (12), 19932-19938.*

INTRODUCTION

The export of goods and services is seen as an engine of economic and social growth. By operating in global markets, companies become more aware of economic changes, changing customer demands, and seasonal fluctuations in the local economy. It has the potential to mitigate the effects of market volatility. Despite these advantages for exports, there are also some opposite reasons. There are several variables affecting National Income and economic growth of an economy. These variables are inter-related to one another. For the convenience of study, they can be divided in to direct and indirect categories. Variables that affect directly are human resources, natural resources, capital formation and technology, whereas variables like, institutions (financial institutions, private administrations etc.), the size of the aggregate demand, saving rates and investment rates, the efficiency of the financial system, budgetary and fiscal policies, migration of labour and capital and the efficiency of the government, etc. influence indirectly. Acemoglu (2009)[1], classified these variables in to economic and non-economic determinants and explained the difference between them.

He said that there are also differences between economic and non-economic determinants. "Proximate" or economic determinants refers to factors like capital accumulation, technological progress, labour and "ultimate" or non-economic sources refers to factors like government efficiency, institutions, political and administrative systems, cultural and social factors, geography and demography. Typically, GDP is a widely used metric and economic growth measured by it. GDP measures the economic activity within the physical borders of a country (whether the producers are native to that country or foreign-owned entities). In India, GDP is calculated as total of GVA at basic prices + Product taxes less Product subsidies. The expenditure approach to calculating the GDP is very popular in most of the countries. In this approach, GDP is calculated by using the formula as follows:

GDP = C + G + I + NX.

Whereas, C=consumption; G=government spending; I=investment; and NX=net exports. All of these components contribute to the GDP of a country.

Gross National Income (GNI) is also a significant measure of economic growth. Nowadays, It is considered better than GDP for measuring overall economic health of an economy. It is the sum of all income earned by citizens or nationals of a country (regardless of whether the underlying economic activity takes place domestically or abroad). It is calculated like GDP + Net primary income from rest of the world (ROW) (Receipts less payments). Net National Income (NNI) is another measure of economic growth is calculate as GNI minus Consumption of fixed capital or Depreciation.

A Survey of Empirical Studies: Several studies have been done by Indian and other economists to analyze the relationship between export growth and economic growth. With the process of planned economic development, the country adopted a policy of import-substitution in place of industrialization as a strategy of economic development in line with other developing countries like Argentina and Brazil, etc. This type of industrialization faced criticism from economists for its high cost as a waste of resources. By the late sixties, the country reached a border in the form of stagnation of exports and a widening gap in the balance of payments. This situation prompted the government to shift from import-oriented industrialization to export-oriented industrialization as a necessity to increase exports so that the balance of payments remains in manageable proportions. This change in policy was also driven by the success of the economies of South Korea, Taiwan and Singapore in Asia and Mexico and Brazil in Latin America.

M.K. Datta Choudhary[1] discounted the role of international trade in the process of economic development of the Indian economy in view of the small size of the external sector as their international trade constituted about 10 per cent of their national income. Some Indian economists like A.K. Bagchi and M.K. Datta Choudhary[2] initially expressed doubts about the success of this policy. V. N. Attri[3] in his study has analyzed the relationship between export growth and economic growth in terms of its effect on the structural transformation of the Indian economy involving a process of industrial development. This study has attempted to analyze the perspective of a broad framework that takes into account the role of aggregate demand expansion, including the following factors: (a) domestic demand expansion, (b) export expansion, and (c) import substitution, but does not take into account the change in the input output coefficient.

Attri's study covers the period 1960-1988. This study uses a multiple regression in the long-form and the dependent variable is the index of industrial production (IP), which is a proxy for domestic production, while the index of stock prices and import prices is used to measure domestic demand, has been used as a proxy of export demand and import demand. Regression analysis concludes that although domestic demand has been the most important variable in determining industrial output, export demand has also been a strong explanatory variable in determining industrial growth over the period. W. R. Clive[4] tried to point out in his study that export based strategy may not be helpful in countries like India. Sukumar Nandy and Basudeb Biswas in their study of the problem in the context of the Indian economy for the period 1960 to 1985 in a bi-variate model used by Sims and Granger to analyze the impact of exports on economic growth Employed causality testing.

The econometric result of the analysis of this study showed that in the Indian context, causality operates in one way, that is, export growth leads to economic growth and therefore this analysis does not support the view of skeptics who export-Led strategy may not be helpful in promoting economic growth in the context of an economy like India. However, this study does not support the conclusion drawn by Sanjeev Gupta in the context of the Indian economy that the relationship between export growth and economic growth is bi-directional in nature as is the case for both Israel and South Korea. In the view of Sukumar Nandi and Basudeb Biswas, the growth of income has no effect on the growth of exports in the Indian context. In a country such as South Korea, the situation in the domestic market has been different than in India, where an export-led strategy of development has neglected domestic market conditions that include large disparities in income distribution and rising unemployment. Furthermore, the openness of the Indian economy was quite limited compared to the small economy of South Korea, which adopted an outward-looking strategy of development with policies to bring more equity in the distribution of income and growth in employment.

In India, exports have been regarded only as a means of bridging the gap in the balance of payments and not as a means of development. The core of the role of exports as an instrument of economic growth in the Indian economy has been an internal policy of development involving import substitution and self-reliance. Although, this approach has been reversed since 1991 with the introduction of the policy of liberalization and globalization, which marked the beginning of higher rates of exports and higher rates of income growth. Prof. V.K.R.V. Rao[5] sees the role of exports in Indian economic development as a way to realize full utilization of productive potential in certain agricultural and industrial sectors and to meet the import needs of the economy in the context of increasing inputs of foreign machines and technical know-how. During this analysis, Prof. Rao discussed the factors on which the growth in exports depends such as increase in domestic production, availability of production for export, reduction in cost, credit, insurance and transport facilities etc. However, Prof. Rao made an important idea. Since the role of exports in Indian economic development, he said that "exports set both the pace and the limits for the tempo of development." [6]

Empirical studies concerning the impact of export growth on economic growth are based on the proposition that export-oriented policies provide equal incentives for sales in domestic and foreign markets. These policies contribute to the allocation of resources according to comparative advantage, resulting in greater capacity utilization and exploitation of economies of scale. Thus, technology improves and employment prospects increase in response to competition abroad. The regression analysis adopted by Balassa, Krueger and Tyler assumes that the direction of causality is from export growth to economic growth and is uniform across countries. "This is unrealistic given the considerable differences in economic structure displayed by developing countries."[7] Sanjeev Gupta has denial the methodology used by Balassa and Tyler to estimate the relationship between export growth and economic growth. He says that the regressions were estimated by them with the use of ordinary least square techniques and hereby the parameters estimated by them were biased. So, cross - sectional regressions used by Balassa and Tyler must be re estimated using simultaneous equation methods.[8] G.S.

Gupta[9] analyzed the question of the role of various factors in determining the variation in growth rates on the basis of data from the sixties and seventies of 29 developing countries. The factors determining economic growth rate included such factors as saving rate, investment rate, price distortion index, multinational corporations, economic penetration ratio, export growth rate, government expenditure, growth rate, etc. The empirical results of this study indicated that the crucial determinants of economic growth are saving rate, investment rate, population growth, price distortion, multinational corporations, economic penetration ratio, export growth and government expenditure growth rate.[10] While export growth accounted for 22.4 per cent of the growth variations and 42.0 per cent of the industrial growth variations among different developing countries[11]. The present study is a version of an explanation of the relationship between Exports and GNI as well as NNI in terms of crore rupees in India from 2005-06 to 2019-20.

OBJECTIVES OF STUDY

The pertinent study is planned to the point of view to trace the relationship (if any) of exports with GNI and NNI in India. In this study, GNI and NNI in volume terms are possible explanatory variables of exports trade in India. Keeping in view these economic variables, the equation is specified as Y=a+ b X

RESEARCH METHODOLOGY

The present study is a version of an explanation of the relationship between Exports and GNI as well NNI in India from 2005-06 to 2019-20, using some statistical tools like Multiple Regression, R Squared, adjusted R Squared, Standard Error, ANOVA and t-test. Where on the one hand, Correlation is concerned with measuring the strength of linear relationship between response variable and predictor variable. On the other hand, regression analysis predicts the value of response variable and explains the impact of changes in a explanatory variable on the response variable. For the concerning empirical analysis, Secondary data and information are sourced from RBI, Handbook of Statistics on Indian Economy, 2016-17 to 2020-21. In addition, books, research papers, articles, etc. were also consulted for collecting required information.

Hypothesis: To the point of view of empirical analysis, it is hypothesized that GNI and NNI are significant positive factors explaining variations in the exports trade in India.

Relation between Gross Domestic Product and Exports in India: It is necessary to analyze the relation between gross domestic product and exports in terms of the proportion which exports bear to gross domestic product. Data have been presented in this respect as follows:

Table 1 reveals and indicates that exports have tended to increase as a proportion of domestic product. While exports constituted 11.6 percent of gross domestic product in 2004-05, this proportion declined to only 10.9 percent of the GDP in 2019-20 in course of 16 years of planning and this shows a very poor response of the growth of exports to the growth of GDP. However, there was a rise in 2013-14 and exports reached to 17.0 percent of GDP.

The figures of GNI, NNI and exports and the rates of growth of GNI, NNI and exports can well be compared to indicate the responsiveness of exports to GNP and NNP. For the sake of, Table 2 indicating the figures as follows:

Table 2 highlights the figures of GNI, NNI, exports and its growth rates in Indian perspectives. It is clear that the growth rate of GNI, NNI and exports were 13.90 percent, 13.92 percent and 21.6 percent, respectively in the year 2005-06 in relation to previous year, but in 2019-20, it has been remained 7.19 percent, 7.21 percent and -3.88 percent, respectively in relation to corresponding previous year[12].

The Empirical Analysis of Relationship between GNP, NNP and Exports of India: In the present study, endeavors have been made to explain the variation in exports via regression model. These variations are explained by G.N.I. and N.N.I. in India. Thereby, the variation in exports can be explained using the variation in the independent variable. For this purpose, observations of dependent and independent variables have been taken from 2005-06 to 2019-20(i.e., 15 years).In this study Y refers to exports, value of GNI and NNI are X_1 and X_2 respectively.

The simple linear regression equation of exports(Y) on G.N.I.(X_1) and exports(Y) on N.N.I.(X_2) are:

$$Y=270895.4543+0.109320617(X_1) \quad (1)$$

$$Y=268944.2+0.122317(X_2) \quad (2)$$

Where, Y refers to the exports of India in ₹ crores, X_1 represents G.N.I. of India in ₹ crores; X_2 represents N.N.I. of India in ₹ crores.

Briefs information about regression statistics

- The multiple correlation coefficients is 0.941807. This indicates that the correlation among the independent and dependent variables is positive and fairly strong. This statistic, which ranges from -1 to +1, does not indicate statistical significance of this correlation.
- The coefficient of determination, R^2, is 88.70%. This means that close to 89% of the variation in the dependent variable (exports) is explained by the independent variable-GNI.
- The adjusted R-square, a measure of explanatory power, is 0.878309. This statistic is not generally interpreted because it is neither a percentage (like the R^2), nor a test of significance (such as the F-statistic).
- The standard error of the regression is Rs.218011.144 crore, which is an estimate of the variation of the observed value of exports, in rupees terms, about the regression line. The standard error is in the same unit of measurement as the dependent variable.

Is the Simple Regression Model Statistically Valid?

It is important to test whether the regression model developed from sample data is statistically valid. For simple regression, we can use 2 approaches to test whether the coefficient of X is equal to zero.

- Using t-test
- Using ANOVA

Table 1. GDP and Exports at current prices of India

Year	GDP at current prices (₹ Crore)	Exports at current prices (₹ Crore)	Exports as % of GDP
2004-05	3242209	375340	11.6
2005-06	3693369	456418	12.4
2006-07	4294706	571779	13.3
2007-08	4987090	655864	13.2
2008-09	5630063	840755	14.9
2009-10	6477827	845534	13.1
2010-11	7784115	1142922	14.7
2011-12	8736329	1465959	16.8
2012-13	9944013	1634318	16.4
2013-14	11233522	1905011	17.0
2014-15	12467959	1896445	15.2
2015-16	13771874	1716384	12.5
2016-17	15391669	1849434	12.0
2017-18	17098304	1956515	11.4
2018-19	18971237	2307726	12.2
2019-20	20339849	2218233	10.9

Notes and source: Data having base year 2004-05 from 2004-05 and base year 2011-12 from 2011-12 to 2019-20 and sourced from RBI, Handbook of Statistics on Indian Economy, 2016-17 to 2020-21.

Table 2. GNI, NNI, Growth Rate of GNI and NNI in India

Year	GNI at current prices		NNI at current prices		Exports	
	(₹Crore)	Growth Rate(%)	(₹Crore)	Growth Rate(%)	(₹Crore)	Growth Rate(%)
2004-05	3219834	-	2899943	-	375340	-
2005-06	3667253	13.90	3303532	13.92	456418	21.60
2006-07	4261472	16.20	3842743	16.32	571779	25.28
2007-08	4966578	16.55	4481882	16.63	655864	14.71
2008-09	5597140	12.70	5031943	12.27	840755	28.19
2009-10	6439827	15.06	5780028	14.87	845534	0.57
2010-11	7702308	19.60	6942089	20.10	1142922	35.17
2011-12	8659505	12.43	7742330	11.53	1465959	28.26
2012-13	9827250	13.49	8766345	13.23	1634318	11.48
2013-14	11093638	12.89	9897663	12.91	1905011	16.56
2014-15	12320529	11.06	10978238	10.92	1896445	-0.45
2015-16	13612095	10.48	12162398	10.79	1716384	-9.49
2016-17	15215269	11.78	13623937	12.02	1849434	7.75
2017-18	16913491	11.16	15149545	11.20	1956515	5.79
2018-19	18768912	10.97	16789288	10.82	2307726	17.95
2019-20	20118353	7.19	17999754	7.21	2218233	-3.88

Notes and source: Same as above.

Table 3. Summary Output of Regression Statistics and ANOVA

Summary Output								
Regression Statistics								
Multiple R	0.941807							
R Square	0.887002							
Adjusted R Square	0.878309							
Standard Error	218011.144							
Observations	15							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	4850146939354	4850146939354	102.0464	0.00000016			
Residual	13	0617875165978	0047528858921					
Total	14	5468022105332						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	270895.4543	127884.9099	2.118275365	0.05399	-5383.096203	547174	-5383.1	547174.0047
GNI(X_1)	0.109320617	0.010821895	10.10179973	0.00000016	0.085941	0.1327	0.08594	0.132699

The explanation of various results which have been drawn in the above analysis is as follows:

Analysis of variance: The analysis of variance information provides the breakdown of the total variation of the dependent variable. Here, value of exports is divided in to the explained and unexplained portions.

- The SS Regression is the variation explained by the regression line; SS Residual is the variation of the dependent variable that is not explained. In the study concerned, 88.7% variations of exports are explained and 11.3% are not explained by GNI.
- The F-statistic is calculated using the ratio of the mean square regression (MS Regression) to the mean square residual (MS Residual). This is statistic can then be compared with the critical F value for 1 and 13 degrees of freedom (available from an F-table) to test the null hypothesis:

H_0 : Slope=0

H_1 : Slope ≠0

Table 4. Summary Output of Regression Statistics and ANOVA

Summary Output								
Regression Statistics								
Multiple R	0.940518							
R Square	0.884575							
Adjusted R Square	0.875696							
Standard Error	220340.5							
Observations	15							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	4.8369	4.83687	99.62677	1.83869			
Residual	13	6.3115	48549934371					
Total	14	5.4680						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	268944.2	129569.8288	2.075669791	0.058328	-10974.4169	548862.8	-10974.4	548862.7758
NNI(X_2)	0.122317	0.012254573	9.981320862	0.000000184	0.09584243	0.148791	0.095842	0.148791222

The explanation of several results which have been drawn in the above analysis is as follows:

Table 5. Residual Output and Probability Output of Exports(Y)

RESIDUAL OUTPUT				PROBABILITY OUTPUT	
Observation	*Predicted Exports(Y)*	*Residuals*	*Standard Residuals*	*Percentile*	*Exports(Y)*
1	671801.8159	-215383.8159	-1.025242769	3.333333333	456418
2	736762.2038	-164983.2038	-0.785332157	10	571779
3	813844.827	-157980.827	-0.752000329	16.66666667	655864
4	882778.254	-42023.25403	-0.200033773	23.33333333	840755
5	974901.317	-129367.317	-0.615797922	30	845534
6	1112916.519	30005.48074	0.14282829	36.66666667	1142922
7	1217557.886	248401.1138	1.18240753	43.33333333	1465959
8	1345216.49	289101.5096	1.3761444	50	1634318
9	1483658.808	421352.1918	2.005667352	56.66666667	1716384
10	1617783.29	278661.7103	1.326450189	63.33333333	1849434
11	1758978.082	-42594.08206	-0.202750956	70	1896445
12	1934238.053	-84804.05334	-0.403673517	76.66666667	1905011
13	2119888.731	-163373.7307	-0.777670946	83.33333333	1956515
14	2322724.5	-14998.49968	-0.071393959	90	2218233
15	2470246.223	-252013.2228	-1.199601433	96.66666667	2307726

Source: Author's own Calculations.

Table 6. Macro-Economic Aggregates

(Amount in ₹ Crore)

Item/Year	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Population (in Lakhs)	12510	12670	12830	12990	13140	13270	13410
GVA at Basic Prices	10363153	11504279	12574499	13965200	15513122	17139962	18343237
Net taxes on products	870369	963680	1197375	1426469	1585182	1831275	1996612
Gross Domestic Product	11233522	12467959	13771874	15391669	17098304	18971237	20339849
Consumption of Fixed Capital	1195975	1342291	1449697	1591332	1763946	1979624	2118600
Net Domestic Product	10037547	11125668	12322177	13800337	15334357	16991613	18221249
Primary income receivable from ROW (net)	-139884	-147430	-159779	-176400	-184813	-202324	-221496
Gross National Income(GNI or GNP)	11093638	12320529	13612095	15215269	16913491	18768912	20118353
Net National Income(NNI Or NNP)	9897663	10978238	12162398	13623937	15149545	16789288	17999754
Other current transfers (net) from ROW	395918	405154	413083	379438	405740	493740	511966
Gross National Disposable Income	11489556	12725683	14025178	15594707	17319231	19262652	20630319
Net National Disposable Income	10293581	11383392	12575481	14003375	15555285	17283028	18511719
Gross Saving	3608193	4019957	4282259	4825113	5538393	5712920	-
Net Savings	2412218	2677666	2832562	3233781	3774447	3733296	-
Gross Capital Formation	3794135	4179779	4422659	4918077	5849224	6108582	-
Net Capital Formation	2598160	2837487	2972961	3326745	4085278	4128958	-
Per Capita GDP (₹)	89796	98405	107341	118489	130124	142963	151677
Per Capita GNI (₹)	88678	97242	106096	117131	128718	141439	150025
Per Capita NNI (₹)	79118	86647	94797	104880	115293	126521	134226
Per Capita GNDI (₹)	91843	100439	109315	120052	131805	145159	153843
Per Capita PFCE (₹)	51764	57201	63339	70258	76794	84808	91440

Notes : 1. Data for 2016-17 are Third Revised Estimates, for 2017-18 are Second Revised Estimates and for 2018-19 are First Revised Estimates.

2. Data for 2019-20 are Provisional Estimates. Base Year: 2011-12 At Current Prices

Source: RBI, Handbook of Statistics on Indian Economy, 2016-17 to 2020

Table 7. GDP and Exports at current prices of India

Year	GDP at current prices (₹ Crore)	Exports at current prices (₹ Crore)	Exports as % of GDP
2004-05	3242209	375340	11.6
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2011-12	8736329	1465959	16.8
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2016-17	15391669	1849434	12.0
2017-18	17098304	1956515	11.4
2018-19	18971237	2307726	12.2
2019-20	20339849	2218233	10.9

Notes and source: GDP=GVA at Basic Prices plus Net taxes on products, data having base year 2004-05 from 2004-05 and base year 2011-12 from 2011-12 to 2019-20 and sourced from RBI, Handbook of Statistics on Indian Economy, 2016-17 to 2020-21.

Table 8. Exports Trade of India

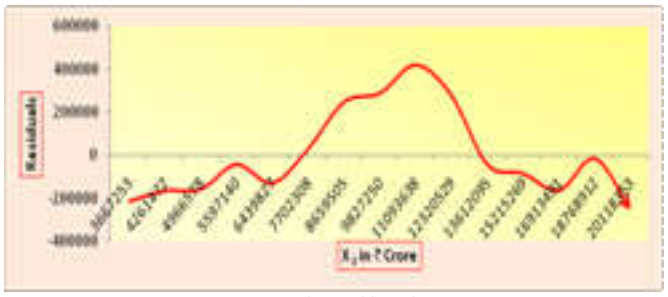
Year	Amount(₹ Crore)	Rate of Growth of Exports(%)
2004-05	375340	-
2005-06	456418	21.60
2006-07	571779	25.28
2007-08	655864	14.71
2008-09	840755	28.19
2009-10	845534	0.57
2010-11	1142922	35.17
2011-12	1465959	28.26
2012-13	1634318	11.48
2013-14	1905011	16.56
2014-15	1896445	-0.45
2015-16	1716384	-9.49
2016-17	1849434	7.75
2017-18	1956515	5.79
2018-19	2307726	17.95
2019-20	2218233	-3.88

Notes and source: Same as above.

Using coefficient information for testing if slope=0: The p-value associated with the calculated F-statistic is probability beyond the calculated value. Comparing this value with 5%, for example, indicates rejection of the null hypothesis. In our study, F value is 102.0464 and p- values=0.00000016. P-value is again very small. If it is smaller than our α level, then, we reject null; not otherwise. Thus, at 0.05 (or 0.01) level, slope is NOT zero implying that our model is statistically valid. This is the same conclusion we reached using t-test. Using ANOVA for testing if slope=0: t-stat=10.10179973 and p- values=0.00000016. P-value is very small. If it is smaller than our α level then, we reject null; not otherwise. If α=0.05, we would reject null and conclude that slope is not zero. Same result holds at a=0.01 because the P-value is smaller than 0.01. Thus, at 0.05 (or 0.01) level, we conclude that the slope is NOT zero implying that our model is statistically valid.

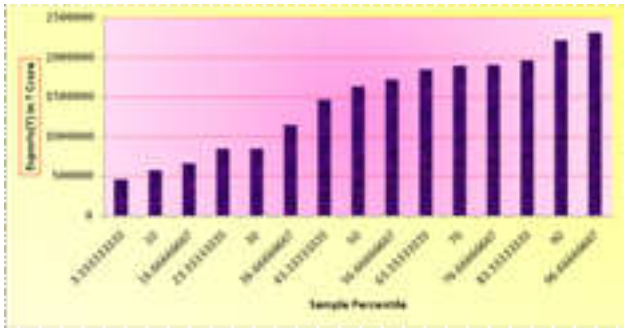
Confidence Interval for the Slope of Size: The 95% Confidence Interval tells us that for every 1 crore increase in GNI, exports will increase by RS.0.1327 crore or 13.27 Lakhs to RS.0.08594 crore or Rs.8.6 Lakhs.

The Estimated Regression Line: The results of the estimated regression line include the estimated coefficients, the standard error of the coefficients, the calculated t-statistic, the corresponding p-value, and the bound of the 95% confidence interval. The independent variables that statistically significant in explaining the variation in the value of exports is the GNI, as indicated by (1) calculated t-statistics that exceed the critical values, and (2) the calculated p-values that are less than the significance level of 5%.



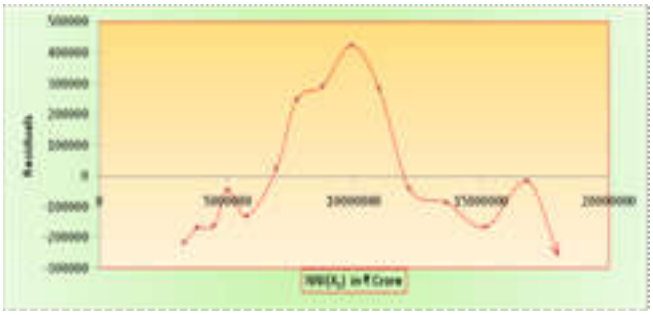
Source: Author's elaborations.

Figure 1. Showing GNI(X_1) Residual Plot



Source: Author's elaborations.

Figure 3. Showing NNI(X_2) Residual Plot



Source: Author's elaborations.

Figure 3. Showing NNI(X_2) Residual Plot

Simple Linear Regression Equation Exports(Y) on NNI (X_2) is:

$$Y=268944.2+0.122317(X_2) \quad \text{(ii)}$$

Gist of information about regression statistics

The multiple correlation coefficient is 0.940518. This indicates that the correlation among the independent and dependent variables is positive and fairly strong. This statistic, which ranges from -1 to +1, does not indicate statistical significance of this correlation.

The **coefficient of determination**, R^2, is 88.46%. This means that close to 89% of the variation in the dependent variable (exports) is explained by the independent variable-NNI.

The **adjusted R-square**, a measure of explanatory power, is 0.875696. This statistic is not generally interpreted because it is neither a percentage (like the R^2), nor a test of significance (such as the F-statistic).

The **standard error of the regression** is Rs. 220340.5crore, which is an estimate of the variation of the observed value of

exports, in rupees terms, about the regression line. The standard error is in the same unit of measurement as the dependent variable.

Checking the Validity of a Simple Regression Model Statistically: It is important to test whether the regression model developed on the basis of sample data is statistically valid. It can be used two approaches to test whether the coefficient of X is equal to zero, are as follows:

- Using t-test
- Using ANOVA

The analysis of variance information provides the breakdown of the total variation of the dependent variable. Here, value of exports is divided in to the explained and unexplained portions.

The SS Regression is the variation explained by the regression line; SS Residual is the variation of the dependent variable that is not explained. In the study concerned, 88.5% variations of exports are explained and 11.5% are not explained by NNI.

The F-statistic is calculated using the ratio of the mean square regression (MS Regression) to the mean square residual (MS Residual). This is statistic can then be compared with the critical F value for 1 and 13 degrees of freedom (available from an F-table) to test the null hypothesis:

H_0: Slope=0
H_1: Slope $\neq$0

Using coefficient information for testing if slope=0

The p-value associated with the calculated F-statistic is probability beyond the calculated value. Comparing this value with 5%, for example, indicates rejection of the null hypothesis. In our study, F value is 99.62677and p-values=0.000000184. P-value is again very small. If it is smaller than our α level, then, we reject null; not otherwise. Thus, at 0.05 (or 0.01) level, slope is NOT zero implying that our model is statistically valid. This is the same conclusion we reached using t-test.

Using ANOVA for testing if slope=0

t- stat =9.981320862 and p- values=0.000000184.P-value is very small. If it is smaller than our α level then, we reject null; not otherwise. If α=0.05, we would reject null and conclude that slope is not zero. Same result holds at a=0.01 because the P-value is smaller than 0.01. Thus, at 0.05 (or 0.01) level, we conclude that the slope is NOT zero implying that our model is statistically valid.

Confidence Interval for the Slope of Size: The 95% Confidence Interval tells us that for every 1 crore increase in NNI, exports will increase by RS. 0.148791crore or 14.88Lakhs to RS. 0.095842crore or Rs. 9.6Lakhs.

The estimated regression line: The results of the estimated regression line include the estimated coefficients, the standard error of the coefficients, the calculated t-statistic, the corresponding p-value, and the bound of the 95% confidence interval. The independent variables that statistically significant in explaining the variation in the value of exports is the NNI, as indicated by (1) calculated t-statistics that exceed the critical values, and (2) the calculated p-values that are less than the significance level of5%.

CONCLUSION

The relationship between value of GNI and value of exports is positive. The larger the GNI, the higher the value of exports. The coefficient of 0.109320617 indicates, on average, an additional one crore increase in GNI the value of exports raised by Rs.0.1093 crore or Rs.10.93 Lakhs. Similarly, the relationship between value of NNI and value of exports is also positive. The larger the NNI, the higher the value of exports. The coefficient of 0.122317 indicates, on average, an additional one crore increase in NNI the value of exports rose by Rs. 0.122317 crore or Rs.12.23 Lakhs.

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