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RESEARCH ARTICLE

A STUDY ON INDIRECT TAX REVENUE, CPI AND INFLATION TREND THROUGH ECONOMETRIC ANALYSIS

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ABSTRACT

Studying the trends in indirect tax revenue**,** Consumer Price Index **(**CPI**)**, and inflation before and after GST implementation is essential to evaluate the reform's success in unifying the economy, ensuring fiscal stability, and protecting consumer purchasing power. The objective of this paper is to identify the trend and to study the propensity of price changes before and after GST by employing Model comparison using Regression analysis the different models (Linear, Quadratic and Exponential) has been considered. The data is collected from government website of Department of revenue, Ministry of finance, which provided yearly data for indirect taxes estimates, and Consumer Price Index (CPI) data and inflation rates are obtained from monthly publications by Central Statistics Office, Ministry of statistics and Programme Implementation (MOSPI) and using this secondary data average yearly values are calculated. The period of study is 10 years consisting of five years before the adoption of GST (2012-2017) and five years after the adoption of GST (2017-2022). The findings shows exponential model is the best fit for both periods, indicating a steady increase in indirect tax revenue and inflation rates. The higher R-squared values for the period before GST suggest that the models were better suited to the economic conditions before GST implementation.

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INTRODUCTION

GST (Goods and Services Tax) is a comprehensive, multi-stage, destination-based indirect tax levied on the supply of goods and services It replaced multiple cascading central and state taxes (like VAT, excise duty, service tax) with a single, unified tax structure applied only on value addition at each stage of the supply chain, ultimately borne by the final consumer. The implementation of the Goods and Services Tax (GST) on July 1st 2017 has significantly transformed India's fiscal landscape, boosting indirect tax revenue through improved compliance while creating mixed, impacts on CPI inflation by reducing tax cascading. The Consumer Price Index (CPI) is a statistical measure that tracks the average change over time in the prices paid by consumers for a representative "basket" of goods and services. Inflation is the rate at which the general level of prices for goods and services rises, subsequently causing purchasing power to fall. Indirect tax revenue, CPI and Inflation are fundamental economic indicators that help measure the health of an economy, the cost of living for citizens, and the revenue generation for governments. They are deeply interconnected, as changes in one often directly impact the others. Analyzing trends is crucial to optimize rate structures, , set tax policies, adjust income brackets, manage inflation, and evaluate the transition from a multi-tax system, assess formalization of the economy, and monitor the long-term impact on consumer prices and fiscal stability.

LITERATURE REVIEW

Valadkhani, A.(2005) examined the magnitude and duration of the goods and service tax effect on the quarterly growth rate of the 11 groups of consumer price index in Australia and used Boxand Tiao intervention analysis and found 7 out of 11 CPI groups a significant effect of GST on price and rest for 4 the effect was found insignificant. Geetha *et al*. (2015) have analyzed the determinants of food price inflation in Malaysia (per capita GDP, petrol price, GST, population, and unemployment) as the main determinants. Used Johensens's co –integration technique and found that all the determinants affected food price inflation positively and significantly in the long run except GST. In the short run Vector Error correction model (VCEM) has been used and found that food price inflation was only affected by per capita GDP, sale tax, petrol price, and population. Dani, S.(2016) has interested to know how the company's growth and development can be hampered by the GST and he came up with, Modi's government model for GST doesn't propose growth increase price inflation and tax revenue collection may not increase. It can only be achieved if there is a clear consensus over the issue of threshold limit, revenue rate, and introduction of petroleum,

electricity, liquor, and real estate under the ambit of GST. Islam *et al*.,(2017) have addressed the factor that affects inflation in Malaysia and used the quantitative method and econometric model to identify the relationship between dependent and independent variables. Sahoo, B. P., Jain, N., & Jain, G.(2017) have studied the post-implementation impact of goods and service tax on inflation for 11 developing and developed countries and used an intervention model to examine the impact of GST on inflation in the short run and long run and concluded that except for China there was no significant evidence found of an increase in inflation after the introduction of GST in both the short run and long run. Babu, S. G.(2019) has analyzed the effect of the Goods and services in India and its impact on the common man's budget and concluded in the long run the burden of GST will be reduced on the common man and consumer should analyze the rates and then consume or purchase according to his income. Madathil, J. C.(2019) examined the impact of GST on CPI (consumer price index) where he collected the data from the Ministry of Statistics and Programme implementation and also the percentage variation in CPI basket after GST implementation, using paired T-Test and concluded that after the implementation of GST every group of CPI basket has increased and also there is no significant impact of GST on CPI. Kumar, A. S., & Dash, S. K.(2021) have examined the impact of GST on price, employed the Bayesian Casual Inference method concluded after GST implementation the price level of food items decreased and at the same, there is a significant impact on commodity groups such as headline CPI, pan, tobacco and intoxicants, clothing and footwear, housing, miscellaneous and non exempted food and beverage. On the other hand, there is no significant impact of GST on food and beverage and non-exempted CPI in the post-intervention period.

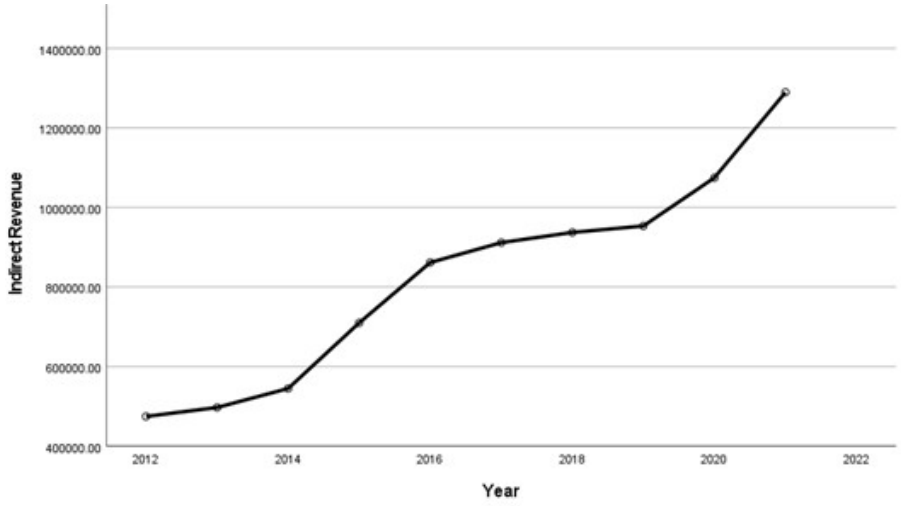
Statement of Problem – Based on available literature and studies, while there is a significant body of research on the impact of GST on overall inflation and revenue collection in India, a detailed, longitudinal, and granular study on the specific propensity of price changes (the tendency to change, speed, and magnitude of adjustment) across all CPI sectors and indirect tax revenue — particularly accounting for post-2020 economic shifts—remains an area with emerging research gaps.

Objectives of the Study

- To study the trend of Indirect tax revenue, CPI and inflation before and after GST
- To study the propensity of price changes before and after GST in Indirect tax revenue, CPI and inflation

Data Analysis

Trend Analysis for Indirect Tax Revenue: In this analysis, data for the years between 2012 to 2017 is before GST data and from 2017 to 2021 is for after GST.



The above graph shows that there is steady growth in the revenue from the year 2012 to 2014 and after that there is sudden increase up to 2016. Further, there is steady growth from 2017 to 2019 and from 2019 the growth in the indirect revenue has significantly accelerated. In summary it shows a general increasing trend of indirect revenue.

Regression Analysis for Indirect Revenue

Linear Model: A linear model is a statistical model that assumes a linear relationship between the dependent variable y and one or more independent variables x.

Model Summary						**ANOVA**		**Coefficients**	
Group	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F-value	p-value	Unstandardized coefficient for Year	p-value
Before GST	1	.948	0.899	0.865	60396.58809	26.709	.014	98705.100	0.014
After GST	1	.903	0.816	0.755	77427.30682	13.317	.036	89350.700	0.36

The linear model shows a R-squares value 0.899 for before GST and value 0.816 for after GST. Here, before GST has high R square value which indicates linear model is a good fit for before GST as compare to after GST. However, the standard error indicates some deviation from linear trend, especially in after GST, suggesting that a more complex model may be a better fit for before GST and after GST. Further, ANOVA gives F value 26.709 with p-value 0.014 (< 0.05) for before GST and F-value 13.317 with p-value 0.036 (< 0.05) for after GST, indicating that the models for before and after GST are statistically significant. Additionally, for before GST, the coefficient for year is 98705.10 with p-value 0.014 (< 0.05) which indicates that on average indirect revenue will linearly increase by 98705 units each year before GST. Whereas, for after GST the coefficient is not statistically significant (p > 0.05).

Exponential Model: An exponential model is employed when the rate of change of the dependent variable is directly proportional to the magnitude of the variable itself.

Model Summary						**ANOVA**		**Coefficients**	
Group	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F-value	p-value	Unstandardized coefficient for year	p-value
Before GST	1	.963	0.927	0.903	0.07945	38.032	.009	0.155	0.009
After GST	1	.917	0.842	0.789	0.06575	15.959	.028	0.083	0.028

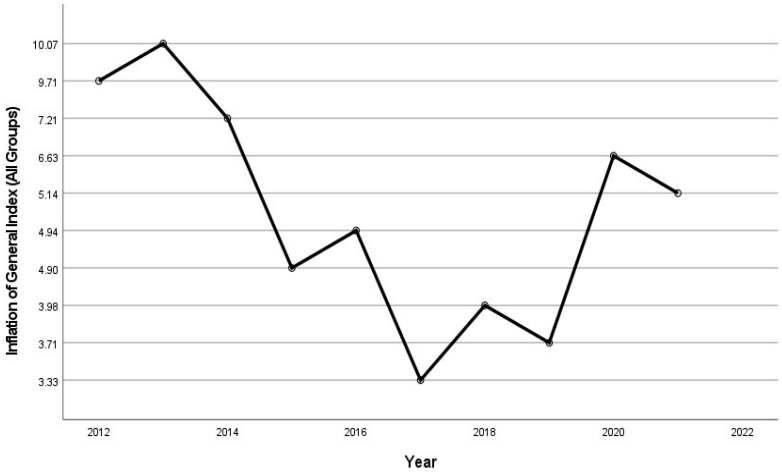
The exponential model shows a R-squares value 0.927 for before GST and value 0.842 for after GST. Here, before GST has high R square value which indicates exponential model is a good fit for before GST as compare to after GST. Further, ANOVA gives F value 38.032 with p-value 0.009 (< 0.05) for before GST and F-value 15.959 with p-value 0.028 (< 0.05) for after GST, indicating that the models for before and after GST are statistically significant. Additionally, for before GST, the coefficient for year is 0.155 with p-value 0.009 (< 0.05) which indicates that on average indirect revenue will exponentially increase by 0.155 units each year and for after GST the coefficient is 0.083 with p-value 0.028 (< 0.05) which indicates that on average indirect revenue will exponentially increase by 0.083 units each year.

Quadratic Model: A quadratic model is a polynomial model that contains a squared component in the relationship between the dependent variable y and the independent variable x.

Model Summary						**ANOVA**		**Coefficients**	
Group	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F-value	p-value	Unstandardized coefficient for Year square	p-value
Before GST	1	.948	0.899	0.866	60345.76502	26.759	.014	24.507	0.014
After GST	1	.904	0.816	0.755	77381.24855	13.336	.035	22.130	0.035

The quadratic model shows a R-squares value 0.899 for before GST and value 0.816 for after GST. Here, before GST has high R square value which indicates quadratic model is a good fit for before GST. However, the standard error indicates some deviation from linear trend, especially in after GST, suggesting that a more complex model may be a better fit for before GST and after GST. Further, ANOVA gives F value 26.759 with p-value 0.014 (< 0.05) for before GST and F-value 13.336 with p-value 0.035 (< 0.05) for after GST, indicating that the models for before and after GST are statistically significant. Additionally, for before GST, the coefficient for year is 24.507 with p-value 0.014 (< 0.05) which indicates that on average indirect revenue will increase by 24.507 units each year before GSTand for after GST the coefficient is 22.130 with p-value 0.035 (< 0.05) which indicates that on average indirect revenue will increase by 22.13 units each year.

Trend analysis for Inflation



In summary, exponential model has the highest R squared value for the period before GST (0.927) and after GST (0.842) which indicates that the exponential model is the best fit model which shows a steady and consistent increase in the revenue before and after GST.

Trend analysis for Inflation: The graph shows the inflation rate from the year 2012 to 2021. From the graph it can be concluded that the inflation rate increases slightly from 2012 to 2013 and then drastically decreases till 2017 year. After 2017, it remains relatable stable until 2019, it experiences a drastic increase. It shows a general decreasing trend of inflations.

Regression analysis for Inflation

Linear model

Model Summary						ANOVA		Coefficients	
Group	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Unstandardized coefficient for Year	p-value
Before GST	1	.934	0.872	0.830	1.02697	20.517	.020	-1.471	0.020
After GST	1	.739	0.547	0.395	1.04151	3.616	.153	0.626	0.153

The linear model shows a R-squares value 0.872 for before GST and value 0.547 for after GST. Here, before GST has high R square value which indicates linear model is a good fit for before GST. However, the standard error indicates some deviation from linear trend, especially in before GST, suggesting that a more complex model may be a better fit for before GST and after GST.

The models for before and after GST are not statistically significant, according to the ANOVA, which also yields F values of 20.517 with p-value 0.020 (< 0.05) for before GST and 3.616 with p-value 0.153 (> 0.05) for after GST. Furthermore, the coefficients for the year before GST is -1.471 with a p-value of 0.020 (< 0.05), and for the year after GST, it is 0.626 with a p-value of 0.153 (> 0.05). The coefficient is statistically significant for before GST period, but it is insignificant for after GST period. Hence, we can conclude that the model is statistically significant and good to fit for before GST period but it not significant and good to fit for after GST period.

Exponential model

Model Summary						ANOVA		Coefficients	
Group	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Unstandardized coefficient for Year	p-value
Before GST	1	.937	0.878	0.837	0.14100	21.590	.019	-0.207	0.019
After GST	1	.784	0.615	0.486	0.19900	4.786	.117	0.138	0.117

The exponential model shows a R-squares value 0.878 for before GST and value 0.615 for after GST. Here, before GST has high R square value which indicates exponential model is a good fit for before GST as compared to after GST. The models for before and after GST are not statistically significant, according to the ANOVA, which also yields F values of 21.590 with p-value 0.019 (< 0.05) for before GST and 4.786 with p-value 0.117 (> 0.05) for after GST.

Furthermore, the coefficients for the year before GST is -0.207 with a p-value of 0.019 (< 0.05), and for the year after GST, it is 0.138 with a p-value of 0. 117 (> 0.05). The coefficient is statistically significant for before GST period, but it is insignificant for after GST period. Hence, we can conclude that the model is statistically significant and good for fitting for before GST period but it not significant and good to fit for after GST period.

Quadratic model

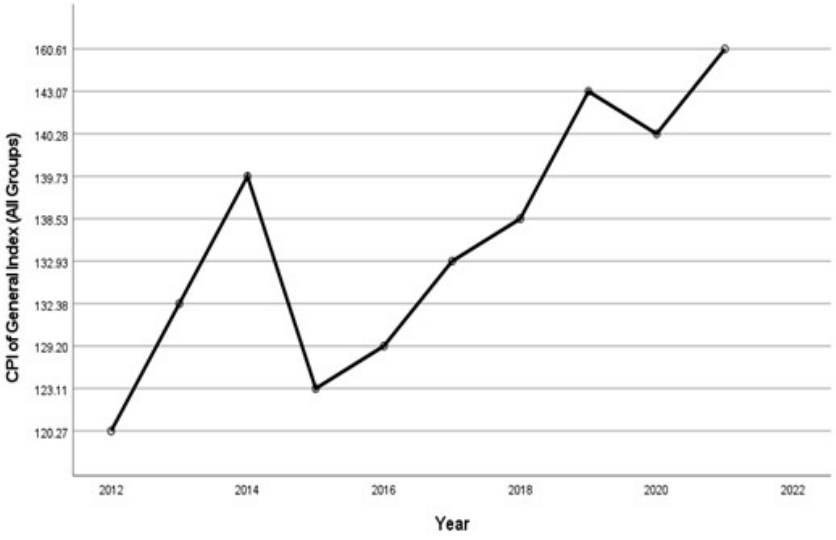
Model Summary						ANOVA		Coefficients	
Group	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Unstandardized coefficient for Year square	p-value
Before GST	1	.934	0.872	0.830	1.02696	20.517	.020	-0.0004	0.020
After GST	1	.739	0.546	0.395	1.04157	3.615	.153	0.0002	0.153

The quadratic model shows a R-squares value 0.872 for before GST and value 0.546 for after GST. Here, before GST has high R square value which indicates quadratic model is a good fit for before GST. However, the standard error indicates slight deviation from linear trend, especially in before GST, suggesting that a more complex model may be a better fit for before GST and after GST.

Further, ANOVA gives F value 20.517 with p-value 0.020 (< 0.05) for before GST and F-value 3.615 with p-value 0.153 (> 0.05) for after GST, indicating that the model for before GST is statistically significant but for after GST, the model is not statistically significant. Additionally, for before GST, the coefficient for year is -0.0004 with p-value 0.020 (< 0.05) and for after GST the coefficient is 0.0002 with p-value 0.153 (> 0.05), which indicates that the coefficient for the year before GST is statistically significant but for after GST, it is statistically insignificant. Hence, we can conclude that the model is statistically significant and good to fit for before GST period but it not significant and good to fit for after GST period.

In summary, exponential model has the highest R squared value for the period before GST (0.878) and after GST (0.615). For after GST, none of the model is fit, but for before GST the exponential model is the best fit model.

Trend analysis for CPI: The above graph gives the trend of CPI between the year 2012 to 2021. The graph shows an increasing trend from year 2012 to 2014 and then a drastic decline in the CPI. From 2015, there is steady increase in the CPI till year 2021. Hence, the graph shows a general increasing trend for consumer price index (CPI).



Regression analysis for CPI

Linear model

Model Summary						ANOVA		Coefficients	
Group	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Unstandardized coefficient for Year	p-value
Before GST	1	.176	0.031	-0.292	8.75979	0.096	.777	0.860	0.777
After GST	1	.862	0.743	0.657	6.13113	8.673	.060	5.710	0.060

The linear model shows a R-squares value 0.031 for before GST and value 0.743 for after GST. Here, after GST has high R square value which indicates linear model is a good fit for after GST. Further, the model for before GST yielded the F statistic of 0.096 with p-value 0.777 (> 0.05), so the model is not good for fitting as it is not statistically significant. But for after GST period, the model yielded a F statistic of 8.673 with the p-value as 0.060 which is slightly greater than the 0.05 threshold.
Similar to ANOVA, the coefficients for the year before GST is 0.860 with a p-value of 0.777 (> 0.05), and for the year after GST, it is 5.710 with a p-value of 0.060. Hence, the coefficient is not statistically significant for the before GST time period, but for after GST period, the p-value is 0.06 which is slightly greater than the general threshold of 0.05 (for p-value approach), so we can conclude that the model is not that much accurate but it can be used for fitting to some extent.

Exponential model

Model Summary						ANOVA		Coefficients	
Group	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Unstandardized coefficient for Year	p-value
Before GST	1	.188	0.035	-0.286	0.06742	0.110	.762	0.007	0.762
After GST	1	.870	0.757	0.676	0.04046	9.328	.055	0.039	0.055

The exponential model shows a R-squares value 0.035 for before GST and value 0.757 for after GST. Here, after GST has high R square value which indicates exponential model is a good fit for after GST as compared to before GST.
According to ANOVA, the model for before GST yielded the F statistic of 0.110 with p-value 0.762 (> 0.05), so the model is not good for fitting as it is not statistically significant. But for after GST period, the model yielded a F statistic of 9.328 with the p-value as 0.055 which is slightly greater than the 0.05 threshold. Similarly, the coefficients for the year before GST is 0.007 with a p-value of 0.762 (> 0.05), and for the year after GST, it is 0.039 with a p-value of 0. 055. Hence, we can conclude that the coefficients are not statistically significant for the before GST time period, but for after GST period, the p-value is 0.055 which is slightly greater than the general threshold of 0.05 (for p-value approach), so we can conclude that the model is not that much accurate but it can be used for fitting to some extent.

Quadratic model

Model Summary						ANOVA		Coefficients	
Group	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Unstandardized coefficient for Year square	p-value
Before GST	1	.176	0.031	-0.292	8.76008	0.096	.777	0.0002	0.777
After GST	1	.862	0.743	0.658	6.12943	8.680	.060	0.0014	0.06

The quadratic model shows a R-squares value 0.031 for before GST and value 0.743 for after GST. Here, after GST has high R square value which indicates quadratic model is a good fit for after GST.

Further, the model for before GST yielded the F statistic of 0.096 with p-value 0.777 (> 0.05), so the model is not good for fitting as it is not statistically significant. But for after GST period, the model yielded a F statistic of 8.680 with the p-value as 0.060 which is slightly greater than the 0.05 threshold.

Similar to ANOVA, the coefficients for the year before GST is 0.0002 with a p-value of 0.777 (> 0.05), and for the year after GST, it is 0.0014 with a p-value of 0.06. Hence, the coefficient is not statistically significant for the before GST time period, but for after GST period, the p-value is 0.06 which is slightly greater than the general threshold of 0.05 (for p-value approach), so we can conclude that the model is not that much accurate but it can be used to fit to some extent.

In summary, exponential model has the highest R squared value for the period before GST (0.035) and after GST (0.757). For before GST, none of the model is fit, but for after GST the exponential model is the best fit model.

CONCLUSION

Indirect Tax Revenue: Exponential Model**:** Highest R-squared values for both periods (0.927 before GST, 0.842 after GST). Best fit model for indirect tax revenue.

Inflation: Exponential Model: Best fit model for both periods (R-squared = 0.885 before GST, 0.629 after GST).

CPI: Linear Model: Best fit for both periods (R-squared = 0.663 before GST, 0.857 after GST). Less variability compared to the quadratic model. The econometric analysis confirms that an exponential model provides the best fit for analyzing indirect tax revenue trends both before and after the implementation of the Goods and Services Tax (GST) in India, signaling a consistent upward trajectory in both revenue and inflationary pressures. While the exponential trend shows steady growth in both periods, studies indicate that models often exhibited higher R-squared values for the pre-GST era, suggesting a more stable, albeit complex, structural fit for those economic conditions.

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