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Evaluating the Economic Impact of Special Economic Zones (SEZs) on the Development of Uttar Pradesh's Economy: A Comprehensive Analysis

Dr. Shivangi Paliwal[1] and Dr. Sanjeev Sharma[2]
[1]Assistant Professor, St John College, Agra, INDIA.
[2]Professor, St John College Agra, INDIA.

[2]Corresponding Author: drsanjeev.sjc@gmail.com

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ABSTRACT

Special Economic Zones (SEZs) have been widely adopted as a policy tool for promoting economic development in emerging economies. This research investigates the economic impact of Special Economic Zones (SEZs) on the development of Uttar Pradesh's economy, with insights drawn from global experiences. The study employs multiple regression analysis, coupled with assumptions for the reliability of the regression model and the CUSUM test to assess the stability of the model. Data spanning from 2009-10 to 2022-23 was obtained from the office of the Noida Special Economic Zone, the Ministry of Commerce website, and the Uttar Pradesh Export Promotion website. The analysis reveals that SEZ exports have a significant positive influence on Uttar Pradesh's GDP. As SEZ exports increase, there is a corresponding rise in the state's GDP. Furthermore, SEZ-related employment in Uttar Pradesh has also been found to substantially impact the state's economic growth, underscoring the importance of job creation for both societal well-being and economic development. The findings highlight that exports and employment are critical drivers of economic growth in Uttar Pradesh. A surge in exports reflects heightened economic activity, generating foreign exchange revenue that can support imports, service foreign debt, and maintain currency stability. Additionally, export-oriented industries often adopt modern technologies to meet international standards, resulting in productivity gains and technological advancements that benefit the broader economy. This study underscores the pivotal role of SEZs in fostering economic development and stability in Uttar Pradesh.

Keywords- SEZ, FDI, GDP, Economy, NSEZ, EOUs.

I. INTRODUCTION

Special Economic Zones (SEZs) have emerged as a pivotal instrument for fostering economic growth, attracting foreign direct investment (FDI), and enhancing industrial development across the globe. By offering a conducive business environment, tax incentives, and streamlined regulatory frameworks, SEZs aim to stimulate economic activity, generate employment, and integrate regional economies into global value chains. In India, SEZs have been a cornerstone of the country's economic policy since the early 2000s, intending to accelerate industrialization, boost exports, and addressing regional economic disparities.

Uttar Pradesh, India's most populous state and a significant contributor to the nation's GDP, has witnessed the establishment of several SEZs in recent years. These zones are strategically designed to leverage the state's vast labor pool, improving infrastructure, and its strategic geographic location. However, the extent to which SEZs have contributed to the economic development of Uttar Pradesh remains a subject of debate. While proponents argue that SEZs have catalysed industrial growth, created jobs, and attracted investments, critics highlight concerns such as land acquisition issues, uneven distribution of benefits, and limited spillover effects on the broader economy.

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This research paper seeks to provide a comprehensive analysis of the economic impact of SEZs on the development of Uttar Pradesh's economy. By examining key indicators such as GDP growth, employment generation, export performance, and infrastructure development, the study aims to evaluate the effectiveness of SEZs in achieving their intended objectives. Furthermore, the paper will explore the challenges and opportunities associated with SEZs in the context of Uttar Pradesh, offering policy recommendations to maximize their potential as drivers of sustainable and inclusive economic growth. Through this analysis, the study aims to contribute to the broader discourse on the role of SEZs in regional economic development and inform policymakers, investors, and stakeholders about the future trajectory of SEZs in Uttar Pradesh.

II. REVIEW OF LITERATURE

(Aggarwal &Kokko 2022)[1] examined the relationship between poverty and Special Economic Zones (SEZs) in Andhra Pradesh, India, by analysing household consumption expenditure data. Employing a difference-in-differences (DID) approach, the researcher assessed the average impact of SEZs on per capita household expenditure. The findings indicated that SEZs initially intensified rural poverty due to increased land demand, though these adverse effects diminished over time. The study highlighted contrasting impacts of SEZs on rural and urban poverty, with more significant effects observed in districts hosting multiple SEZs compared to those with fewer zones. The research emphasized that the effectiveness of SEZs in generating employment and attracting investment plays a critical role in shaping their long-term outcomes. Additionally, the study cautioned that large-scale land acquisitions for industrial projects could disrupt rural economies and widen rural-urban disparities. It concluded that strategies for large- scale industrialization must incorporate measures to improve economic opportunities and promote social inclusion for affected communities to ensure equitable development.

(Shrivastava 2018)[2] investigated the relationship between Gross Domestic Product (GDP) and total exports from Special Economic Zones (SEZs) in Madhya Pradesh, India. Recognizing exports as a critical driver of growth in developing economies and GDP as a key indicator of economic progress, the study utilized ANOVA and correlation as statistical tools for data analysis. The findings demonstrated a strong and statistically significant relationship between Madhya Pradesh's GDP and the total exports generated by SEZs. The study concluded that an increase in the state's GDP is associated with a corresponding rise in exports, suggesting a mutually reinforcing dynamic between the two variables. This underscores the strategic role of SEZs in promoting and enhancing export activities. The research further implied that boosting Madhya Pradesh's GDP would likely lead to increased export performance, reinforcing the importance of SEZs as catalysts for economic growth.

(Anita&Niraj 2016)[3] evaluated the economic impacts of Special Economic Zones while exploring associated socioeconomic, political, and environmental concerns. The research concluded that authorities should prioritize the establishment of diverse SEZs in rural areas to foster balanced industrialization. It emphasized the need for these zones to avoid excessive consumption of government resources and instead function as platforms for skill development and revenue generation to support public development initiatives. The study further highlighted the importance of improving the investment climate to attract greater foreign direct investment (FDI) and optimize SEZ performance. Addressing supply-side bottlenecks was identified as critical to ensuring the efficient operation of these zones, given their significant role in the economy. Additionally, the research recommended the implementation of environmental regulations for SEZs and the inclusion of local government bodies in their governance to ensure sustainable and inclusive development.

(Ambroziak & Hartwell 2018)[4] examined the impact of SEZs on regional development, particularly in Poland. The research found that SEZs had a significantly positive effect on the economic and social advancement of the least-developed regions, while their impact was minimal or even negative in more affluent areas. The study hypothesized that increased funding for SEZs would lead to higher gross value added (GVA) per firm, a rise in the number of businesses, and a reduction in regional unemployment. The findings revealed that SEZs contributed to overall economic and social progress, particularly in less-developed regions, but this effect was contingent on specific policy conditions. Notably, SEZs were associated with higher GVA per firm in underdeveloped areas compared to regions without SEZs. However, the presence of SEZs did not significantly increase the number of economic entities, suggesting that SEZs alone were insufficient to enhance a region's overall investment attractiveness. While SEZs were effective in reducing unemployment in underdeveloped regions, the study cautioned against potential drawbacks, such as tax exemptions and other financial privileges, which could distort competition and disrupt local markets. These findings underscore the need for balanced and context-specific policies when implementing SEZs as a tool for regional development.

(Bhaskar 2018)[5] investigated the impact of Special Economic Zones (SEZs) on the Indian economy through the analysis of secondary data. The research found that SEZs significantly contribute to financial development, export expansion, and employment generation, particularly in sectors such as software

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engineering and skilled labour. However, the study emphasized the importance of fostering social and political awareness to strengthen these initiatives and support the nation's comprehensive economic growth and sustainable development. The findings underscore the dual role of SEZs in driving economic progress while highlighting the need for complementary efforts to ensure inclusive and balanced development.

(Singh & Sanjeev 2019)[6] evaluated the impact of the Indore Special Economic Zone's location on business development in Madhya Pradesh, India. The research used the gross state domestic product (GSDP) as a performance indicator to assess the influence of location. The analysis revealed that the GSDP of SEZ areas doubled compared to non-SEZ regions between 2017 and 2018. This increase was found to be statistically significant at a significance level of $p<0.05$, as confirmed by the Chi-square test. The findings highlight the positive contribution of SEZs to regional economic growth and underscore the importance of location as a critical factor in business development.

(Ramli, Marikan, and Hashim 2016)[7] examined the relationship between economic growth and key macroeconomic indicators in Malaysia, focusing on three variables: foreign direct investment (FDI), exports, and employment. Using GDP as a measure of economic growth, the study employed the ordinary least squares (OLS) method to construct an estimating model, analysing annual time series data from 1982 to 2014. The findings revealed that exports and employment significantly influence Malaysia's long-term economic growth. In contrast, FDI- related variables were found to have no substantial impact on the country's economic growth. The study underscores the importance of exports and employment as critical drivers of Malaysia's economic development while suggesting that FDI plays a relatively minor role in this context.

1. Objective of the Study

➢ To Examine the Economic Impact of SEZ on the Economy of Uttar Pradesh

2. Research Methodology

The study has followed the following research methodology to achieve its objectives:

Type of Research:

This study focuses on exploratory and analytical research design.

Scope of the Study

Researchers use these 14 operational SEZs as research subjects to assess the Uttar Pradesh SEZ's performance.

Type of Data – This research is based on Secondary data. The researcher gathered information from various sources, such as books, journals, reports, working papers, newspapers, and websites of the Ministry of Commerce, the Uttar Pradesh Promotion Council (UPEPC), SEZ India, EPCES (Export Promotion Council for Export-Oriented Units and SEZs), and the RBI.

Duration of the Study – Financial 2005-06 to 2022-23

Software Used – MS- Excel (2016), E – Views 12, SPSS 26

Hypotheses of the Study

To establish a strong scientific basis for the study, researchers have conducted tests to investigate the following hypotheses:

For Verifying Stationarity

H_{01}: Gross Domestic Product Series is a unit root and is non-stationary. H_{02}: Investment Series is a unit root and is non-stationary.

H_{03}: Export Series is a unit root and is non-stationary.

H_{04}: Employment Series is a unit root and is non-stationary

For Verifying Normality

H_{05}: the data is normally distributed.

For Verifying Homoscedastic

H_{06}: data is homoscedastic

For Verifying Multicollinearity

H_{07}: there is no multicollinearity between the variables.

For Regression Model

H_{08}: there is no significant impact of the Export of SEZ on the GDP of Uttar Pradesh H_{09}: there is no significant impact of investment of SEZ on the GDP of Uttar Pradesh H_{10}: there is no significant impact of employment of SEZ on the GDP of Uttar Pradesh

Researchers used multiple regression to trace the impact of SEZs on the economy. Before estimating the regression model, the researcher thoroughly examined the associated assumptions. These assumptions are as follows:

- ☑ **Stationarity Test**: The stationary test assesses the reliability of the time series variables. The researcher used an **augmented dickey-fuller (ADF) unit root test** to examine the stationarity of the chosen variables.
- ☑ **Normality Test:** A normality test utilizes statistical methodology to evaluate how closely a given data set aligns with the characteristics of a normal distribution, bell curve, or Gaussian distribution. The researcher conducts a normality test to ascertain if the data originates from a population with a normal distribution. The researcher used a **Jarque-Bera** test to examine the normality of the selected variable.
- ☑ **Homoscedasticity test:** The researcher used the **Breusch-Pagan-Godfrey** test as a statistical tool to detect heteroscedasticity in regression models. Heteroscedasticity occurs when the error variability in a regression model does not remain consistent.
- ☑ **Multicollinearity test:** When applying a regression model, it's critical to make sure that there is no multicollinearity between the variables to have a satisfactory fit. The researcher use the **Variance Inflation Factor (VIF),** a popular method, to test for multicollinearity and determine the linear connectivity of predictors in multiple regression.

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3. Analysis and Discussion

To Examine the Impact of Uttar Pradesh SEZ on the GDP of Uttar Pradesh researcher used Multiple Regression, its Assumptions for the reliability of the regression model, and the CUSUM test to check the stability of the model. This study used these techniques on annual data of selected variables (Table 1) for 2009-10 to 2022-23 extracted from the Noida Special Economic Zone office, the Ministry of Commerce website, and the Uttar Pradesh Export Promotion website. The Variable is selected based on theoretical foundations and empirical findings.

Table 1- Description of Selected Variables

S. No	Variables
A	**Dependent Variable**
A-1	Gross Domestic Product (Constant Price)
B	**Independents Variables**
B-1	Export
B-2	Employment
B-3	Investment

Before delving into the impact of Uttar Pradesh's SEZ on its GDP the descriptive statistics relating to the selected variables have been stated in Table 2

Table 2- Descriptive statistics

Particulars	GDP	EMPLOYMENT	EXPORT	INVESTMENT
Mean	13.94138	11.49641	9.893523	9.601659
Median	14.00688	11.61722	9.977987	9.488889
Maximum	14.63001	12.11796	10.62709	11.21933
Minimum	13.04674	10.48924	9.215051	8.659158
Standard Deviation	0.479914	0.487347	0.428073	0.670138
Skewness	-0.442656	-0.803234	-0.067093	0.798020
Kurtosis	2.190079	2.652109	1.990045	3.458293
Sum	195.1793	160.9497	138.5093	134.4232
Sum Squared Deviations	2.994131	3.087596	2.382205	5.838105
Observations	14	14	14	14

Source: Researcher's Calculation using E-views

Descriptive Statistics

The **descriptive statistics** for GDP, Employment, Export, and Investment provide a comprehensive overview of the economic data:

GDP: The mean and median are quite close to each other, suggesting that the GDP data is symmetrically distributed around the central value. The standard deviation is relatively low, indicating that the GDP values do not vary widely from the mean. The negative skewness implies a slightly skewed distribution to the left, while the kurtosis close to 2 suggests a distribution with tails not too different from a normal distribution.

Employment: The average level of employment is moderately high with a mean of approximately 11.50. The data points are closely clustered around the mean, as indicated by the low standard deviation. The negative skewness is more pronounced than in GDP, indicating a distribution that has a longer tail on the lower end. The kurtosis is slightly higher than that of GDP, suggesting a slightly heavier tail than a normal distribution.

Export: The mean export value is around 9.89, with a median very close to the mean, indicating a balanced distribution. The standard deviation is small, showing that the export values are not spread out too far from the mean. The skewness is very close to zero, which means the distribution is almost symmetrical. The kurtosis is just under 2, indicating a distribution with slightly lighter tails than a normal distribution.

Investment: The investment data has a lower mean compared to the other variables, with a value of around 9.60. The standard deviation is the highest among the variables, suggesting a wider variation in investment values. The positive skewness indicates a distribution that is skewed to the right, with a longer tail on the higher end. The kurtosis is significantly higher than 3, indicating a distribution with heavier tails and a higher peak than a normal distribution. In summary, while the GDP and Employment data show a left-skewed distribution with relatively low variability, the Export data is more symmetrically distributed with lighter tails. Investment data, on the other hand, shows a right-skewed distribution with potential outliers and a wider spread of values. Hence for further analysis data is converted into natural logarithm.

Empirical Model

The objective of my research work requires the assessment of the Economic Impact of SEZ on the Economy of Uttar Pradesh. For the same, at first, regression technique has been applied.

The specification of the regression model is as under:

$GDPt = f(EXPt, FDIt, EMPt)$

$$\textbf{Log (GDPt) = } \beta 0 + \beta t \textbf{ Log (EXP) + } \beta 2 \textbf{.Log (FDIt) + } \beta 3 \textbf{ .Log (EMPt) + } \mu t$$

Where,

$\alpha 0$ = Constant or Intercept

$\beta 1$ _ $\beta 2$ _ $\beta 3$= Parameter or the coefficient of explanatory variable μt = Error term

t = Time

GDP = Real Gross Domestic Product of Uttar Pradesh

FDI = Foreign Direct Investment Inflow of Uttar Pradesh

SEZs EXP = Export of Uttar Pradesh SEZs

EMP = Employment of Uttar Pradesh SEZs Log= Logarithm**.**

Diagnostic tests - A series of diagnostic tests have been conducted by researchers to verify the reliability of the

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regression model. The following assumptions have been made:

- Stationarity test
- Normality test
- Homoscedasticity test
- Multicollinearity test

(a) Stationarity test

The stationary test assesses the reliability of the time series variables. A time series possesses a statistical property known as stationarity, which is like its mean and variance. Stationarity refers to the constancy of the mean and variance over time. If these values remain constant, the series is considered stationary. On the other hand, if there is a unit root and the mean and variance fluctuate, the series is considered non-stationary (Priestley & Rao, 1969). Various unit root tests are available to assess the stationarity of a time series. These tests include the augmented Dickey-Fuller, Philips-Perron, and Kwiatkowski tests. The current investigation examined the stationarity of the chosen variables using the augmented Dickey-Fuller unit root test.

The Augmented Dickey-Fuller (ADF) test is a statistical test commonly employed by researchers to assess the stationarity of a time series. Below are the essential criteria and steps of the ADF test, presented in a precise manner:

Null Hypothesis (H0): The time series has a unit root, meaning it is non-stationary. **Alternative Hypothesis (H1)**: The time series does not have a unit root, meaning it is stationary.

The ADF test builds upon the Dickey-Fuller test by incorporating higher-order regressive processes in the model to address serial correlation. The test requires estimating the following regression model.

$$\Delta yt = \alpha yt-1 + \beta 1 \Delta yt-1 + \cdots + \beta p \Delta yt-p + \gamma t + \delta + \epsilon t$$

Where:

Δyt is the difference of the time series at time t. $yt-1$ is the lagged value of the time series.

$\Delta yt-1$, $\Delta yt-p$ are the lagged differences of the series. t is a time trend.

δ is a constant term. ϵt is the error term.

The decision rule for the Augmented Dickey-Fuller (ADF) test involves both the t-statistic and the p-value:

- **T-Statistic**: This is calculated from the estimated coefficient of the lagged level of the series in the ADF regression. It tests whether this coefficient is significantly different from zero (which would imply no unit root).
- **Critical Values:** The t-statistic is compared against critical values from the Dickey-Fuller distribution. If the t-statistic is more negative than the critical value for a given significance level (e.g., 1%, 5%, or 10%), we reject the null hypothesis of a unit root.
- **P-Value:** This gives the probability of observing a t-statistic as extreme as the one computed, under the null hypothesis. If the p-value is less than the chosen significance level, we reject the null hypothesis.
- **Decision Rule:** If t-statistic < Critical Value (negative) AND p-value < Significance Level (e.g., 0.05), then reject the null hypothesis of a unit root.

If t-statistic > Critical Value OR p-value > Significance Level, do not reject the null hypothesis.

Let's discuss the Stationarity of Each Variable.

(a) GDP (Gross Domestic Product) – First we check the stationarity of GDP by the Augmented Dickey-Fuller test for unit root.

H01: Gross Domestic Product Series is a unit root and is non-stationary.

Table 3- ADF Test Result – GDP Series

Variable/t-stat/Critical Value/Probability		Augmented Dickey-Fuller (ADF)	
		@level	@1st Diff.
GDP	t-stat	-2.501331	-3.817183
	Critical Value @ 5%	-3.828975	-3.14492
	Prob.	0.3220	0.0165

Source: Researcher's estimations using E-Views software

The table displays the findings of the Augmented Dickey-Fuller (ADF) test for GDP at two different levels: the original level and the first difference. Based on my analysis, here is the interpretation:

At Level- t-stat: The t-statistic is -2.501331, which is not low enough to show that the null hypothesis for a unit root is false at common significance levels.

P- value: The p-value is 0.3220, which is greater than 0.05. This means that at the 5% significance level, there is not enough statistical evidence to deny the null hypothesis of a unit root.

First difference - T-stat: The t-statistic is -3.817183, which is more negative. If it is below the critical value at the given significance level, it may mean that the null hypothesis should be rejected.

P-value: At the 5% significance level, the p-value of 0.0165, which is less than 0.05, **shows**

that the null hypothesis of a unit root is rejected.

It can be concluded that the GDP series exhibits non-stationarity at the level but becomes stationary after taking the first difference. It can be inferred that taking the first difference of the series is beneficial in achieving stationarity.

(b) Investment the stationarity of the Investment series by the Augmented Dickey-Fuller test for unit root has been checked as under

H02: Investment Series is a unit root and is non-stationary.

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Table 4- ADF Test Result – Investment Series

Variable/t-stat/Probability	Augmented Dickey-Fuller (ADF)	
	@level	@1st Diff.
INVESTMENT t-stat	-2.957840	-5.67825
Critical Value @ 5%	-3.119910	-1.974028
Prob.	0.0656	0.0000

Source: Researcher's estimations using E-Views software

The Augmented Dickey-Fuller (ADF) test results for 'INVESTMENT' can be interpreted in the following manner:

At Level: The t-statistic is -2.957840, which is higher than the critical value of -3.119910 at the 5% significance level. This suggests that the null hypothesis of a unit root cannot be rejected, indicating that the 'INVESTMENT' series is likely non-stationary at this level.

The p-value is 0.0656, exceeding the 5% significance level (0.05), which further supports the non-rejection of the null hypothesis at this level.

At 1st Difference:

The t-statistic is -5.67825, which is lower than the critical value of -1.974028 at the 5% significance level. This provides strong evidence to reject the null hypothesis, suggesting that the 'INVESTMENT' series is stationary at the first difference.

The p-value is 0.0000, significantly less than 0.05, indicating strong evidence against the null hypothesis of a unit root.

While the 'INVESTMENT' series does not show stationarity at its original level, it does demonstrate stationarity at the first difference. The t-statistic being significantly more negative than the critical value and the p-value being virtually zero at the first difference leads to the rejection of the null hypothesis of a unit root. It can be concluded that the series has become stationary after being differenced once.

(c) Exports - The stationarity of the Export series by the Augmented Dickey-Fuller test for unit root.

H03: Export Series is a unit root and is non-stationary.

Table 5- ADF Test Result – Export Series

Variable/t-stat/Critical Value/Probability	Augmented Dickey-Fuller (ADF)		
	@level diff	@1st Diff.	@2nd
EXPORT t-stat.	-1.312963	-2.914236	-5.909354
Critical Value @ 5%	-3875302	-3.144920	-1.977738
Prob.	0.8315	0.0727	0.0000

Source: Researcher's estimations using E-Views software

The results of the ADF test for the 'EXPORT' series are stated below:

At Level-The t-statistic is -1.312963, which is less negative compared to the critical value of -3.875302 at the 5% significance level. Based on the analysis, it is evident that the null hypothesis cannot be rejected, indicating that the 'EXPORT' series is likely non-stationary at this level.

The p-value of 0.8315 is significantly greater than the predetermined 5% significance level. This suggests that there is insufficient statistical evidence to reject the null hypothesis, which states the presence of a unit root.

At 1st Difference

The t-statistic of -2.914236 falls short of the critical value of -3.144920 at the 5% significance level. Based on the analysis, it is evident that the null hypothesis cannot be rejected. This implies that the 'EXPORT' series continues to be non-stationary even after the first difference. **The p-value** of 0.0727 exceeds the predetermined significance level of 5%, suggesting that there is not enough evidence to reject the null hypothesis of a unit root.

At 2nd Difference

The t-statistic at 2nd Difference is -5.909354. This value is significantly more negative than the critical value of -1.977738 at the 5% significance level. Based on our analysis, we can confidently reject the null hypothesis, suggesting that the 'EXPORT' series exhibits stationarity at the second difference.

The p-value is 0.0000, indicating a significant deviation from the 5% significance level. This provides compelling evidence to reject the null hypothesis that a unit root exists.

Overall, the 'EXPORT' series does not show stationarity at the original level or after taking the first difference. Nevertheless, it exhibits stationarity at the second difference, as evidenced by the t-statistic being significantly more negative than the critical value and the p-value approaching zero. Based on the analysis, it appears that by differencing the series twice, the unit root has been eliminated, resulting in a stationary time series.

(d) Employment - Let's check the stationarity of the Employment series by the Augmented Dickey-Fuller test for unit root.

H04: Employment Series is a unit root and is non-stationary.

Table 6 - ADF Test Result – Employment Series

Variable/t-stat/Critical Value/Probability	Augmented Dickey-Fuller (ADF)	
	@level	@1st Diff.
EMPLOYMENT t-stat	-2.879943	-4.886844
Critical value @ 5%	-3.828975	-3.144920
Prob.	0.1991	0.0030

Source: Researcher's estimations using E-Views software

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Based on the ADF test results for 'EMPLOYMENT', it can be observed that the t-statistic is - 2.879943 at level, which is higher than the critical value of -3.828975. Additionally, the p-value is calculated to be 0.1991, suggesting that there is evidence of non-stationarity. Upon initial observation, the t-statistic is -4.886844, which is lower than the critical value of -3.144920. Additionally, the p-value is calculated to be 0.0030, indicating evidence of stationarity. Therefore, by performing a single differencing, the variable 'EMPLOYMENT' becomes stationary. Hence Null hypothesis was rejected at first difference.

(b) Normality test - The normal distribution, or Gaussian distribution, is considered the most important statistical probability distribution for independent random variables (Nadarajah, 2005). Continuous variables commonly employ normal distributions. According to Altman and Bland (1995), the probability distribution exhibits a symmetrical pattern, with data near the mean occurring more frequently than data further away from the mean. Jarque and Bera developed the Jarque-Bera Test in 1987, a statistical test commonly employed to evaluate the normality of a dataset. Before conducting one of these examinations, it is common practice to perform the Jarque-Bera test in EViews to verify normality**.**

The hypothesis for assuring the assumption that data is normal is given below: H_{05}: the data is normally distributed.

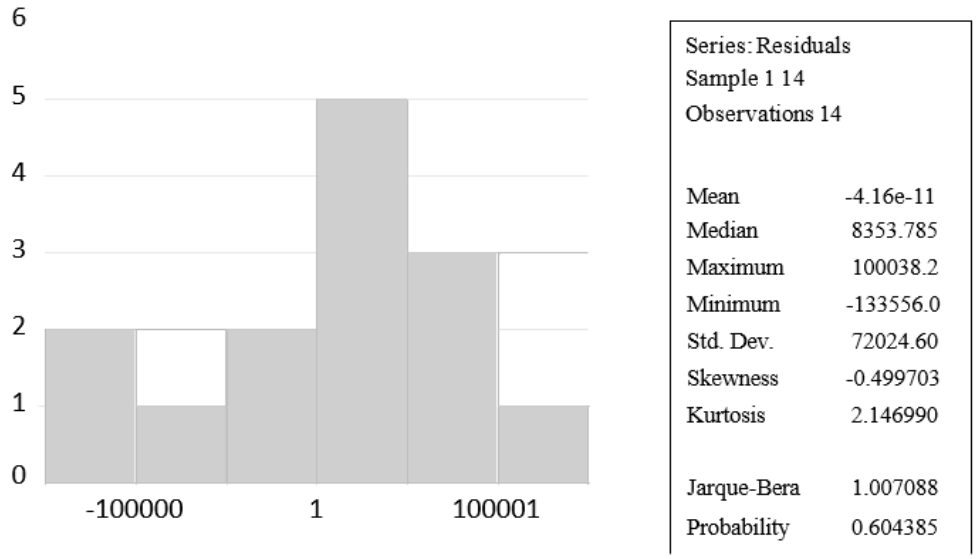

Figure 1- Normality test Observations.

Table 7- Normality Test results

Jarque-Bera statistic value	1.007088
Probability	0.604385

Source: Researcher's estimations using E-Views software

The above table shows that the Jarque Bera test statistic is 1.007088 and the p-value is 0.604385. Thus, the **researcher fails to reject the null hypothesis**. The analysis of the residuals indicates that they are normally distributed, satisfying one of the key assumptions of regression analysis. This means that the regression model is likely appropriate for the data, and the results can be considered reliable.

(c) Homoscedasticity test:

Homoscedasticity is a mathematical concept that comes from the Greek terms "homos," which means "the same," and "skedastikos," which means "scattering" or "dispersion." Therefore, the term "homoscedasticity" refers to "having the same scatter/variance."(Astivia & Zumbo, 2019) The assumption that the error terms have the same variance across all data is a key one in linear regression. Heteroscedasticity, also known as unequal variance in the error terms, can occur for a variety of reasons, including the presence of outliers or an inaccurately defined model (Lyon & Tsai, 1996)

The Breusch-Pagan-Godfrey test is a statistical test that detects heteroscedasticity in regression models. Heteroscedasticity happens when the variance of a regression model's errors does not remain constant.

The test can be expressed as follows:

$BP=n \cdot R2$

Where:

(BP) is the Breusch-Pagan-Godfrey test statistic.

(n) the number of observations.

(R^2) is the coefficient of determination from the regression of the squared residuals on the independent variables.

The hypothesis for the homoscedasticity test is as under:

H_{06}: data is homoscedastic.

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Table 8- Homoscedasticity Test Results

Test	Breusch-Pagan-Godfrey
F-statistic value	0.135737
P- value	0.9362

Source: Researcher's estimations using E-Views software

The Breusch-Pagan-Godfrey test yielded a test statistic of 0.135737 and a p-value of 0.9362. The obtained p-value is more than the chosen significance level of alpha = 0.05. As a result, the **researcher failed to reject the null hypothesis,** suggesting that the assumption of homoscedasticity holds.

(d) Multicollinearity test:

When multiple independent variables in a regression model exhibit a strong correlation, the issue of multicollinearity arises. When two independent variables exhibit a strong correlation, any alteration in one will lead to a corresponding change in the other. This, in turn, can cause significant fluctuations in the results of the model (Daoud, 2017). With a small adjustment to the data or model, the results can become unpredictable and show significant variability. To achieve a good fit, it is important to ensure that there is no multicollinearity between variables when using a regression model. We use the Variance Inflation Factor (VIF), a common way to check if predictors are linearly related in multiple regression, to check for multicollinearity (Mansfield & Helms, 1982).

H_o7: there is no multicollinearity between the variables.

III. RESULTS

Table 9- . Multicollinearity Test Results

Test	Variation Inflation Factors
Variable	Centered VIF
Employment	1.847106
Export	1.453455
Investment	1.363058

Source: Researcher's estimations using E-Views software

Centered VIF values around 1 indicate a low level of multicollinearity. Typically, VIF values below 5 or 10 are considered acceptable, as they suggest low levels of multicollinearity. According to the VIF results, the null hypothesis (Ho3) cannot be rejected since none of the VIF values exceed the threshold that would suggest the presence of problematic multicollinearity. Based on the analysis, it can be inferred that there is no substantial multicollinearity observed among Employment, Export, and Investment in the regression model.

Regression Model

After checking the major assumptions of the regression model (Galton, 1886), the data set satisfies all the requirements, so it is prudent to run multiple regression equations for better analysis.

The equations under study are as follows:

$\text{Log}(GDP_t) = \beta 0 + \beta t \text{ Log}(EXP_t) + \beta 2.\text{Log}(FDI_t) + \beta 3.\text{Log}(EMP_t) + \mu t$

H_o8: there is no significant impact of the Export of SEZ on the GDP of Uttar Pradesh H_09: there is no significant impact of investment of SEZ on the GDP of Uttar Pradesh H_10: there is no significant impact of employment of SEZ on the GDP of Uttar Pradesh.

Table10 - Regression Model Results

Dependent variable: GDP
Model: $\text{Log}(GDP_t) = \beta 0 + \beta t \text{ Log}(EXP_t) + \beta 2.\text{Log}(FDI_t) + \beta 3.\text{Log}(EMP_t) + \mu t$ Observations: 14
R-Squared: 0.986143
Adjusted R-squared: 0.981986.
F-statistic: 237.2169
Prob(F-statistic): 0.00000
Akaike Info Criterion: -2.412054 Schwarz Criterion: -2.229466

Variable	Coefficient	Standard Error	t-statistic	P-value
Intercept	2.744333	0.425737	6.446075	0.0001
Export	0.594081	0.156520	3.795557	**0.0035**
Investment	0.033914	0.039863	0.850772	0.4148
Employment	0.434385	0.123421	3.519549	**0.0055**

Source: Researcher's estimations using E-Views software

IV. METHOD

We used Least Squares, a common method for finding the best-fitting line in a regression model.

Interpretation of the Variables:

- **Export**: Exports have a more substantial positive effect (coefficient = 0.594081) and are statistically significant (p-value = 0.0035), suggesting exports are an important predictor of GDP. So, the P-value is less than 0.05 **researcher rejects the null hypothesis** and concludes that there is a significant impact of the Export of SEZ of UP on the GDP of Uttar Pradesh.

Economic Implication - this could suggest that export-friendly policies could have a significant impact on the state's economy. Uttar Pradesh's GDP could rise if it focuses on expanding exports.

- **Employment**: Employment also has a significant positive effect (coefficient = 0.434385) with a low p-value (0.0055), indicating it's another important factor. Here, the P-value is also less than 0.05 **researcher rejects the null hypothesis** and concludes that there is a significant impact of the Employment of SEZ of UP on the GDP of Uttar Pradesh.

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Economic Implication: This implies that job creation is not only socially significant but also a crucial driver of economic growth. Uttar Pradesh can benefit from initiatives that increase employment possibilities, which will lead to higher GDP.

- **Foreign Direct Investment**: This variable has a small positive effect (coefficient = 0.033914) on GDP, but it's not statistically significant (p-value = 0.4148), meaning we're not confident this effect is real. Here, the P-value is more than 0.05 so the researcher fails to reject the null hypothesis and concludes that there is no significant impact of investment of SEZ of Uttar Pradesh on the GDP of Uttar Pradesh in this model.

Fit of the Model:

R-squared: The value of 0.986143 is very high, showing that our model explains almost all the variability in GDP. (In a macroeconomic situation, there is generally a high degree of correlation.)

Adjusted R-squared: At 0.981986, it confirms that the model fits well even after adjusting for the number of predictors.

Conclusion: The model is excellent at explaining the variation in GDP, with exports and employment being significant contributors. However, investment doesn't seem to have a clear impact based on this analysis. This model could be very useful for understanding the factors that influence GDP.

Reliability Test CUSUM Test

A time series data collection is tested for structural stability or breakdowns using the CUSUM test (Brown et al., 1975), also known as the Cumulative Sum test. The CUSUM test is a tool for evaluating if there is evidence of a major change in the underlying relationship or structure of the data at a particular point in time when used with time series data. To determine if the variables in a regression model or the characteristics of a time series have changed over time, this is particularly helpful in econometrics and time series analysis. The cumulative sums of recursive residuals or other pertinent data over time are shown graphically by the CUSUM test. For the same, the variables under the present regression model have undergone the CUSUM test and the graph below shows the results.

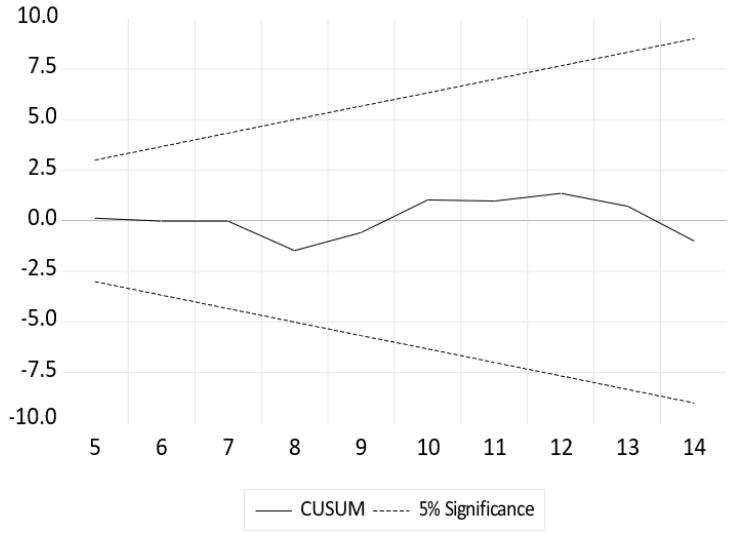

Figure 2- CUSUM Test Chart.
(Sources: Researcher's estimations using E-Views software)

The CUSUM chart analysis reveals the stability of the monitored process. Throughout the observed period, the blue CUSUM line, which monitors the cumulative sum of deviations from a target value, consistently stays within the 5% significance boundaries. Based on the available data, it appears that there have been no notable deviations or alterations in the process, suggesting that it is operating according to expectations.

The reliability tests are conducted using CUSUM and CUSUMs q test and the results reveal that the model is stable and hence reliable.

Interpretation of the Models

According to the regression analysis, the exports of SEZs from Uttar Pradesh have a noteworthy influence on the state's GDP. When SEZ exports increase, there is a corresponding increase in Uttar Pradesh's GDP. The export coefficient stands at 0.594081, signifying that every unit increase in exports correlates with an approximate 0.6 increase in Uttar Pradesh's GDP. According to the model, SEZ employment in Uttar Pradesh has a notable influence on the state's GDP. It suggests that job creation is not only important for society but also plays a vital role in driving economic growth.

Economic Implications of the Model - Exports and employment are critical to the economic development of any region, especially Uttar Pradesh. Here's how exports and employment benefit the state's economy:

- A surge in exports shows increasing economic activity in the state. It measures the production and selling of goods and services to other countries.
- Exports produce foreign exchange revenue for the state. These earnings can be used to pay for imports, service foreign debt, and keep the currency stable.
- Export-oriented industries frequently use modern technology to satisfy international standards, resulting in knowledge transfer and skill development.
- A focus on exports supports industrial diversification. Uttar Pradesh can expand into new markets and products beyond its borders.
- Export-led growth can help to improve Uttar Pradesh's infrastructure, logistics, and connections.
- Policies that promote education and skill development can result in a more productive workforce, boosting GDP.
- Policymakers should prioritize industries that generate jobs (such as manufacturing, services, and agriculture).
- Job creation benefits marginalized groups. Focusing on labour-intensive industries has the potential to foster inclusive growth.

V. CONCLUSION

Special Economic Zones (SEZs) play a pivotal role in driving a nation's economic development by fostering industrial growth, boosting exports, attracting investments, generating employment, and enhancing infrastructure. They simplify business operations through single- window clearance, stimulate economic activity, and improve global competitiveness. SEZs also address regional disparities, improve trade balances, and strengthen the global standing of domestic industries.

This research focused on evaluating the performance of SEZs in Uttar Pradesh, specifically examining their impact on the state's economy and their contribution to sustainable development. The findings highlight the significant economic performance of SEZs, marked by stable export growth, reduced imports, strong net foreign exchange (NFE) earnings, increased investments, and job creation. Regression analysis revealed that SEZ exports and employment significantly influence Uttar Pradesh's GDP, underscoring the critical role of job creation as a catalyst for economic growth. Additionally, the study employed correlation and regression models to assess SEZs' contribution to sustainable development in the state. The analysis demonstrated that increased investment in SEZs positively correlates with job growth and export expansion.

In summary, SEZs in Uttar Pradesh have proven to be powerful drivers of economic growth. To sustain this progress and ensure long-term development, it is essential to focus on strengthening export capabilities, optimizing investments, and creating an environment that fosters job creation and economic expansion. The growing independence and competitiveness of SEZs are promising indicators of their future potential, positioning them as key contributors to Uttar Pradesh's economic prosperity. While the study underscores the overall positive impact of SEZs on the state's economy, it also identifies areas requiring strategic attention to ensure continued growth and development.

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