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STRIDES – A STUDENTS' JOURNAL OF SHRI RAM COLLEGE OF COMMERCE
ISSN 2581-4931 (PRINT)

Shri Ram College of Commerce is well known for its academic excellence and dedicated approach towards dissemination of knowledge in the academic world. The college appreciates the role of research in education and is committed to developing an inclination towards research in both faculty and students. In this pursuit, the college has taken the initiative to launch a new Journal named 'Strides – A Students' Journal of Shri Ram College of Commerce'.

ABOUT THE JOURNAL

It is a double blind reviewed bi-annual Journal launched exclusively to encourage students to pursue research on the contemporary topics and issues in the area of commerce, economics, management, governance, polices etc. The journal provides an opportunity to the students and faculty of Shri Ram College of Commerce to publish their academic research work.

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Shri Ram College of Commerce is committed to upholding the high academic standards. Therefore, the Committee On Publication Ethics (COPE) follows a 3-Stage Selection Process while approving a paper for publication in this Journal. The policy is as follows:

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To maintain high academic standards, academic ethics and academic integrity each research paper received by COPE (Committee On Publication Ethics) is sent for screening of plagiarism on "Turnitin". The committee adheres to the maximum tolerance limit of 25%.

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The journal adheres to a rigorous double-blind review policy. Each research paper received by COPE is sent for review to the *Referee* (Subject Expert). The reports submitted by the *Referees* are sent to the respective students for improvement (if any, suggested by the *Referees*). After reporting all the suggestions recommended by the *Referees*, the revised and improved version of the papers are re-submitted by the students to the COPE.

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The following guidelines are to be carefully adhered by the students before final submission of the manuscript. The submitted manuscripts not conforming to the following guidelines are not taken into consideration for any further processing.

Format

Format of the article on the front page should be:

a) Title
b) Name(s) of the student(s) and mentor along with their details
c) Abstract
d) Keywords

Abstract

The abstract should capture the essence of the article and entice the reader. It should typically be of 100 -150 words, and in Italics.

Font type and word limit

The research paper is to be typed on A-4 size paper with single line spacing. The complete length of the paper should not exceed 5000 words including endnotes and references. The font size should be 12 and font style should be Times New Roman.

Referencing style

The Journal adheres to the APA (American Psychological Association) Referencing Style, Sixth Edition. Students must refer to the APA Referencing Guidelines to ensure conformance to this reference style. For further information you may visit the following link - http://www.apastyle.org

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Endnotes should be serially arranged at the end of the article well before the references and after conclusion.

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The first letter of the caption for table, figure, graph, diagram, picture etc. should be in capital letter and the other words should be in small letter - e.g. Table-1: Demographic Data of Delhi, Figure-1: Pictorial Presentation of Population etc.

MANUSCRIPT SUBMISSION GUIDELINES

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Hard Copy: The hard copy (3-Sets) of the manuscripts should be submitted in the Administrative Office of the College.

Declaration

As part of the submission process, the student and mentor needs to declare that they are submitting original work for the first publication in the Journal and that their work is not being considered for publication elsewhere and has not already been published elsewhere. Again, the paper should not have been presented in any seminar or conference. The scanned copy of duly signed declaration by the students and their respective mentors has to be emailed along with the research paper.

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AWARD

The authors of best three papers from every Issue are awarded – First Prize, Second Prize and Third Prize on the SRCC Annual Day.
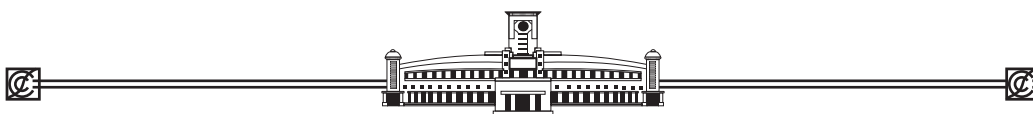
Principal's Message

The mission statement of the college signifying the existence and its road map to the achievement of its vision, reads as:

"To achieve and sustain excellence in teaching and research, enrich local, national and international communities through our research, improve skills of alumni, and to publish academic and educational resources"
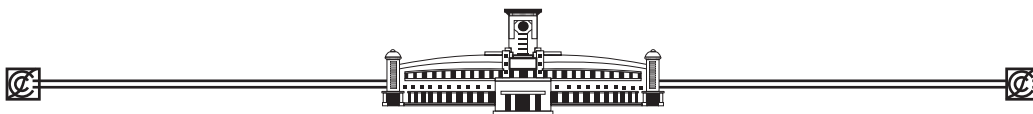
To achieve and promote excellence in publications and applied research, the college has taken the initiative to launch a new journal exclusively to publish students' research papers and articles. It will be an add-on to the enriched catalogue of college publications and academic literature.

The Journal has provided an opportunity to the students of our college to focus on research. Since the students were not opened to the research methodologies at the undergraduate level, they were mentored by experienced faculty of our college. Simultaneously, their articles were also reviewed by the referees and tested for plagiarism before publication. After reporting all the suggestions recommended by the referees, the articles were revised and then finally published. The college had successfully released the foundation issue of the Journal **"Strides - A Students' Journal of Shri Ram College of Commerce, Volume 1, Issue 1, 2016-17"** on the occasion of 91st Annual Day of the College held on 13th April, 2017. The Journal was released by **Shri Prakash Javadekar, Honb'le Union Minister of Human Resource Development, Government of India.**

I would like to congratulate the students whose papers are published in this issue of the journal and simultaneously encourage all the students to contribute their research papers and articles for the successive issues of the Journal.

Best wishes for their future endeavors.

Prof. Simrit Kaur
Principal

Editor's Message

Shri Ram College of Commerce is well known for its academic excellence and dedicated approach towards dissemination of knowledge in the academic world. The college appreciates the role of research in education and is committed to developing an inclination towards research in both faculty and students. In this pursuit, the college has taken the initiative to launch a new Journal named 'Strides - A Students' Journal of Shri Ram College of Commerce' to encourage students to pursue research under the guidance of the faculty of Shri Ram College of Commerce.

It is a bi-annual Journal launched exclusively to publish academic research papers and articles by the students on contemporary topics and issues in the area of commerce, economics, management, governance, policies etc.

In order to maintain the high standards of publication, COPE (Committee On Publication Ethics) has been constituted. The COPE shall be the apex authority to take all the decisions related to the publication of research papers and articles in Strides. The decision of COPE shall be final and binding.

To maintain the high academic standards, academic ethics and academic integrity, a rigorous process of double blind review of research papers is followed along with screening of plagiarism of each manuscript received by the COPE for publication. The research work published in Strides is original and not published or presented at any other public forum.

The foundation issue of the Journal **"Strides - A Students' Journal of Shri Ram College of Commerce, Volume 1, Issue 1, 2016-17"** was successfully released on 91st Annual Day of SRCC held on 13th April, 2017 by **Shri Prakash Javadekar, Honb'le Union Minister of Human Resource Development, Government of India.**

The successive Issues of 'Strides - A Students' Journal of Shri Ram College of Commerce' shall be bi-annually released.
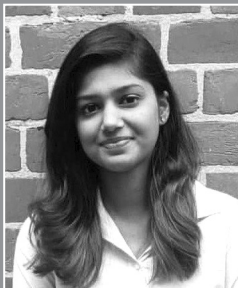
I congratulate all the students whose research papers are published in this Issue of Strides and express my sincere thanks to their mentors and referees.

Dr. Santosh Kumari
Editor

RESEARCH PAPERS

Environmental Kuznets Curve: An Analysis for India

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Abstract

This paper purports that the EKC for India is not an inverted "U" shaped curve based on the relationship between environmental degradation and per capita income. This is done with the help of key developmental variables (GDP, GDP per capita) and key environmental variables (CO2, CO2 per capita) using semi log equations for growth analysis and structural equations for EKC analysis for the time period 1990-2014. The findings of the paper reveal that there is strong evidence for the existence of an N-shaped EKC for India with the GDP term, its square and cube, all turning out to be significant with the expected signs.

Keywords: Environment, Economic development, Pollution, Environmental Kuznets Curve.

1. INTRODUCTION

Globalisation refers to the mixing of markets within the economy, that increases the interconnectedness of all the countries. Here people get closer and closer where there is a burgeon in exchange for goods and services and also in culture from different parts of the world. Creation of economic interdependence is one of the key factors for the betterment of many developed nations including India which is attained by globalisation. The main reason for the

rapid growth of India is because of its open economy where there is openness to foreign trade and investment. The concept of liberalisation was initiated in India in 1991 where the role of foreign investors increased and the restriction on private business decreased. Liberalisation of trade, reduction of tariffs, restriction and other barriers to free trade has a positive effect by ways of development, but is negative on the other hand by ways of reduction in the environmental quality and leads to degradation.

The introduction of economic reforms in India in 1991, uplifted the private sector as well as the public private partnership where all these initiatives were aiming for a rapid growth in industrialisation. The main impact of these initiatives has been directly seen through the amount of increase in air pollution. Compared to all other pollutants Suspended Particulate Matter (SPM) causes more respiratory and lung problems. In 1995 people died prematurely cause of SPM were around 52000 in 36 Indian cities and Delhi holds the record where there was a premature death every hour in 1997.

Globalisation led to an increase in economic development and increased the utilisation of natural resources to meet the demand of trade and production. It also led to an increase in the rate of extinction in flora and fauna by ways of deforestation, overfishing, dam construction etc. The positive result of globalisation and liberalisation in India can be seen through its foreign trade that has increased India's share in world trade and share of India's GDP where it was 0.53 percent and 6 percent respectively in 1990-91 and has increased to 1.96 percent and 23.39 percent respectively in 2014-2015. In spite of an increased GDP there is also an increase in CO_2 emission of India that was 619115 kilotons in 1990 raised to 22,38,377 kilotons in 2014 (WTO).

To understand the concept of increase in environmental degradation in order to an increase in economic development can be studied through ENVIRONMENTAL KUZNETS CURVE. The idea of EKC was first introduced by Grossman and Krueger. The EKC literature attempts to examine the aggregate impact of economic globalization and liberalisation and the environment.

The main objectives of the paper are:

1] To find trends in the growth of key developmental variables (GDP, GDP per capita)

2] To find trends in the growth of key environmental variables (CO2, CO2 per capita)

3] To test the validity of the EKC hypothesis for India

Accordingly, the primary hypotheses of this paper are:

1] There are no trends in the growth of key developmental variables (GDP, GDP per capita)

2] There are no trends in the growth of key environmental variables (CO2, CO2 per capita)

3] The EKC hypothesis does not hold true for India.

2. CONCEPTUAL FRAMEWORK:

The environmental Kuznets curve (EKC) is a hypothesized relationship between economic development and environmental quality. There are enormous factors or indicators to check the quality of environment. Environmental Kuznets Curve reveals how a specific measurement of environmental quality changes as the income of a nation increases. Environmental degradation goes up to a level where the development of the economy reaches a stage and after that stage the degradation reduces or the quality of the environment increases. In the early stage of economic development, the pressure on environment increases faster than income and decreases relative to GDP growth at higher income levels.

Inverted U shaped EKC: According to the EKC, first proposed by Grossman and Krueger (1991), the inverted u shaped relationship between environmental degradation and income level with the following three different channels :

1] scale effect

2] composition effect

3] technique effect

In the initial stage of economic development, there is a massive use of natural resources and an increase in the emission of pollutants that increase environmental degradation. This is known as **scale effect.** As income increases, the polluting activities decreases and there is a structural change that influences the environment with economic development. This is known as **composition effect.** As the economy attains a good stage on development, it starts to invest more in its R&D and technological process to bring in new ideas replacing the pollution causing technology. This is known as **technique effect.** Therefore, EKC plays a negative scale effect in the early stages and then a positive structural and

technical effect after attaining a certain stage.
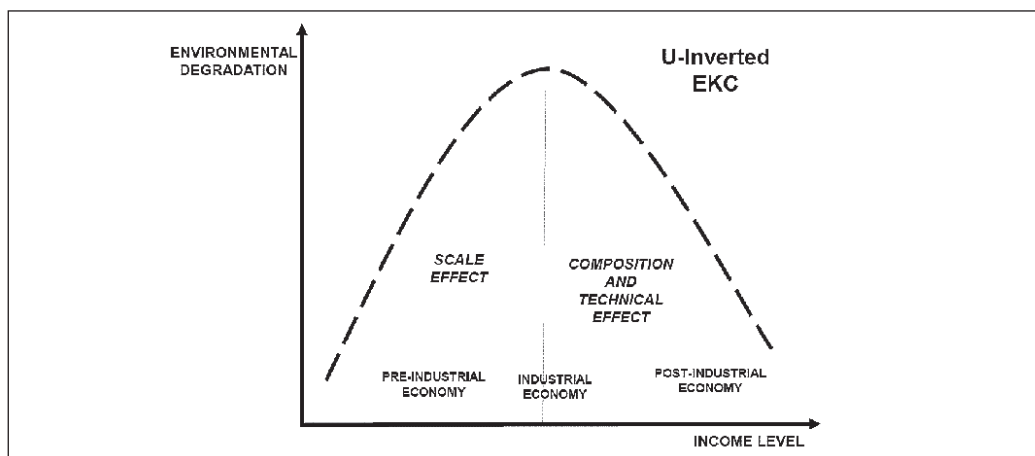
The idea of inverted U-shaped curve for environmental degradation and per capita income was given by Grossman and Krueger in 1991. This idea gained support from the Development Report of World Bank 1992 and Discussion Paper of ILO 1993. Many researchers have also supported the idea of inverted U-shaped curve in their studies like Culas (2012) who investigated the curve for 23 African countries using Fixed Effect Model (FEM) and also by using Random Effect Model (REM)he investigates the same for 9 Latin American countries. The inverted U shaped relationship has also been proved in the works of Leitão (2010) who used the methodology of FEM for 94 differently developing level countries.

A standard explanation was by Dasgupta et al. (2002) regarding the inverted U-shaped curve: In the initial level of industrialisation, people focus more on the development of the economy than on the environmental quality whey they fail to minimise the pollution rate. After attaining a certain stage of development, the leading industrial sectors starts becoming cleaner where the people concern moves to improving the environment that leads to effective run of regulatory institutions. The conventional EKC has purported an inverted-U shaped curve based on a quadratic function and not the cubic function of income and a measure of environmental degradation.

N shaped EKC: The recent literature on EKC has challenged the validity of such an EKC in the long run. Recent work on EKC purports the same as an N-shaped curve explained in three phases:

- **First phase:** This phase is characterised by poorer countries representing the upturn in the EKC as these countries can't afford cleaner technologies.

- **Second Phase:** This phase is characterised by middle income countries, wherein investments in cleaner technologies bring about delinking of economic development and environmental degradation

- **Third Phase:** This phase is characterised by a relatively higher level of income representing relinking of economic development and environmental degradation as the benefit from cleaner technologies is out rate by pollution caused due to consumption patterns.

This reveals that after a certain stage of development, there is again a positive relationship (N shaped curve) between environmental degradation and economic development. Torras and Boyce (1998) revealed that the occurrence of N-shaped curve is possible when the scale effects overcome the composition effect and technical effects. The idea of N-shaped curve was found in the1990s where many researchers thought it was a new phenomenon. The following are the studies that prove the occurrence of N-shaped curve. Grossman and Krueger (1995) and Panayotou (1997) used economic development and sulphur dioxide (SO2) for EKC and found a N- shaped relationship. The main problem in the above cases were the existence of few observation after the second turning point. This was because of the extreme end of the data set which led to dismissing of the N-shaped curve. Lee et al. (2009) proved that the occurrence of inverted U shaped curve is because of the quadratic model being used and when cubic model is adopted, the result will be a N shaped curve. Moomaw and Unruh (1997) adopted the methodology of FEM and cross-sectional OLS,in their studies proving the occurrence of an N-shaped EKC. Methods like pooled OLS and generalized least squares are also used for examining where N-shaped EKC for Austria and for 15 Latin American countries respectively.
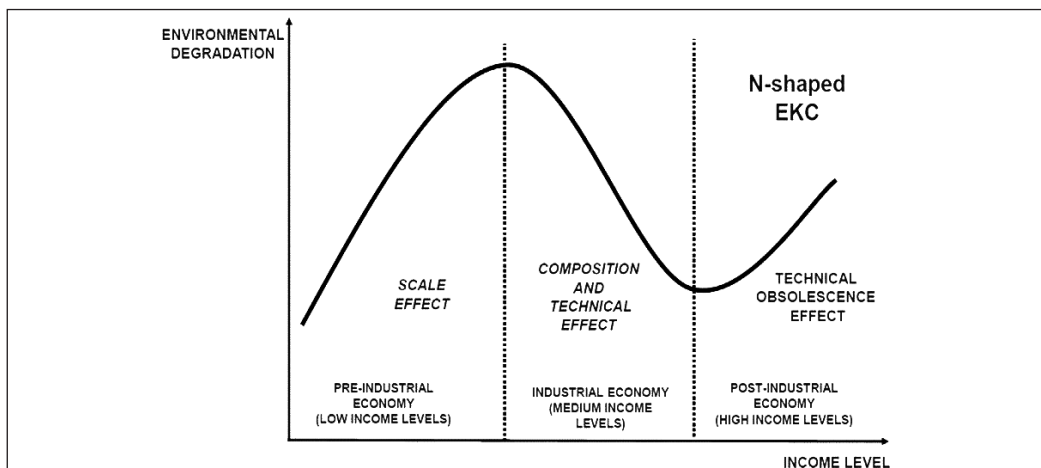
3. LITERATURE REVIEW:

Shanbaz and Sinha (2019) attempted to investigate the Environmental Kuznets Curve (EKC) using CO2 emission for the time period 1991-2017. The end result of the above study shall be categorized into the following methods: time series data and panel data. It is found that the above case has different shapes of curve, whereas few papers and researchers say that no proof has been authenticated for EKC. The findings of the above EKC estimation with the help of CO2 is indecisive and the root cause of this depends upon the choosing of method, interval of time, selection of contexts etc.

Qayyum Khan et al. (2018) has attempted to investigate the result of financial growth, the disparity in income, utilization of energy and per capita GDP on carbon dioxide and EKC for three emergent nations- Bangladesh, India and Pakistan for the time period 1980-2014.The methodology adopted for examining the relationship were Technology model with Fully Modified Ordinary Least Squares (FMOLS), Regression on Population, Affluence. The findings reveal that the study has a positive relationship with CO2 emission only with India whereas there is an inverse relationship for Pakistan and Bangladesh. Added to it, income disparity in Bangladesh gave a rise to CO2 emission and is inverse in the case of India and Pakistan.

Mohapatra and Giri (2009) attempted to investigate the discharge of Sulphur dioxide, Nitrogen dioxide and Suspended Particulate Matter (SPM) in India using EKC to find out the relationship between economic growth and the above parameters for the time period 1991-2013. Time series data and cross section are the methodologies adopted. This method has been applied to 15 states particularly in the industrial and residential location. The end result of the paper reveals that there is only directional inverted U-shaped curve applicable for both the locations without being significant. And when we take developmental indicators into consideration the end results are being significant with the sign expected.

Wu et al. (2015) attempted to investigate the relationship between $C0_2$ emission and per capita income during the years 1990-2005. Innovated model of quantile regression was the methodology adopted and was applied to 104 nations worldwide. The findings reveal a positive relationship for upper-middle, low-middle- and low-income nations in every quantile.

Sinha and Shahbaz (2017) attempted to investigate the current inexhaustible energy generation in India where it had made an endeavour to evaluate EKC

using carbon dioxide in India for the time period 1972-2015. Unit root test with multiple structural breaks and autoregressive distributed lag (ARDL) approach to long run are the methodology adopted. The findings of the paper revels an inverted U-shaped curve for India. No positive impact has been seen on CO_2 but for overall energy utilisation, the long run elasticity is higher than the short run.

Pal and Mithra (2017) attempted to examine the long run relationship among CO_2, utilization of energy and investigates the EKC hypothesis for the time period 1971-2012. The study has used the methodology of the autoregressive distributed lag model of Pesaran et al. (2001. The findings of the paper reveal that there is existence of N shaped EKC.

4. DATA AND METHODOLOGY

4.1 DATA:

World development indicator (WORLD BANK) is the main source for all the data collected. Aggregate C02 emission (kt)and CO2 emission per capita (metric tons) are the dependent variables and GDP (current US$) and GDP per capita (current US$) are the independent variables taken for the time period 1990-2014.

4.2 METHODOLOGY:

Methodology can be divided into two parts namely:

1] **Growth Analysis -** This shows the trend in growth of dependent and independent variable through semi log equations.

2] **EKC Analysis –** Our main interest is in the theory of EKC which we examine in two forms through structural equations with GDP as the explanatory variable in aggregate and per capita terms. The methodology for EKC analysis has been based on Gambhir (2017).

STEP-1 Growth Analysis:

We study trends in growth of 4 variables namely, aggregate CO2 emission (kt), CO_2 emission per capita (metric tons), GDP(US$), GDP per capita (US$) through a set of semi log equations. Visually we observe the trends in variables through graphs. In the absence of structural equation, we have estimated growth in macroeconomic variable through a semi log equation where we use year as an all catch variable. It is usually interpreted as the exogenous effect on the dependent variable.

General form $Y_t = e^{\alpha + \beta t}$

Log linearizing and adding the error term,

$LnY_t = \alpha + \beta_t + e_t$

Property of a semi log equation,

$LnY_t = \alpha + \beta_t$

$LnY_{t-1} = \alpha + \beta (t-1)$

$LnY_t - LnY_{t-1} = \beta [t - (t-1)]$

$Ln (Y_t/Y_t - 1) = \beta$

So, β = annual growth rate.

Estimating growth equation:

1) $LnCO_{2t} = \alpha 1 + \beta_{1t} + e_{t1}$ (1)

    α_1 = intercept

    β_1 = slope/growth rate

    ACGR = [AL (β_1)– 1] *100

2) $LnCO_{2t} = \alpha_2 + \beta_{2t} + e_{t2}$ (2)

    $\alpha 2$ = intercept

    $\beta 2$ = slope/growth rate

    ACGR = [AL (β_2)– 1]*100

3) $LnGDP_t = \alpha_3 + \beta_{3t} + e_{t3}$ (3)

    $\alpha 3$ = intercept

    $\beta 3$ = slope/growth rate

    ACGR = [AL (β_3)– 1]*100

4) $LnGDPC_t = \alpha_4 + \beta_4 t + e_{t4}$ (4)

    α_4 = intercept

    β_4 = slope/growth rate

    ACGR = [AL (β_4)– 1]*100

STEP-2 EKC ANALYSIS:

With aggregate CO_2 emission as dependent variable, we study the two forms of EKC through the following estimating equations:

$$1)\ CO_{2t} = \alpha_5 + \beta_5 GDP_t + \beta_6 GDP2_t + et_5 \tag{5}$$

$$2)\ CO_{2t} = \alpha_6 + \beta_7 GDP_t + \beta_8 GDP2_t + \beta_9 GDP3_t + et_6 \tag{6}$$

With per capita CO_2 as dependent variable, we study the two forms of EKC through the following estimating equations:

$$1)\ CO2PC_t = \alpha_7 + \beta_{10} GDPC_t + \beta_{11} GDPC2_t + et_7 \tag{7}$$

$$2)\ CO2PC_t = \alpha_8 + \beta_{12} GDPC_t + \beta_{13} GDPC2_t + \beta_{14} GDPC3_t + et_8 \tag{8}$$

5. ANALYSIS AND RESULTS:

1] GROWTH ANALYSIS:

- Aggregate co2 emissions

Table-1: Summary output for aggregate CO2 emission (kt)

	Coefficients	Standard error	t Stat	P-Value
Intercept	-89.55067917	2.757622556	-32.473871	1.02E-20
Year	0.051694769	0.001377425	37.53000904	3.87E-22

Here, the R square value is 0.983932955, which suggests that our regression line fits the data very well.

Estimated equation:

$$LnCO_2 = -89.55067917 + 0.51_t + et_1 \tag{9}$$

Emission starts at a low level (-89.55) and has grown at a rate of 0.051 at the time period between 1990-2014. Here, both the values are significant so this shows that there was a definite trend of aggregate CO2 emissions growing at a rate of 5.16% per annum over the period 1991-2014.

Figure-1: Trends in aggregate C02 emission (kilotons)
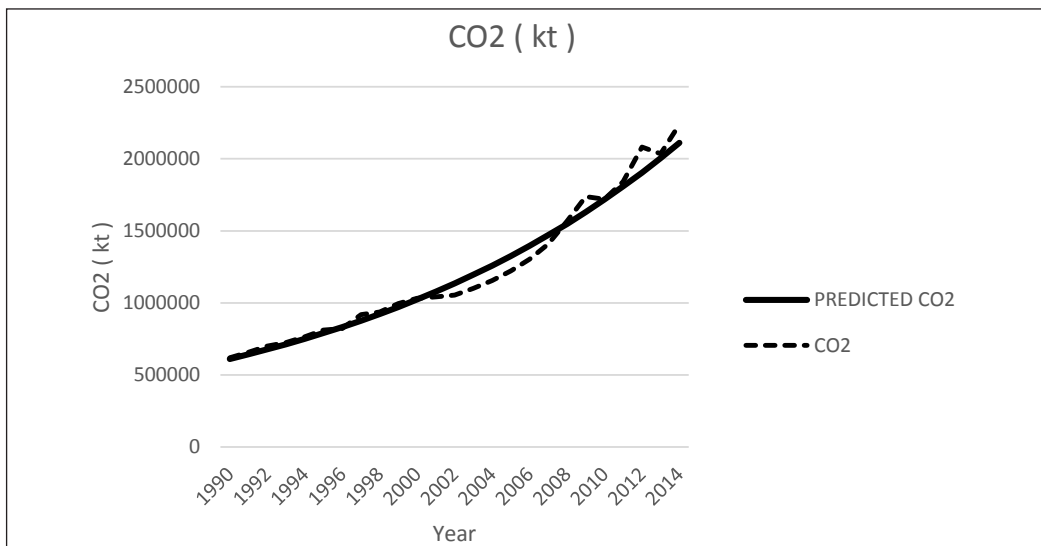
- Per capita CO2 emissions

Table-2: Summary output for CO2 emission per capita (in metric tons)

	Coefficients	Standard error	T Stat	P – value
Intercept	-69.18344641	3.051645525	-22.67086588	3.09422E-17
Year	0.034581605	0.001524289	22.68704591	3.04591E-17

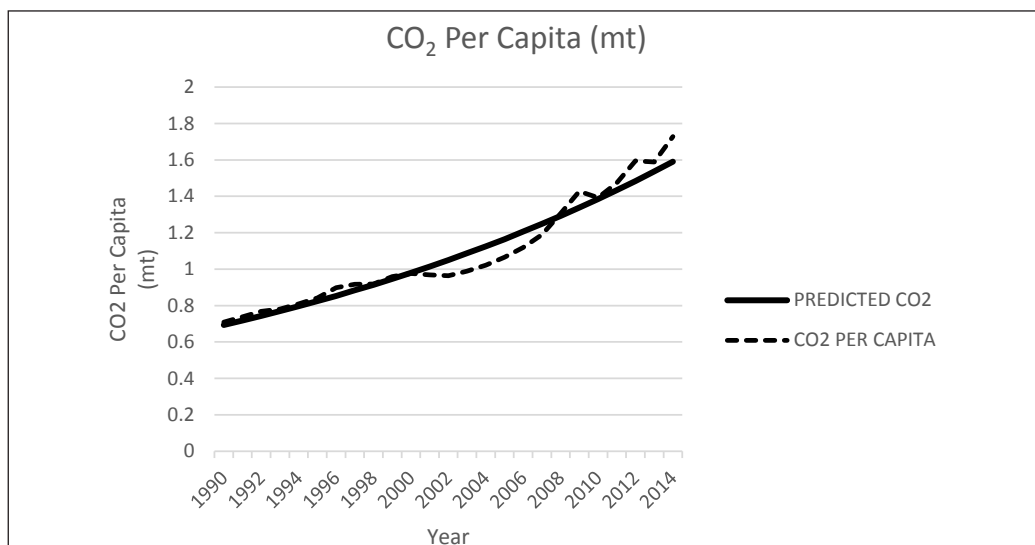Here R square value is 0.957225382 which suggests that our regression line fits the data very well.

Estimated equation:

$$LnCO2PC_t = -69.18344641 + 0.034_t + et_2 \hspace{3cm} (10)$$

The emissions start at low level (-69.18) but are found to be growing at a rate of 3.45% per annum over the time period 1990-2014. Per capita emission indicates a behavioural trend which shows that while population is growing, the per capita emissions are growing at a slower rate.

Figure-2: Trends in Per capita CO2 (metric tons)

- Summary output for GDP

Table-3: Summary output for aggregate GDP (US BILLION $)

	Coefficients	Standard error	t Stat	P – value
Intercept	-175.7570574	7.936611407	-22.14510052	5.18887E-17
Year	0.091046977	0.003964316	22.96663156	2.32455E-17

Here, the R square value is 0.958217232, which suggests that our regression line fits the data very well.

Estimated equation:

$$\text{LnGDP} = -175.7570574 + 0.091046977_t + et_3 \qquad (11)$$

GDP starts at low level (-175.75) and has grown at a rate of 9.1% for the time period between 1990-2014. Here, both the values are significant. This shows that in the beginning India was yet to embark on a growth trajectory but over the 25-year period, GDP grows at a rate of 9.1 per cent per annum.

Figure-3: Trends in GDP (US BILLION $)
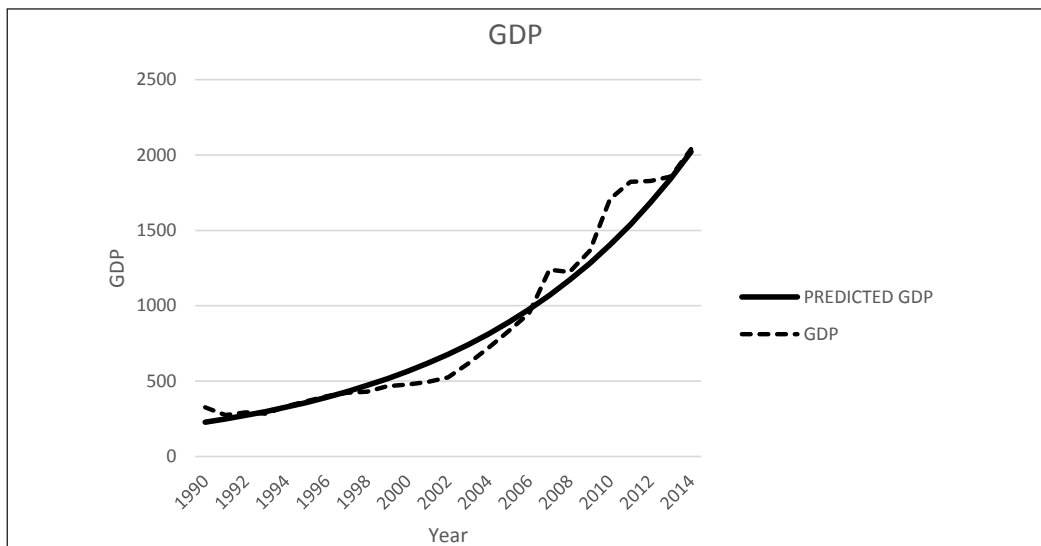
• Summary output for GDP per capita

Table-4: Summary output for GDP per capita (in US $)

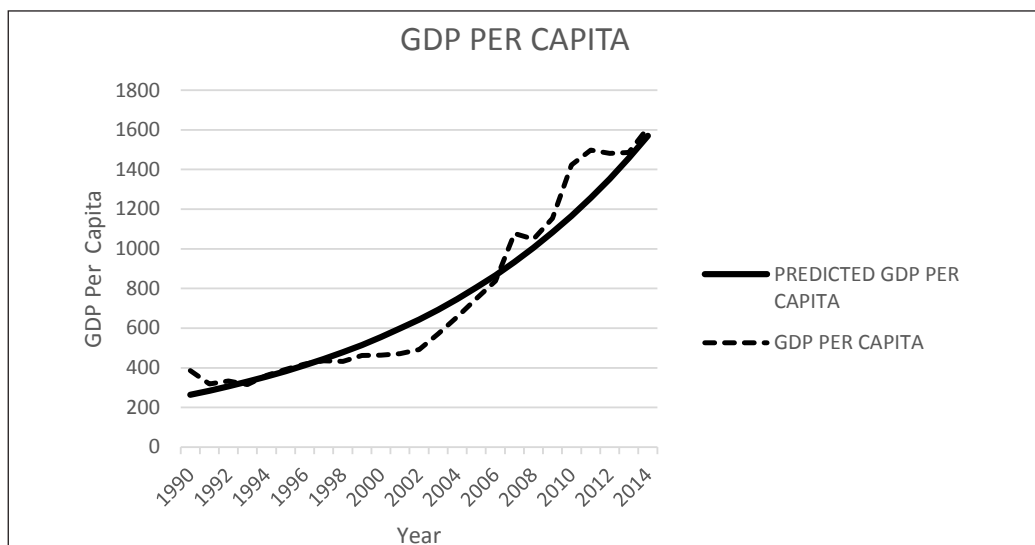|	Coefficients	Standard error	t Stat	P – value
Intercept	-142.2626711	8.31769173	-17.1036239	1.41996E-14
Year	0.07429068	0.004154664	17.88127182	5.46986E-15

Here the value of R square is 0.932893716, which suggests that our regression line fits the data very well.

Estimated equation:

$$LnGDPC_t = -142.2626711 + 8.31769173_t + et_4 \qquad (12)$$

The per capita GDP starts at a low level (-142.26) but grows at a rate of 7.4% per annum over the period 1990-2014. The impact of behavioural tendencies can be inferred from the dip in the growth rate of per capita GDP in comparison to the growth rate of GDP in aggregate terms. This again implies that while population is growing, per capita GDP is growing at a slower rate.

Figure-4: Trends in GDP per capita (US $)

2] EKC ANALYSIS:

With aggregate CO_2 emissions as the dependent variable, we study 2 forms of EKC

- Inverted-U shaped EKC:

Table-5: Summary output for inverted U shaped EKC

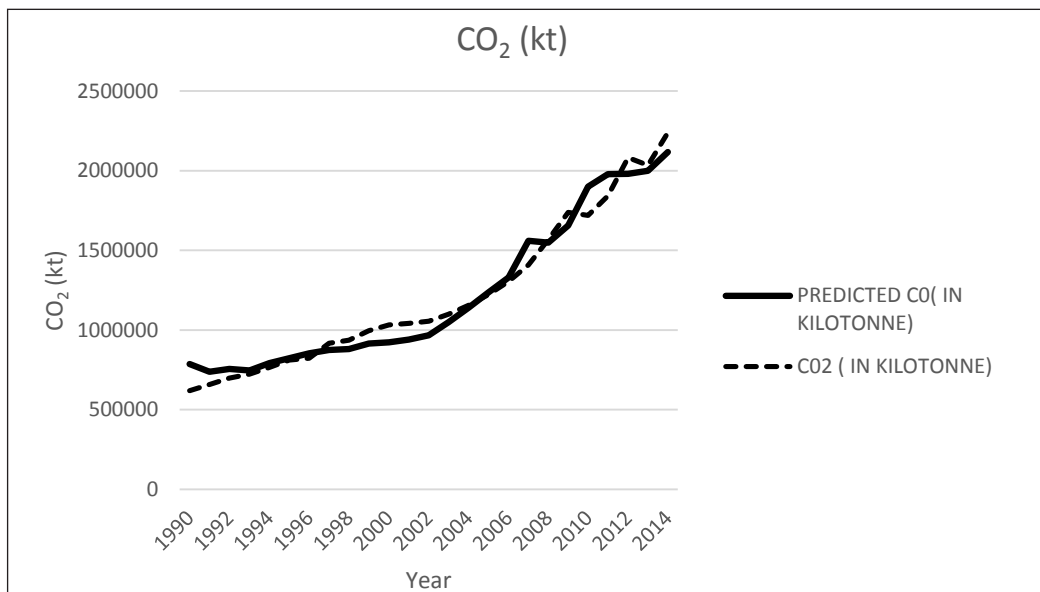|	Coefficients	Standard error	t stat	P – value
Intercept	473695.9	71146.0356	6.65807864	1.07783E-06
GDP (IN US BILLION $)	986.051635	177.2473173	5.563139968	1.36323E-05
GDPsq (IN US BILLION $)	-0.088381609	0.080192179	-1.102122544	0.282319953

Here the value of R square is 0.96545095, which suggests that our regression line fits the data very well.

ESTIMATED EQUATION:

$$CO2_t = 473695.9 + 986.051635 GDP_t - 0.0883816092_t + et_5 \qquad (13)$$

This equation is meant to verify an inverted U shaped EKC which is the conventional form of EKC. the initial level of CO2 emissions is 473695 kilotons. The coefficient of GDP (986.05) is positive and highly significant. The coefficient of the square term of GDP is negative but not significant. This renders weak evidence on the quadratic term though the sign is as expected. Since the GDP terms bear the expected signs, it is indicative of an inverted u-shaped curve.

Figure-5: Inverted U shaped EKC using CO2 (kilotons)

- N-shaped EKC

Table-6: Summary output for N shaped EKC

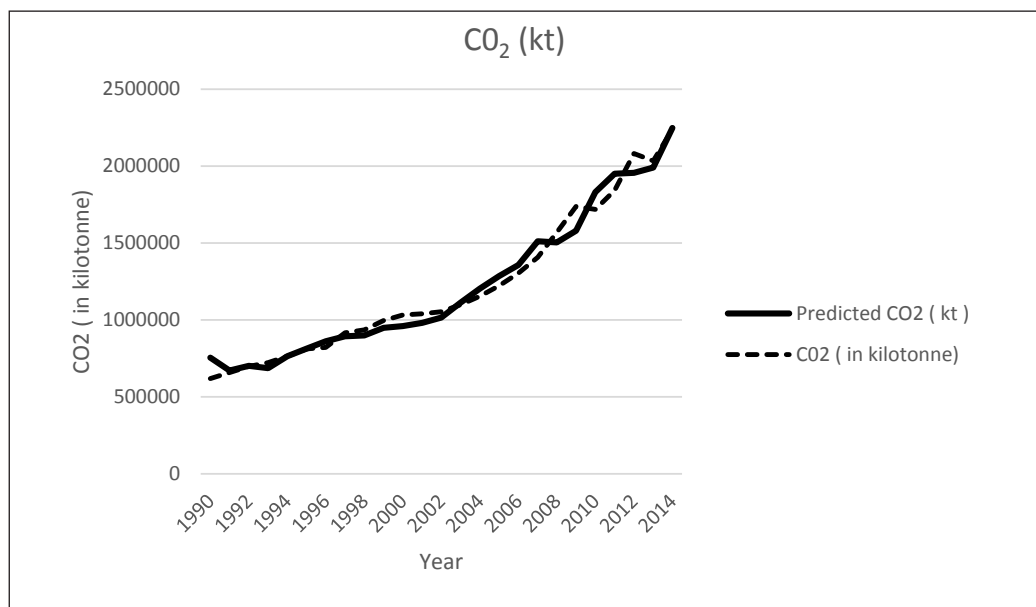|	Coefficients	Standard error	t Stat	P – value
Intercept	102179.008	127927.1302	0.798728212	0.433389047
GDP (US BILLION $)	2504.432019	486.3376695	5.149574413	4.21378E-05
GDPsq (US BILLION $)	-1.708890815	0.499062568	-3.424201546	0.002548959
GDP cube (US BILLION $)	0.000488863	0.0001492	3.276562137	0.003601491

Here the value of R square is 0.977138478, which suggests that our regression line fits the data very well.

ESTIMATED EQUATION:

$$CO2_t = 102179.008 + 2504.432019GDP_t - 1.708890815GDP2_t + 0.000488863GDP3_t \quad (14)$$

The intercept term is smaller (102179.008) which indicates that the second form of EKC is accounting for more explained variation which implies that this form is more viable than the previous form. Perhaps the effect of the cubic term of GDP was getting combined with the intercept of the previous form. The co-efficient of GDP is large, positive and significant. However co-efficient of the quadratic term is relatively small but significant with the expected sign. For the cubic term, the co-efficient is very small but positive and significant. This implies that the co-efficient of all terms of GDP turns out to be significant and with the expected signs. This renders evidence for the validity of an "N" shaped EKC for India.

Figure-6: N shaped EKC using CO2 (kilotons)

With per capita C02 emissions as the dependent variable, we study the 2 forms of EKC:

- Inverted U shaped EKC:

Table-7: Summary output for inverted U shaped EKC

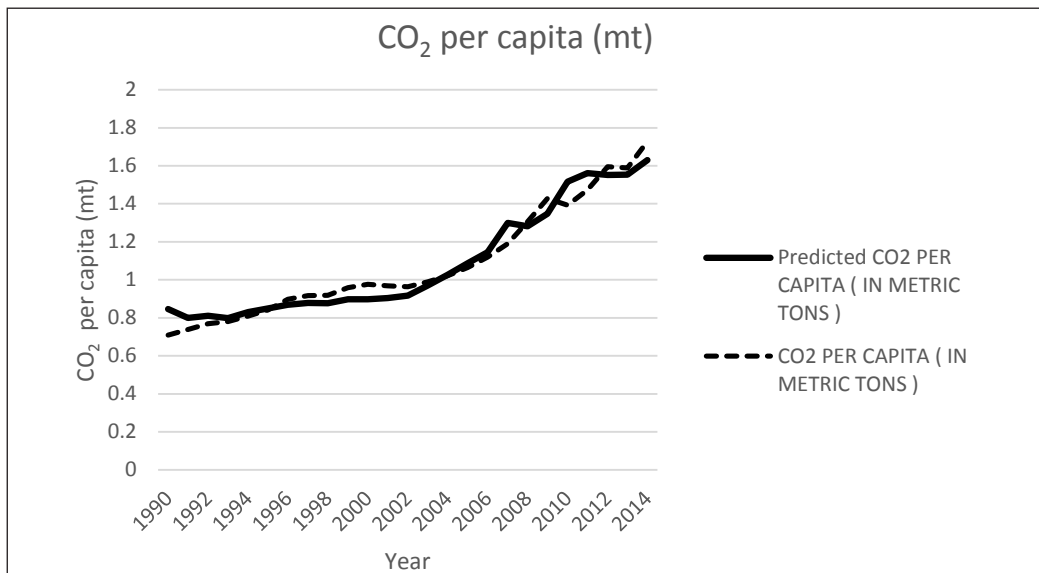|	Coefficients	Standard error	t Stat	P – value
Intercept	0.580967625	0.073447036	7.910021393	7.11896E-08
GDP Per Capita (in US $)	0.000698297	0.00020194	3.457938521	0.00223877
GDP Per Capita sq. (Metric Tons)	-2.91361E-08	1.08007E-07	-0.269761449	0.789857965

Here the value of R square is 0.95163215, which suggests that our regression line fits the data very well.

ESTIMATED EQUATION:

$$CO2PC_t = 0.580967625 + 0.000698297GDP_t -2.91361E-08GDP2_t + et, \qquad (15)$$

the intercept is 0.581(metric tons) which is statistically significant. This indicates the initial level of per capita emissions. The per capita GDP term (0.00069) is positive and significant, however the square of per capita GDP is negative but not statistically significant. This implies that the findings based on aggregate CO2 emissions have been re-iterated by the findings for per capita CO2 emissions.

Figure-7: Inverted U shaped EKC using CO2 per capita (metric tons)

- • N shaped EKC:

**Table-8:** Summary output for N shaped EKC

	Coefficients	Standard error	t Stat	P – value
Intercept	0.191664492	0.177490677	1.079856672	0.292452717
GDP per capita (in US $)	0.00236434	0.000727314	3.250781148	0.003824436
GDP per capita square (in US $)	-2.05052E-06	8.5948E-07	-2.385769812	0.026539479
GDP per capita cube (in US $)	7.22392E-10	3.05144E-10	2.367378352	0.027595059

Here the value of R square is 0.961821286, which suggests that our regression line fits the data very well.

Estimated equation:

$$CO2PC_t = 0.191664492 + 0.00236434GDPC_t - 2.05052E\text{-}06GDPC2_t + 7.22392E\text{-}10GDPC3_t \quad (16)$$

Through the equation constructed for per capita emissions, we infer the same phenomena of the cubic term being merged in the intercept in the equation representing the conventional EKC. The coefficient of GDP is 0.0023 which is positive and significant. The coefficient of the square of GDP is negative and significant. And the coefficient of the cubic term of GDP is positive and significant. This renders evidence for an N shaped EKC in per capita terms, however this evidence is weaker in comparison to the evidence generated for the N shaped EKC based on aggregate CO_2 emissions.

Figure-8: N shaped EKC using CO2 (metric tons)
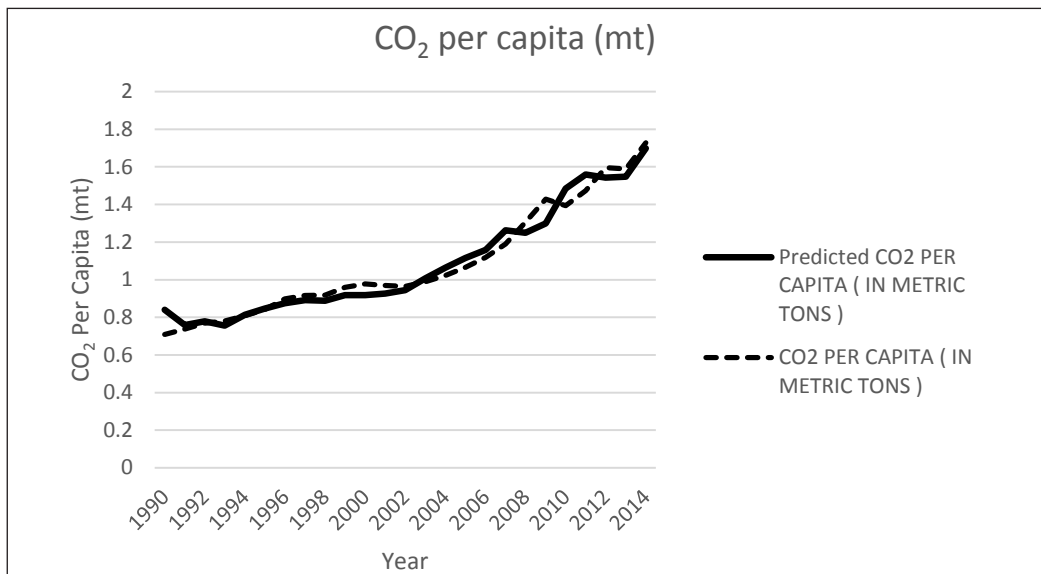
6.CONCLUSION:

EKC occupies a central position in any discussion on environmental degradation and development. While development and environment have always been understood as a conflicting phenomenon, EKC offers the possibility of reconciling the two by purporting that at higher levels of development, the environmental pollution shall invariably come down owing to investments in greener technologies. However, the modern literature has challenged this conventional notion of an inverted U-shaped EKC by suggesting that the downturn expected in the inverted-U shaped pattern shall be succeeded by an upturn at relatively higher levels of income. Hence, in the long run what economies would experience would be an N-shaped EKC. Against this backdrop, we attempted to investigate the form of EKC hypothesis valid for India over the time period 1990-2014. With CO2 emissions as the dependent variable and GDP as the independent variable, we tested EKC in two forms: inverted-U shaped EKC and N-shaped EKC. The same has been examined with these variables in per capita terms.

We found strong evidence for the existence of an N-shaped EKC with the GDP term, its square and cube, all turning out to be significant with the expected signs. These findings were reiterated in the per capita terms as well.

This implies that the conventional notion of EKC stands defeated, and merely investment in greener technologies cannot make a country sustain its lower

levels of pollution over time rather it is the consumption patterns that act as the key determinant in sustaining or bringing down the pollution levels. Since, EKC appears for India in an N-shaped form, it implies that at a higher level of income, the benefit from investment in cleaner technologies shall be outweighed by the environmental degradation caused due to consumption patterns in the long run.

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HISTORY OF THE JOURNAL

The idea to launch this Journal was discussed in December 2016 by the former Officiating Principal, **Dr. R. P. Rustagi** with **Dr. Santosh Kumari,** the Editor of the Journal. Since the idea appealed to **Dr. Santosh Kumari**, she took the initiative to contribute to SRCC by creating this new academic research Journal and took the responsibility for its Creation, Registration, License and ISSN (International Standard Serial Number) etc. along with *Editorship*. Therefore, **Dr. Santosh Kumari, Assistant Professor in the Department of Commerce, Shri Ram College of Commerce** was appointed as the Editor of the Journal vide. Office Order – SRCC/AD-158/2017 dated March 14, 2017. She meticulously worked hard in creating the concept and developing the structure of the Journal. She introduced the concept of COPE (Committee On Publication Ethics) to maintain the high academic standards of publication.

On behalf of SRCC, **Dr. Santosh Kumari** made every effort in seeking License from Deputy Commissioner of Police (Licensing), Delhi to register the Journal at "The Registrar of Newspapers for India, Ministry of Information and Broadcasting, Government of India". The paper work for seeking license started under the former Officiating Principal, **Dr. R.P. Rustagi** on March 27, 2017. The foundation Issue of the Journal "**Strides – A Students' Journal of Shri Ram College of Commerce, Volume 1, Issue 1, 2016-17**" was successfully released on the 91st Annual Day of SRCC held on April 13, 2017 by **Shri Prakash Javadekar, Honb'le Union Minister of Human Resource Development, Government of India**. The title of the Journal got verified and approved by the Registrar of Newspapers for India, Ministry of Information and Broadcasting, Government of India on April 21, 2017. On September 1, 2017, **Prof. Simrit Kaur** joined SRCC as Principal and signed each and every legal document required for further processing and supported **Dr. Santosh Kumari**.

On December 18, 2017, the College got the license "**License No. - DCP / LIC No. F. 2 (S / 37) Press / 2017"** to publish 'Strides – A Students' Journal of Shri Ram College of Commerce'. Due to change of Printing Press, the License got updated on March 09, 2018. On April 26, 2018, the SRCC Staff Council unanimously appointed **Dr. Santosh Kumari as the 'Editor of Strides'** for the next two academic years.

On April 27, 2018 (The Foundation Day of the College), **Dr. Santosh Kumari** submitted the application for the registration of the Journal. On May 04, 2018, the SRCC received the '**Certificate of Registration**' for **"Strides – A Students' Journal of Shri Ram College of Commerce"** and got the **Registration No. DELENG/2018/75093** dated May 04, 2018. *On behalf of Shri Ram College of Commerce, it was a moment of pride for Dr. Santosh Kumari to receive the 'Certificate of Registration' on May 04, 2018 at the Office of Registrar of Newspapers for India, Ministry of Information and Broadcasting, Government of India (website - www.rni.nic.in).*

On May 07, 2018, **Dr. Santosh Kumari** submitted the application for seeking ISSN (International Standard Serial Number) at "ISSN National Centre – India, National Science Library, NISCAIR (National Institute of Science Communication and Information Resources). Weblink - http://nsl.niscair.res.in/ISSNPROCESS/issn.jsp". Finally, the College received the International Standard Serial Number "**ISSN 2581-4931 (Print)**" **on June 01, 2018.**

We are proud that this journal is an add-on to the enriched catalogue of SRCC's publications and academic literature.

RELEASE OF FOUNDATION ISSUE OF STRIDES

Foundation Issue of the Journal *"Strides - A Students' Journal of Shri Ram College of Commerce, Volume 1, Issue 1, 2016-17"* was successfully released on the 91st Annual Day held on April 13, 2017 by Shri Prakash Javadekar, Honb'le Union
Minister of Human Resource Development, Government of India.

SHRI RAM COLLEGE OF COMMERCE