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Examining the Relationship between Diffrent Modes of Infrastructure Financing and Economic Growth in India

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Abstract: *With an aim to achieve a status of 5 trillion economy, India has to fulfil the criteria of achieving minimum 9%+ growth rate consistently for next five years. But at present, the economic indicators of India reflect a dismal picture to achieve that goal. The economic growth rate of India has gone down to almost five percent in first quarter of financial year 2019-20. Since the opening up of the Indian economy in 1991,* ***the role of private sector in reviving the country's growth cannot be overstated. Expanding investment in infrastructure is often projected as a weapon which can play a counter cyclical role in the phase of such economic crisis. In an attempt to analyse the impact different modes of investment in infrastructure on economic growth of India, this paper examines the trend of investments by private as well as both public and private (joint) since 1990s. Further, a time series econometric analysis is carried out for a period of twenty-eight years (1990-2018) wherein the nexus between investments (primarily in transportation and energy sector) and economic growth of India (GDP per capita) is examined. To examine the dynamic relationship between the variables, their causality, exogeneity and comparability, the Vector auto regression (VAR) model, along with the Forecast Error Variance Decomposition (FEVD) and Vector Error Correction Model (VECM) is used. The results of VAR and VECM suggests that there is significant impact of investment in infrastructure upon economic growth of India.***

Keywords: Infrastructure, Public Private Partnership, Vector Auto regression, Investment, Economic growth.

INTRODUCTION

Infrastructure could be said as the superstructure of a nation's overall development. It represents a broad spectrum of activities and services without which no activity can be undertaken in the economy Inadequate infrastructure financing in India has posed a great challenge in the last few years. It is often argued by the intellectuals that not only the infrastructure projects have been delayed but also the growth rate of gross fixed capital formation has been disappointing over the past few years. In the Budget speech back in 2015-16, the Union Finance Minister himself had emphasized the need for increasing public investment in infrastructure, to induce private investment for providing public goods.

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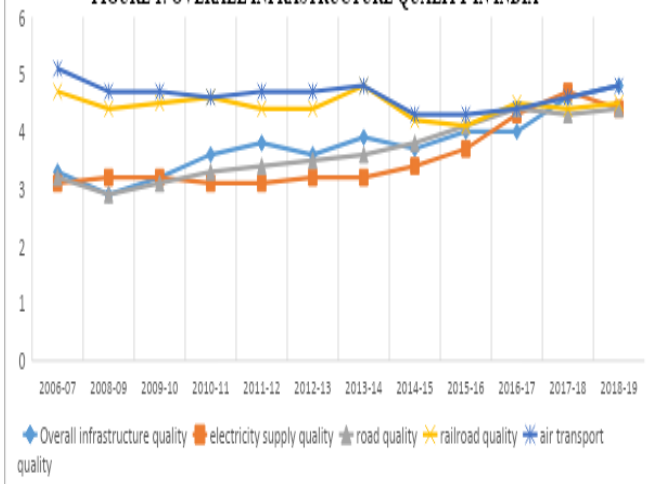
A. Infrastructure and Economic Development: The linkage

The relationship between infrastructure development and output growth can be traced from the following factors: Firstly, different means of infrastructure such as road, power, water, transport etc. are also used as inputs for further productive activities in an economy. Therefore inadequate infrastructure may lead to sub-optimal utilization of productive resources of an economy. For instance-

improvement in road infrastructure not only enlarges market size of an economy but also it reduces cost of carrying over different economic activities. Similarly, the increase in economic growth also leads to further improvement in the existing stock of infrastructure of an economy. Secondly, a backward linkage between economic growth and infrastructures also exists. This is mainly because- growth makes demand on infrastructure- with the increase in income levels, the composition of infrastructure changes. Many studies have observed a causal relation between infrastructure development and economic growth. Even some studies indicated that around 6.5 percent of the total value added is contributed by the infrastructural services. Thus given the above type of linkage as established theoretically and empirically by the existing studies, infrastructural financing and development is important not only for economic growth but also for poverty and inequality reduction.

FIGURE 1: OVERALL INFRASTRUCTURE QUALITY IN INDIA



Source: Collected from Global Competitiveness Reports, various issues, World Economic Forum (WEF).

B. Objectives

1. To study the overall status of infrastructure and to analyse the trend of various modes of investment in Infrastructure in India.

2. To examine the dynamic relationship, causality and exogeneity between Investment in transport and energy sector (under both private and PPP mode) and GDP growth of India.

C. Data Sources and Methodology

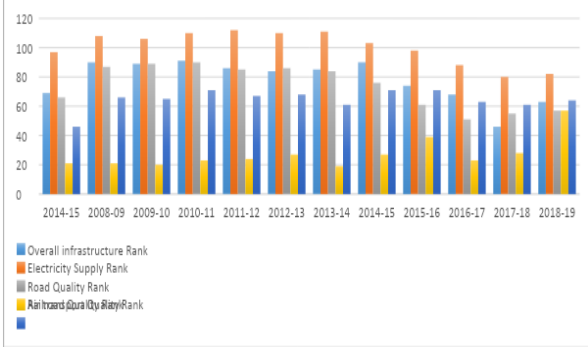
The data used in this study is secondary in nature ranging for a time period of 28 years i.e. from 1960 to 2018. The sources of collecting data are Department of Economic Affairs, Government of India, Public Private Partnership Database, Government of India, Ministry of Statistics and Programme Implementation (MOSPI), World Bank Database, RBI Statistical Handbooks, and various government WEF reports.For examining the research objectives, the study employs both descriptive statistics and econometric estimation techniques. To deal with the first objective we have used statistical tools like graphs, tables, charts, scatter plots and regression lines etc. For the second objective, the variables used are investments in transportation sector and energy sector by private sector alone and also both public and private sector. To represent economic growth, GDP per capita all in current US$ is used. We used the Vector auto regression (VAR) model, Forecast Error Variance Decomposition (FEVD) and Vector Error Correction Model (VECM) to examine the dynamic relationship between the variables, their causality and exogeneity.

II. INDIA'S INFRASTRUCTURE SECTOR: AN OVERVIEW

The World Economic Forum's "The Global Competitiveness Report" provides qualitative measure of infrastructure quality which is based on the Executive Opinion Survey. The survey is a tool for capturing vital information at a global level and is qualitative portrait of each country's economic and business environment. The survey includes the key infrastructure sectors of India viz. Electricity Supply, Road Quality, Railroad Quality, and Air transport Quality.Based on this qualitative survey, India's rating in overall infrastructure quality for a period of fourteen years i.e. from 2006-07 to 2014-15 is presented in Table 1. India's score on infrastructure quality ranged between 3.3 and 3.9 out of 7, and its ranking ranged from 70 to 90 out of 144 countries covered in the survey

In 2014-15, India's score was 3.7 and it ranked 90 out of 144 in overall infrastructure quality. India's ranking has been comparatively declining among the other countries of the world. Even in India Competitiveness Report, 2009, it was stated that the inadequate supply of infrastructure is a major factor that inhibits the investors in expanding their business in India.Based on WEF surveys, the quality of roads infrastructure in India presents a disappointing picture. India ranks around 80th in quality of road infrastructure which is far behind some of its neighbouring countries - China (49th), Sri Lanka (32nd), Bhutan (56th), and Pakistan (75th). Importance of roads for development is immense but roads in India are in poor condition and half of the roads in India are unpaved.

FIGURE 2: OVERALL INFRASTRUCTURE RANK IN INDIA: GLOBAL LEVEL



Source *Collected from Global Competitiveness Reports, various issues, World Economic Forum (WEF). Score is based on Executive Opinion survey question where 1 = extremely underdeveloped infrastructure; 7 = extensive and efficient. Rank figures are based on World Ranking for India.*

Railways- the other major mode of transport in India is one of the largest in the world. In terms of quality of railroad network India managed to rank around 20th over the past few years. However, it has started to lose its score and rank from 2009 onwards indicating towards the fact that Indian railways, being the primary mode for carrying passengers and freight is under severe capacity constraints and this is having a serious impact on its quality.

India's air transport is scored 4.3 and ranked 71st in 2014-15. With an end to the state monopoly in commercial aviation sector in 1994, there was a proliferation of private airlines and it increased competition in the system. This has led to an increase in air traffic – both cargo and passengers.

Based on data from 2005, the average Energy Development Index (EDI) for India was 0.295. Even within the Indian states there was wide disparity. As depicted in chart 1 and 2, both quality and ranking of Electricity Supply in India is far from satisfactory. Although there is a slow improvement in quality of electricity yet India is continuing to lag behind in the world ranking.

The quality of main infrastructure sectors like Roads and Electricity were found to be quite bad when compared internationally or ranked by firms within India or when the quantitative indicators on quality were looked at. However, there were some sub sectors in India which were doing well in terms of quality such as civil aviation.

A. India's infrastructure deficit: The investment gap

The infrastructure deficit that the India is facing in the form of congested roads and railways or inadequate hospital facilities are the main factors that are consistently constraining rapid and competitive economic growth. All of these factors collectively responsible for low productivity, poor competitiveness, high costs, slow pace of urbanization etc. Even with the half of the budgetary support provided by the government and enough scope of private funding, there still exists a funding gap of 9% of total requirement.

Sector-wise Projected Investment in Infrastructure in India {(At Current Prices) (2012-2013 to 2016-2017)}
(Rs in Crore)

Project	Total Eleventh Plan	Twelfth Plan Projections					Total Twelfth Plan
		2012-13	2013-14	2014-15	2015-16	2016-17	
Roads and Bridges	453121	150466	164490	180415	198166	221000	914536
Railways	201237	64713	78570	96884	121699	157355	519221
MRTS (Mass Rapid Transport System)	41669	13555	17148	22298	29836	41322	124158
Airports	36311	7691	10716	15233	21959	32116	87714
Ports (Including ILW)	44536	18661	25537	35260	49066	69256	197781
Electricity	728494	228405	259273	294274	333470	386244	1501666
Non-Conventional Energy	89220	31199	42590	58125	79075	107637	318626
Oil and Gas Pipelines	62534	12211	16604	23833	36440	59845	148933
Telecommunications	384962	105949	136090	176489	230557	294814	943899
Irrigation (Including Watershed)	243497	77113	87386	99178	112506	128186	504371.0
Water Supply and Sanitation	120774	36569	42605	49728	58084	68333	255319.0
Storage	17921	4480	6444	9599	14716	23202	58441.0
Total	**2424277**	**751012**	**887454**	**1061316**	**1285573**	**1589308**	**5574663.0**

Source: Ministry of Statistics and Programme Implementation Govt. of India. (ON611)

India's estimated investment requirements in Infrastructure are seen at over 700 billion Dollars by 2022 as per the Economic Survey. This requirement is one reason that the government is looking for potential overseas investors interested in investing in infrastructure. Doing business ties with flexible and easy norms coupled with speedy implementation can fill this gap. Given the enormity of investment required and the limited availability of public resources for investment in physical infrastructure in India, the projected infrastructure requirements have made it imperative for the government to explore avenues for increasing investment in infrastructure through a combination of public and public-private partnership mode of delivery.

III. THE TRANSPORTATION AND ENERGY SECTOR: A BRIEF PROFILE

TABLE- 1 Classification of Infrastructure sub-sectors as per SCINS

SECTOR	SUB SECTOR	COVERAGE
Transport	Road transport	Roads and bridges, Tunnels, Moto vehicles r
	Rail transport	Railways, Signalling, communications systems, Rail yards, Stations, Rolling stock
	Inland water transport	Inland waterways, Inland water vessels
	Sea & coastal transport	Seaports, Ships and other vessels
	Air transport	Airports, Air crafts
Energy/ Power	Electricity(Thermal, Hydro, Nuclear)	Generation plants, wind mills, transmission and distribution lines, electric substations, Coal Reserves, Coal fields/mines, Coal washeries
	Petroleum & Natural gas	Oil and gas pipeline networks Distribution terminals, Gas fields/wells, Refineries

A. Transport Sector

Transportation sector is the soul of infrastructural projects in India since highest number of investments and projects have been undertaken in this sector. Additionally, efforts are needed to mainstream Public Private Partnerships in several areas such as power transmission and distribution, water supply and sewerage and railways where there is substantial resource deficit and also a need for efficient delivery of services. To fulfil the increasing demands, huge investments is needed mainly in transportation sector (roads, railways, ports and civil aviation) as well as energy sectors for increase of capacities and transformation. The financing from the public sector plays a vital role in building transport infrastructure. However, the requirements of resources are much larger than the public sector can provide, therefore, the public-private partnership (PPP) mode plays a important role infrastructure financing in India.

B. Energy Sector

Energy as a means of infrastructure plays a very important role for viable economic growth of an economy. The development of the energy sector also leads to extraction of natural resources and therefore responsibilities for environment management and social aspects also needs to be addressed simultaneously. India is set to remain one of the top five energy consuming country as it continues with its economic growth programs, and strive to improve its standard of living.

According to IEA, India is on the fourth rank in terms of energy consumption as it consumes over 4 per cent of the world's total annual energy.

From the figure 3, it is seen that investment in both the sectors has increased only after 2000s. Again, since 2012 it is seen declining gradually. However, as per the Economic Survey, 2018-19, the creation of physical infrastructure accelerated significantly during 2014-19.

IV. EMPIRICAL ANALYSIS

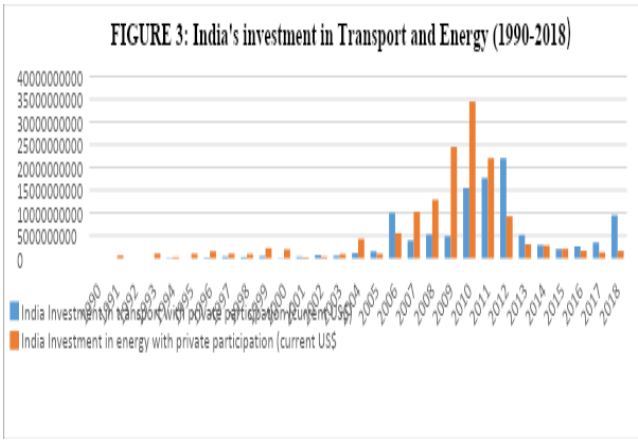
A. Relationship between GDP and investment in infrastructure development (PPP mode):

To test the relationship between infrastructure and economic growth in India, the Vector Auto Regression (VAR) model is used in this study. To interpret the results of VAR, the forecast error variance decomposition (FEVD) is also used. To represent economic growth, the variable of GDP per capita (measured in current US$ values) and as proxies for financing in infrastructure sector the variables like total investment in the energy sector and total investment in transportation sector with private participation (in current values US$) for the time period of 28 years i.e. from 1990 to 2018 are incorporated. In the analysis, the VAR model for three variables is constructed as follows:

$$X_t = \propto_{1i} + \sum_{i=1}^{n} \beta_{1i} X_{t-i} + \sum_{i=1}^{n} \gamma_{1i} Y_{t-i} + \sum_{i=1}^{n} \rho_{1i} Z_{t-i} + u_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$Y_t = \propto_{2i} + \sum_{i=1}^{n} \beta_{2i} X_{t-i} + \sum_{i=1}^{n} \gamma_{2i} Y_{t-i} + \sum_{i=1}^{n} \rho_{2i} Z_{t-i} + u_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$Z_t = \propto_{3i} + \sum_{i=1}^{n} \beta_{3i} X_{t-i} + \sum_{i=1}^{n} \gamma_{3i} Y_{t-i} + \sum_{i=1}^{n} \rho_{3i} Z_{t-i} + u_{3t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$



Source: based on data collected from World Bank Database

Where $\propto_{1i}$, $\propto_{2i}$ and $\propto_{3i}$ represent the intercept terms. ⍰,⍰ and ⍰represents the estimated coefficients; and n represents the optimal lag order, which is determined by the Akaike information criterion (AIC).

First the Augmented Dickey-Fuller (ADF) unit root test is used to check the stationary of the three variables. After the first differencing, the all the three variables became stationary.

The following are the results and interpretations of the VAR Model:

1. By going through the t-statistic, it is apparent from the results of VAR model that, per capita GDP has a very strong impact on its own value. Similarly, investment in the energy sector has a very strong impact on its own value. Moreover, it is seen that per capita GDP has an impact on the investment in transportation sector.

2. In the short run, it is seen from the FEVD that both the variables: GDP per capita and investment in energy sector has an impact on economic growth; that is on the variable of GDP per capita. Although the impact of investment in transportation on economic growth was very negligible; but its impact has increased in the long run.

B. Relationship between GDP and investment in infrastructure development (Private mode):

To analyze the nature of relationship between GDP and private investment in infrastructure development in India, we have incorporated three variables in this analysis, they are: 1) GDP Per capita (Constant $ 2011), 2) Private investment in Energy (US $) and 3) Private Investment in Transportation (US $); whereas the period of the study is 1991-2018. First of all the three series become stationary after the first differencing and then accordingly proper lag have been chosen as suggested by the Aikaike Information Criteria (AIC) (In this case it is three). Then the Johansen co-integration test suggested that these three series were co-integrated. Accordingly Vector Error Correction (VEC) Model has been applied to determine the long run and short run relationship between Economic growth and Private Investment in Infrastructure.VECM is a restricted VAR that is used with co-integrated Series. The VECM has co-integration relations built into the specification so that it restricts the long run behaviour of the endogenous variables to converge to their co-integrating relationships while allowing for short run adjustments. The co-integration term is also known as the Error Correction Term (ECT) since the deviation from the long run equilibrium is gradually corrected through a series of short run adjustments.

The Error Correction Model for co-integrated Series is:

$$\Delta y_t = \beta_0 + \sum_{i-1}^{n} \beta_i \Delta y_{t-i} + \sum_{i=0}^{n} \delta_i \Delta x_{t-i} + \varphi z_{t-i} + \mu_t$$

Where Z is ECT and is OLS residual from the following long run co integrating regression:

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$$

And

$$z_{t-1} = y_{t-1} - \square_0 - \square_1 x_{t-1}$$

Here it is worth mentioning that the co efficient of ECT is also known as the speed of adjustment, because it measures the speed at which Y returns to equilibrium after a change in X.

The estimation of VECM showed that there is long run causality running from private investment in infrastructure to Economic growth. In other words, Private investment in energy and transportation has significant impact on GDP Per capita in the long run while the impact in the short run was largely absent as indicated by Wald Test.

VI. CONCLUSION:

To conclude, from the analysis, it has been found that In India there has been a sharp decline in the private investments over past decades, which cannot be considered as a good sign for development of infrastructures in the country. Therefore now the time has come to revitalize the public-private partnership to boost the infrastructure investment. To attain this goal, the first and foremost task will be to undertake the responsibility of restructuring the existing PPP contracts. Moreover, necessary steps should be undertaken to provide incentives to private investors so that the gap that exists between the demand and supply could be narrowed down. Finally, National PPP program should be made more comprehensive such that it could clearly spell out the objectives, scopes and implementing principles of the PPP Programme envisaged by the government.Moreover, the results of VAR and VECM for combined public-private investment and private investment respectively suggested that infrastructure do contribute towards economic growth although through different modes of infrastructure building.

APPENDICES:

I. Appendix for VAR:

Unit root test result for the variables at first differencing:

1. INVESTMENT IN TRANSPORT:

Null Hypothesis: D (LNTR) has a unit root

	t-statistic	*P* value
ADF Test Statistic	-5.393354	0.0003
1% level	-3.788030	
5% level	-3.012363	
10% level	-2.646119	

2. INVESTMENT IN ENERGY:

Null Hypothesis: D (LNEN) has a unit root

	t-statistic	*P* value
ADF Test Statistic	-9.925974	0.0000
1% level	-3.711457	
5% level	-2.981038	
10% level	-2.629906	

3. GDP PER CAPITA:

Null Hypothesis: D (LNG) has a unit root

	t-statistic	*P* value
ADF Test Statistic	-4.201284	0.0030
1% level	-3.699871	
5% level	-2.976263	
10% level	-2.627420	

Result of Johansen co-integration test:

Result of VAR:

Date: 07/31/19 Time: 10:21
Sample (adjusted): 1998 2018
Included observations: 21 after adjustments
Trend assumption: Linear deterministic trend
Series: LNEN LNG LNTR
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.576991	24.14724	29.79707	0.1943
At most 1	0.182657	6.079620	15.49471	0.6861
At most 2	0.084065	1.843996	3.841466	0.1745

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.576991	18.06762	21.13162	0.1273
At most 1	0.182657	4.235624	14.26460	0.8337
At most 2	0.084065	1.843996	3.841466	0.1745

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Vector Autoregression Estimates
Date: 07/31/19 Time: 10:40
Sample (adjusted): 1997 2018
Included observations: 22 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LNEN	LNG	LNTR
LNEN(-1)	0.424851	-0.005439	0.156519
	(0.20456)	(0.00446)	(0.20701)
	[2.07688]	[-1.22002]	[0.75609]
LNG(-1)	-0.981130	1.010261	0.901322
	(0.62767)	(0.01368)	(0.63519)
	[-1.56313]	[73.8512]	[1.41899]
LNTR(-1)	0.566610	0.004496	0.519086
	(0.24436)	(0.00533)	(0.24728)
	[2.31877]	[0.84424]	[2.09914]
C	8.428417	0.007135	-0.307279
	(3.96102)	(0.08633)	(4.00846)
	[2.12784]	[0.08265]	[-0.07666]
R-squared	0.685380	0.998720	0.742752
Adj. R-squared	0.632944	0.998506	0.699877
Sum sq. resids	11.71279	0.005564	11.99502
S.E. equation	0.806666	0.017581	0.816327
F-statistic	13.07065	4679.743	17.32377
Log likelihood	-24.28268	59.89152	-24.54459
Akaike AIC	2.571152	-5.081047	2.594963
Schwarz SC	2.769524	-4.882676	2.793334
Mean dependent	21.77958	8.198672	21.49319
S.D. dependent	1.331458	0.454862	1.490097

Determinant resid covariance (dof adj.)	0.000100
Determinant resid covariance	5.48E-05
Log likelihood	14.27417
Akaike information criterion	-0.206743
Schwarz criterion	0.388371
Number of coefficients	12

II. Appendix for VECM:

1. Result of Unit Root:

Group unit root test: Summary
Series: GDP, ENERGY, TRANSPORT
Date: 11/08/19 Time: 00:42
Sample: 1991 2018
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.34563	0.0004	3	77
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.76634	0.0001	3	77
ADF - Fisher Chi-square	27.5709	0.0001	3	77
PP - Fisher Chi-square	23.9036	0.0005	3	78

2. Johansen Co-Integration Test:

Sample (adjusted): 1995 2018
Included observations: 24 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP ENERGY TRANSPORT
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.733074	63.21729	29.79707	0.0000
At most 1 *	0.676532	31.51846	15.49471	0.0001
At most 2 *	0.168575	4.430736	3.841466	0.0353

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.733074	31.69883	21.13162	0.0011
At most 1 *	0.676532	27.08772	14.26460	0.0003
At most 2 *	0.168575	4.430736	3.841466	0.0353

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GDP	ENERGY	TRANSPORT
0.000163	-8.17E-10	1.22E-09
-0.002803	4.21E-10	-7.43E-10
0.003833	-2.28E-10	-4.87E-11

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	-4.039026	-24.58384	14.66928
D(ENERGY)	1.96E+09	4.93E+08	6.69E+08
D(TRANSPORT)	-8.19E+08	1.08E+09	7.30E+08

1 Cointegrating Equation(s): Log likelihood -1217.990

Normalized cointegrating coefficients (standard error in parentheses)

GDP	ENERGY	TRANSPORT
1.000000	-5.02E-06	7.52E-06
	(8.5E-07)	(1.4E-06)

3. Result of VECM:

Vector Error Correction Estimates
Date: 11/08/19 Time: 00:58
Sample (adjusted): 1995 2018
Included observations: 24 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
GDP(-1)	1.000000
ENERGY(-1)	-5.02E-06
	(8.5E-07)
	[-5.89950]
TRANSPORT(-1)	7.52E-06
	(1.4E-06)
	[5.36486]
C	-5005.549

Error Correction:	D(GDP)	D(ENERGY)	D(TRANSP...
CointEq1	-0.000657	318413.9	-133259.1
	(0.00210)	(94718.6)	(102227.)
	[-0.31221]	[3.36168]	[-1.30356]
D(GDP(-1))	0.505873	-9587138.	4470435.
	(0.29633)	(1.3E+07)	(1.4E+07)
	[1.70710]	[-0.71896]	[0.31062]
D(GDP(-2))	0.357177	-31045735	-9231439.
	(0.31751)	(1.4E+07)	(1.5E+07)
	[1.12495]	[-2.17294]	[-0.59867]
D(GDP(-3))	0.102460	22369122	21132714
	(0.36324)	(1.6E+07)	(1.8E+07)
	[0.28207]	[1.36851]	[1.19791]
D(ENERGY(-1))	-1.90E-09	1.948740	-0.424171
	(8.8E-09)	(0.39649)	(0.42792)
	[-0.21548]	[4.91496]	[-0.99123]
D(ENERGY(-2))	-8.07E-09	1.184847	0.271164
	(9.8E-09)	(0.44322)	(0.47836)
	[-0.81949]	[2.67325]	[0.56686]
D(ENERGY(-3))	1.06E-08	1.142516	-0.295230
	(1.0E-08)	(0.47147)	(0.50884)
	[1.01191]	[2.42331]	[-0.58020]
D(TRANSPORT(-1))	-6.59E-09	-2.299074	0.155710
	(1.4E-08)	(0.63668)	(0.68716)
	[-0.46607]	[-3.61101]	[0.22660]
D(TRANSPORT(-2))	-1.07E-08	-1.233964	0.118656
	(7.8E-09)	(0.35045)	(0.37823)
	[-1.37835]	[-3.52109]	[0.31371]
D(TRANSPORT(-3))	-4.54E-09	-0.413409	-0.106156
	(4.0E-09)	(0.17830)	(0.19243)
	[-1.14668]	[-2.31865]	[-0.55166]
C	28.47496	4.00E+09	-2.25E+09
	(37.7483)	(1.7E+09)	(1.8E+09)
	[0.75434]	[2.35328]	[-1.22965]
R-squared	0.813777	0.842167	0.785303
Adj. R-squared	0.670528	0.720757	0.620151
Sum sq. resids	52218.72	1.06E+20	1.23E+20
S.E. equation	63.37842	2.85E+09	3.08E+09
F-statistic	5.680872	6.936560	4.755042
Log likelihood	-126.2762	-549.2078	-551.0386
Akaike AIC	11.43969	46.68398	46.83655
Schwarz SC	11.97963	47.22392	47.37650
Mean dependent	200.1314	55196250	3.90E+08
S.D. dependent	110.4161	5.40E+09	4.99E+09

4. OLS Estimation:

Estimation Method: Least Squares
Date: 11/08/19 Time: 01:00
Sample: 1995 2018
Included observations: 24
Total system (balanced) observations 72

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.000657	0.002105	-0.312206	0.7565
C(2)	0.505873	0.296335	1.707100	0.0958
C(3)	0.357177	0.317506	1.124946	0.2675
C(4)	0.102460	0.363245	0.282070	0.7794
C(5)	-1.90E-09	8.81E-09	-0.215481	0.8305
C(6)	-8.07E-09	9.85E-09	-0.819486	0.4175
C(7)	1.06E-08	1.05E-08	1.011913	0.3178
C(8)	-6.59E-09	1.41E-08	-0.466072	0.6438
C(9)	-1.07E-08	7.79E-09	-1.378347	0.1760
C(10)	-4.54E-09	3.96E-09	-1.146678	0.2585
C(11)	28.47496	37.74832	0.754337	0.4552
C(12)	318413.9	94718.62	3.361683	0.0017
C(13)	-9587138.	13334734	-0.718960	0.4765
C(14)	-31045735	14287423	-2.172942	0.0359
C(15)	22369122	16345597	1.368511	0.1790
C(16)	1.948740	0.396492	4.914956	0.0000
C(17)	1.184847	0.443224	2.673247	0.0109
C(18)	1.142516	0.471469	2.423309	0.0201
C(19)	-2.299074	0.636684	-3.611011	0.0009
C(20)	-1.233964	0.350449	-3.521088	0.0011
C(21)	-0.413409	0.178298	-2.318646	0.0257
C(22)	4.00E+09	1.70E+09	2.353279	0.0237
C(23)	-133259.1	102227.1	-1.303560	0.2000
C(24)	4470435.	14391798	0.310624	0.7577
C(25)	-9231439.	15420008	-0.598666	0.5529
C(26)	21132714	17641337	1.197909	0.2382
C(27)	-0.424171	0.427922	-0.991234	0.3277
C(28)	0.271164	0.478359	0.566864	0.5741
C(29)	-0.295230	0.508843	-0.580198	0.5651
C(30)	0.155710	0.687155	0.226600	0.8219
C(31)	0.118656	0.378230	0.313714	0.7554
C(32)	-0.106156	0.192432	-0.551656	0.5843
C(33)	-2.25E+09	1.83E+09	-1.229651	0.2262
Determinant residual covariance		2.42E+40		

Equation: D(GDP) = C(1)*(GDP(-1) - 5.01939083916E-06*ENERGY(-1) + 7.52362036885E-06*TRANSPORT(-1) - 5005.5490872) + C(2) *D(GDP(-1)) + C(3)*D(GDP(-2)) + C(4)*D(GDP(-3)) + C(5)*D(ENERGY(-1)) + C(6)*D(ENERGY(-2)) + C(7)*D(ENERGY(-3)) + C(8) *D(TRANSPORT(-1)) + C(9)*D(TRANSPORT(-2)) + C(10) *D(TRANSPORT(-3)) + C(11)

Observations: 24

R-squared	0.813777	Mean dependent var	200.1314
Adjusted R-squared	0.670528	S.D. dependent var	110.4161
S.E. of regression	63.37842	Sum squared resid	52218.71
Durbin-Watson stat	2.007757		

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