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Economic Growth and Industrial Production Nexus in Rajasthan

S K Kulshrestha[1], Narain Sinha[2] and M R Singariya[3]

[1]*Assistant Professor, Vardhman Mahaveer Open University, Kota, E-mail: skulshrestha@vmou.ac.in*
[2]*Professor, Department of Economics, University of Botswana, Gaborone, E-mail: narainsinha@yahoo.co.uk*
[3]*Associate Professor, Department of Economics, S. D. Government College, Beawar, E-mail: mr.singariya@gmail.com*

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Abstract: Industrial development affects per capita income by providing income to factors of production. The history of economic development shows that there is a positive correlation between industrial development and per capita income. India is the seventh-largest country in the world in which Rajasthan state is the largest state where 61 per cent area under the desert. The natural resources in the state are favorably suited for investments in sectors such as cement, ceramics, and agro-based industries. Government of Rajasthan is also promoting the investment through the development of several special economic zones in the sectors of gems and jewellery, handicrafts, IT, electronics and textiles. The industrial development of the state is very slow due to lack of infrastructural development however industries contributes about 30.19% in GSDP. This paper-based on industrial production and per capita GDP data from 1980-81 to 2015-2016. The results show that industrial production and per capita GDP are stationary at first difference. Johansen co-integration test shows that there is exist of co-integrating equations. There is two co-integrating vector with Johansen's test. Error correction model-derived that there is a long-run connection. This empirical study does not support short-run causality

1. INTRODUCTION

Rajasthan is the largest state in India and there is a need for fast economic development. There is a natural corridor which connects northern states to western states so industrial development makes the state as a commerce centre. The state is doing well to improve investment in the industrial sectors. Industrial development plays a vital role in the rapid growth of national and per capita income. Many studies suggest that advanced countries have a close relationship between industrial development and per capita income. Rajasthan's better part of employment depends on agriculture and allied activities. Many business enterprises were established such as the Birlas, Singhanias and Shriram's. All prominent Business masters like the Modis, Bangurs, Poddars Thapars, Goenkas, and Rankas have established their industries in the state. The state encouraged investments in the IT companies such as Infosys, Wipro and automotive sectors like Mahindra and Honda.

2. OBJECTIVES OF THE STUDY

The objective of this paper is to empirically inspect the impact of industrial production on per capita GDP in Rajasthan. This paper is also examined in the long run and short-run causality and significance between industrialization and per capita GDP of the state.

3. LITERATURE REVIEW

The empirical and theoretical opinions are favoured of the concept of industrialization was précised by Bolaky (2011) which signifies a transition from an agriculture economy to a manufacturing economy to service sector economy as the major means of subsistence. O'Sullivan and Sheffrin (2007) precise industrialization process which transforms people agrarian to an industrial one. Industries impacted society by modernization, the development of large scale production which leads to economic growth. Several empirical studies have supported a positive relationship between industrialization and economic growth. Some literature argues the importance of industrial development another emphasis on the service sector. Szirmai and Verspagen's (1991) explained the contribution of manufacturing. Rodrik (2009) explained the relationship between GDP growth and industry shares. Singariya and Sinha (2015) have done an empirical study based on time series data from 1971-2013 on relationships among per capita GDP, agriculture and manufacturing sectors in India and concluded that per Capita GDP affects manufacturing sector strongly in the long run.

4. DATA AND METHODOLOGY

This study is based time series data collected from statistical abstracts of Directorate of Economics and Statistics, Jaipur from the year 1980-2016. The following econometric tools have used for analysis:

(i) Granger Causality: This provides information related to the unidirectional or bidirectional relationship between variables. To test for Granger causality, the following equations are estimated;

$$Y_t = \alpha_0 + \Sigma\, \alpha_i X_{t\text{-}i} + \Sigma\, \beta_j Y_{t\text{-}j} + \mu_{1t}$$
$$X_t = \lambda_0 + \Sigma\, \lambda_i Y_{t\text{-}i} + \Sigma\, \delta_j X_{t\text{-}j} + \mu_{2t}$$

The null hypothesis is that Yt does not cause Xt or vice versa. Therefore, the rejection of the null hypothesis shows the presence of Granger causality.

(ii) Tests of Stationary: This paper is based on macro-economic variables such as per capita income and industrial production. Engle and Granger (1987) described a linear combination of two non-stationary variables may be stationary if such a stationary linear combination be existent and the non-stationary time series to be cointegrated. Non-stationarity is difficult in the analysis of time series. When a variable is not found stationary, it implies that means and variances are not consistent over time, which shows observation is correlated with its lags. So there is a need to check that data series is stationary or non-stationery. The unit root tests in series for check whether series is stationery or not.

The Augmented Dickey-Fuller test equation is as under:

$$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{p} \alpha i\ \Delta Y_{t-i} + \mu_t$$

If the δ is insignificant then the unit root exists in the series hence.

(iii) Co-integration: Co-integration suggests variables to be linked and should not diverge in the long-run. Variables can drift in short-run but for an equilibrium among such variables to exist. Thus, 'Co-integration' is the equilibrium relationship overtime.

(iv) Johansen Co-integration: It is based on the maximum likelihood estimation in a Vector Auto Regressive model (VAR). If we have a set of k variables ($k \geq 2$) which are integrated of first order i.e. I (1). Given a set of K time series variables $y_t = (y_{1t}, \_\_\_\_ , y_{Kt})$, the basic VAR model is of the form:

$$y_t = A_1 y_{t\text{-}1} + \text{———} + A_p y_{t\text{-}p} + u_t$$

The above VAR needs to be transformed into a Vector Error Correction Model (VECM) of the following form:

$$\Delta Y_t = \Pi Y_{t-1} + \Sigma_{i=1}^{k} \Gamma_i\, \Delta Y_{t-I} + \mu_t$$

Where $\Pi = (\Sigma\, \beta_i) - I_k$ and $\Gamma_i = -\Sigma_{j=i+1}^{k} \beta_j$

This VAR model holds k variables which is first difference form dependent variable and k-1 lags of the dependent variables that are differences, with Ã coefficient matrix. This test is affected by the lag length used in the VECM.

5. RESULT AND DISCUSSION

Granger causality tests suggest that there is no impact of per capita income and industrial production at the level of 5 per cent.The test accepted the null hypothesis. It is clear that either short run or long run per capita income and industrial production not influenced statistically. To know the short run or long run relationship the paper unit root test has taken for further analysis. Table 2 explains that per capita GDP and industrial production are not stationary at the level and first difference with an intercept but these variables are stationary at the first difference with trends and intercept. Lag Order plays an important role to know the co-integrating equation. So table 3 shows that Lag Order Selection Criteria for co-integrating through VAR model in which sequential modified LR test statistic, Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion(SC) and Hannan-Quinn information criterion (HQ) suggests that two lags criteria is better than other lag order for the co-integrating equation. Unrestricted co-integration Rank Test (Trace) indicates that there are two co-integrating equations at the 0.05 level in Table 4 through the Johansen co-integration test. It is clear from table 5 that using Vector Error Correction Estimates for identifying short-run and the long-run relationship between Per Capita GDP and industrial production in which long-run relationship exists. The equation shows there is a significant relationship between the variables. We are using Vector Error Correction Estimates for identity short-run and the long-run relationship between Per Capita GDP and industrial production. So the equation shows there is a significant relationship between the variables. By the help of Vector Error Correction Estimates the equation for identity and long-run and short-run equation for calculating the impact we generate the following model and mention model 1.

Co-integrating Model

D(PCI) = C(1)*(PCI(-1) - 0.0052636759447*INDUSTRIALPRODUCTION(-1) - (1640.09079713) + C(2)*D(PCI(-1)) + C(3)*D(PCI(-2)) + C(4)*D(INDUSTRIAL PRODUCTION(-1)) + C(5)*D(INDUSTRIAL PRODUCTION(-2)) + C(6)

(Model 1)

The least-square model in table 7 is used for identifying short-run and long-run causality in this C(1) is the speed of adjustment towards a long-run equilibrium that

Table 1: Granger Causality Test Results

Null Hypothesis:	*Obs*	*F-Statistic*	*Prob.*
Per Capita Income does not Granger Cause Industry	34	1.74	0.19
Industry does not Granger Cause Per Capita Income		2.17	0.13

Table 2: Unit Root Test

Variable	*Augmented Dickey-Fuller test statistic (MacKinnon (1996) one-sided p-values)*		
	Level (Intercept)	*First Difference (Intercept)*	*First Difference (Trends and Intercept)*
Per Capita GDP	4.08 (1.0000)	-2.57(0.1075)	-10.48 (0.0000)
Industrial Production	4.39 (1.0000)	-0.04(0.9471)	-7.92 (0.0000)

Table 3: Lag Order Selection Criteria

Lag	*Log L*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	-533.1262	NA	1.84e+13	33.38289	33.42869	33.39807
1	-442.2067	170.4740	6.68e+10	27.76292	27.85453	27.79329
2	-440.0524	3.904784*	6.22e+10*	27.69077*	27.82818*	27.73632*
3	-439.5417	0.893615	6.42e+10	27.72136	27.90457	27.78209
4	-439.1067	0.734062	6.66e+10	27.75667	27.98569	27.83258

Table 4: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	*Eigen value*	*Trace Statistic*	*Critical Value 0.05*	*Prob.***
None *	0.335264	18.50497	15.49471	0.0170
At most 1 *	0.141348	5.028917	3.841466	0.0249

Table 5: Normalized cointegrating coefficients (standard error in parentheses)

PCI	*Industrial Production*
1.000000	-0.005264
	(0.00033)

Table 6: Vector Error Correction Estimates

Cointegrating Eq:		CointEq1
PCI(-1)		1.000000
INDUSTRIAL PRODUCTION(-1)		-0.005264
		(0.00033)
		[-15.7260]
C		-1640.091
Error Correction:	**D(PCI)**	**D(INDUSTRIAL PRODUCTION)**
CointEq1	-0.208083	-37.03334
	(0.06316)	(13.1107)
	[-3.29472]	[-2.82467]
D(PCI(-1))	-0.330763	95.18062
	(0.18657)	(38.7307)
	[-1.77284]	[2.45750]
D(PCI(-2))	0.255395	40.24941
	(0.20284)	(42.1076)
	[1.25910]	[0.95587]
D(Industrial Production(-1))	-0.001770	-0.614604
	(0.00113)	(0.23532)
	[-1.56145]	[-2.61183]
D(Industrial Production(-2))	-0.000735	-0.195998
	(0.00101)	(0.21019)
	[-0.72548]	[-0.93250]
C	3051.758	536507.3
	(775.336)	(160952.)
	[3.93605]	[3.33333]
R-squared	0.527935	0.425311
Adj. R-squared	0.440515	0.318887
Sum sq. resids	35122208	1.51E+12
S.E. equation	1140.536	236764.5
F-statistic	6.039100	3.996390
Log likelihood	-275.8093	-451.8830
Akaike AIC	17.07935	27.75049
Schwarz SC	17.35144	28.02258
Mean dependent	1865.762	440328.1
S.D. dependent	1524.807	286884.6
Determinant resid covariance (dof adj.)	6.16E+16	
Determinant resid covariance	4.13E+16	
Log likelihood	-724.9151	
Akaike information criterion	44.78273	
Schwarz criterion	45.41762	

Table 7: Least Squares Method for Model 1

	Coefficient	*Std. Error*	*t-Statistic*	*Prob.*
C(1)	-0.208083	0.063156	-3.294721	0.0028
C(2)	-0.330763	0.186573	-1.772837	0.0875
C(3)	0.255395	0.202840	1.259099	0.2188
C(4)	-0.001770	0.001134	-1.561447	0.1301
C(5)	-0.000735	0.001013	-0.725482	0.4744
C(6)	3051.758	775.3358	3.936047	0.0005
R-squared	0.527935	Mean dependent var		1865.762
Adjusted R-squared	0.440515	S.D. dependent var		1524.807
S.E. of regression	1140.536	Akaike info criterion		17.07935
Sum squared resid	35122208	Schwarz criterion		17.35144
Log likelihood	-275.8093	Hannan-Quinn criter.		17.17090
F-statistic	6.039100	Durbin-Watson stat		2.041240
Prob(F-statistic)	0.000711			

must be statistically significant with a negative sign. So both condition is fulfilled we can say there is long-run causality from the per capita GDP and industrial production. So it implies that our one industrial production influenced per capita income. The R^2 coefficient of determination is 0.53 this implies that 53 per cent of variation is explained. F-statistic is also statistically significant so the model is fit for estimates.

For short-run causality between Per Capita GDP and industrial output, there is a need to estimate wald statistics. There is null hypothesis is C (4) = C (5) = 0. The test result has shown in table 8 where Chi-square value is not statistically significant. We accept the null hypothesis that implies that there is no short-run causality. This implies that there is no short-run relationship between the variables. There is a need to test for serial correlation, heteroskedasticity and normality for check assumption of the error term. So we used the Breusch-Godfrey Serial Correlation LM Test in table 9 which shows that there is no Serial Correlation. Breusch-Pagan-Godfrey in

Table 8: Short Run Relationship Test

Wald Test:			
Test Statistic	*Value*	*df*	*Probability*
F-statistic	1.221197	(2, 27)	0.3107
Chi-square	2.442394	2	0.2949

Table 9: Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.420322	Prob. F(2,25)	0.6614
Obs*R-squared	1.073551	Prob. Chi-Square(2)	0.5846

Table 10: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.683740	Prob. F(6,26)	0.6643
Obs*R-squared	4.497329	Prob. Chi-Square(6)	0.6097
Scaled explained SS	3.480492	Prob. Chi-Square(6)	0.7466

Table 11: Normality Test

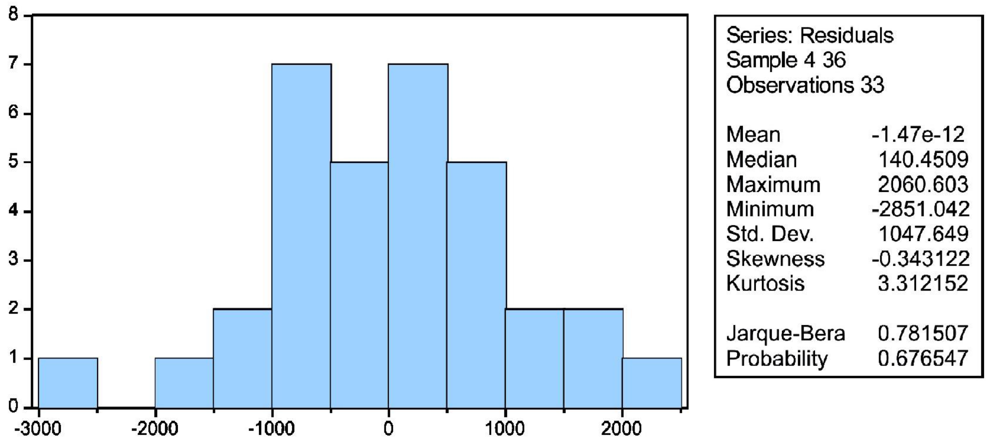

table 10 test suggests that there no heteroskedasticity and for normality test in table 11 Jarque- Bera test shows that there are errors normally distributed.

6. CONCLUSION

Rajasthan is a desert prominent developing state of the country. The industry is playing a vital role in the long run for enhancement of state economic growth. The government needs to focus on industrial development and push the sector for long-run sustainable development of the state. However, this paper suggests that there is not a short-run relationship between industrial production and economic growth. The reason behind this is that industrial development takes time to the trickle-down effect that has proved in this study.

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