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Granger Causality between Mineral Exports and Growth of GDP: A Case Study of India

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Abstract

This paper attempts to examine whether there is any bi-directional causality or long-run equilibrium relationship between mineral exports and Gross Domestic Product in the context of the Indian Economy by taking the data for the period 1987-2018. Unit-root test, Jhonsen co-integration test, and Granger-causality test have been used to examine the stationarity, a long-run equilibrium between the variables and two-way bidirectional causality respectively. It has been observed that the data are stationary at first difference. There is no co-integrating equation implying that there is no common trend and long-run equilibrium between the variables. The Granger causality test reveals that the causality runs from the GDP growth to mineral exports but not the other way round. The government should not over emphasize on the exports of the mineral resources to achieve high growth rate of GDP.Goverment should try to find a balance between exploitation and augmentation.

Keywords: Cointegration, Unit Root Test, granger-Causality, Mineral Exports and GDP.

Introduction

The objective of the majority of the economies has been to achieve high economic growth at the cost of straining the economy's natural resources. Unsustainable paths have been followed to achieve targeted high economic growth by overexploiting the economy's scarce and non-renewable resources in the name of industrialization and infrastructural development. Mineral resources have been a major natural resource exploited by humans from time immemorial. The rapid industrialization and infrastructure development has resulted in increased demand and large scale exploitation of mineral resources. In this regard, the adoption and use of scientific methods for maximizing mineral exploration, prospecting of mining beneficiation, and economic utilization have been emphasized since the implementation of National Mineral Policy, 2008.

India has long been recognized as a nation well endowed in natural mineral resources. India ranked 4th amongst the mineral producer countries, behind China, United States and Russia, on the basis of volume of production, as per the Report on Mineral Production by International Organizing Committee for the World Mining Congress. It however ranked 8th on the basis of value of Mineral production, during 2009.India is the third largest producer of coal and fourth largest producer of iron ore in 2018.The domestic mining sector currently contributes about 10 to 11% to the industrial sector and about 2.2% to 2.5% to the economy's GDP. The economy is endowed with vast reserves of key metallic and non-metallic minerals including iron ore, bauxite, coal, limestone and manganese. India is among the top 10 producers for these ores The states of Chhattisgarh, Jharkhand and Orissa are the most mineral rich regions in the economy globally.

The resource curse theory which has been reaffirmed by precedents and theories that resource endowed countries becoming less wealthy and less governed than their resource-scarce counterparts. According to Aunty(1993) the resource curse refers to the paradox that countries and regions with an abundance of natural resources, specifically non-renewable resources like minerals tend to have less economic growth and worse political development outcomes than countries with less natural resource. In general it seems to be the case that the more natural resources a country has, the poorer it performs. The phenomenon is

referred to in the literature as the curse of natural resources (Sach and Warner, 2001;Gylfason,2001). Sach and Warner,2001 have observed negative pattern when the growth of per capita income is regressed against the export of natural resources as a share of GDP, and the negative relation persists even when controlling for other variables such as differences in the level of investment between countries and for climate and geography. What lies behind this curse of natural resource?

With this background, the paper makes an attempt to know the trend of growth of mineral exports(metallic) from India since 1987 till 2017.During this period of liberalization, vast FDI have been attracted to be invested in mining sector. It is extremely important to know whether increasing exports of minerals in last thirty years have led to economic growth i.e. GDP growth in the context of Indian Economy and vice versa. It tries to examine whether there is any bi- directional causal relation or there is a long-run stable relationship between mineral exports and growth of GDP

Review of Literature

A humble attempt has been made to review some of the earlier literature. In theoretical growth model, exports are considered as an engine of growth. First, exports being a component of GDP, the increase of exports directly increase GDP. An increase in exports means increase in employment in export sector industries which, in turn, increase income and GDP, reallocating resources from less productive sectors to exports industry and enhancing capacity utilization and thereby exports growth promotes GDP growth (Ben-David and Loewy, 1998). Shakouri, B, and Yazdi, S (2012) have investigated the causal relationship between mining exports, imports, and economic growth of Iran and they have found that there is a linkage between mining exports, imports, and economic growth. As mining exports granger cause economic growth, greater emphasis should be given on promoting the growth and development of mineral exporting countries by ensuring increased productivity in such sector. Econometric tools such as Cointegration, Error Correction model, Granger causality, Augmented Dickey-Fuller Test are used to test the causality and long-run relationship. The study covers the time-period 1959-2008. Sahoo, K.A., Sahoo.D& Sahu, N.C.(2016) have investigated the relationship between mining export, industrial production, and economic growth in India using annual time series data from 1981 to 2010. It is based on the secondary sources of data extracted from the Reserve Bank of India database. The multivariate cointegration technique has been employed to see the long-run equilibrium relationship among variables. Further, Granger causality based on vector error correction model (VECM) has been adopted to see both short-run and long-run causality among the variables. The cointegration results confirm that mineral exports, industrial production, and economic growth are cointegrated, indicating the existence of long-run equilibrium relationship among variables. Similarly, the VECM Granger causality result holds that there is a long-run Granger causality relationship running from economic growth and industrial production to the mineral export of India.

Sampathkuma, T et al investigate the relationship between export and economic growth in the SAARC countries during 1990-91 to 2012-13. The nature and direction of the relationship between export and economic growth was examined by applying cointegration and Granger Causality tests. The obtained results showed that there is unidirectional causation from economic growth to export for Bangladesh and India, and bidirectional causation was found for Afghanistan and Sri Lanka, and no causation was obtained for Bhutan, Maldives, Nepal, and Pakistan. The obtained contradictory results for the SAARC countries indicate that despite the fact a long period of economic co-operation there was not enough export orientation to have its effect on economic growth. Unless and until the social / political issues are settled, it will be difficult to realize the benefits of export to augment economic growth.

Sahoo, A.K., Sahu, N.C. & Sahoo, D & Pradhan,B.B(2014) have tried to explore the dynamic relationship among mineral export, economic growth and industrial production in India over the period from 1981 to 2010. The present study is based on secondary data which is extracted from the Reserve Bank of India database on Indian economy. We have adopted a vector auto regression (VAR) model analysis based upon impulse response function (IRF) and variance decomposition (VD) to find out the relationship among variables. The result of IRF suggests that economic growth responses positively to a shock in mining export, whereas industrial production responses in a negative way. It has been found that mining export is not contributing at large towards industrial production of India in the short run, but in the long run, a significant share of industrial production is caused by mining export. It is also found that both industrial production and economic growth explain for variation in mineral export in India in the long run. Mineral export and economic growth in India: evidence from VAR model analysis.

Some analysts believe that the causality direction is from export to economic growth which expressed as Export-Led Growth (ELG) hypothesis (Balassa 1978, Edwards 1998). The export development and free entry and exit are considered as the key causes of economic growth. For example, firms can take advantage of more efficient allocation of resources, scale economies and encouraging creativity and innovation caused by foreign competition (Helpman and Krugman 1985).

This paper has carried out simple granger causality relationship between mineral exports and GDP growth of India for the recent time period 1987 to 2018 by converting nominal data into real terms along with it has tried to examine whether there is any cointegrating equation between these variables to suggest any policy measures to be mineral oriented for the first time.

Research Methodology

The data for the present study are obtained from the database of Reserve Bank of India i.e.,

Handbook of Statistics on Indian Economy.The time series annual data of mineral exports are taken after the proper interpretation of India's export data for the present study and have been converted to real exports, being adjusted by WPI with 2004-05 base. The second variable is the GDP at constant price for the period 1987-2018where data have been converted to common series with 2004-05 as a base by splicing data series with different base years. GDP at constant price is used as a proxy variable to assess the growth of the Indian economy. All the time series employed in the study covers the period from 1987-2018. To analyze data we have used Eviews-7 and got the results.

$$; = A_1 y_{t-1} + \cdots + A_p y_{t-p} + B x_t + \varepsilon_t$$

Model Specification: This paper uses a Vector Auto Regression (VAR) to identify the relationship Gross Domestic Product (Y), miningexports (MINEX) All values will be in real terms. In addition, they will be expressed in the logarithmic form. Two macroeconomic variables which are built upon the

$$\text{where, } \Pi = \sum_{i=1}^{p} A_i - I, \text{ and } \Gamma = -\sum_{j=i+1}^{p} A_i$$

followingaugmented output function.

Y = f (MINEX) (1)

Estimation Technique: The study employs a three-step procedure to determine the causality relationship between mining exports and economic growth.

Unit Root Test

First, the Augmented Dickey-Fuller (ADF) tests are used to check whether each data series is integrated and has a unit root. The ADF test is based on the value of t-statistics for the coefficient of the lagged dependent variable compared with special calculated critical values. If the calculated value is greater than the critical value, then we reject the null hypothesis of a unit root; the unit root does not exist, and our variable is stationary (Enders 1995; Gujarati 2003). The ADF test is based on the following regressions.

$$\Delta Yt = \alpha 0 + \alpha 1 Yt\text{-}1 + \alpha 2 t + \alpha j \, \Delta Yt\text{-}j + \varepsilon t$$

Where Y is a time series, t is a linear time trend, is the first difference operator, is a constant, n is the optimum number of lags on the dependent variable and is the random error term. In the above equation, α is constant, ρ is the coefficient of time drift, Y denotes the variable under consideration. In our study, the variables include Exports and Gross Domestic Product. Δ denotes the first difference operator; t denotes drift in time, ε is a stationary random error. The test for stationarity is applied on the coefficient of Yt-1 in the above equation. If the coefficient α, is found to be notably different from 0, the null hypothesis is rejected interpreting that that the variable Y contains a unit root and states that the variable does not have unit root. Akaike Information Criterion is used to determine the proper lag length criterion in ADF test.

Cointegration Test: The results of the integration tests are then pursued by Cointegration tests. The existence of long-run equilibrium (stationary) relationships among economic variables is referred to in the literature as cointegration. The Johansen procedure will be employed to examine the question of cointegration and provide not only an estimation methodology but also explicit procedures for testing for the number of cointegrating vectors as well as for restrictions suggested by economic theory in a multi variate setting. Engel and Granger (1987) pointed out that a linear combination of two or more non-stationary variables may be stationary. If such a stationary combination exists, then the non-stationary time series are said to be co-integrated. The VAR based cointegration test using the methodology developed in Johansen (1991, 1995) is described below: Consider a VAR of order p

Where yt is a k-vector of non-stationary I(1) variable, xt is a d-vector of deterministic variables and εt is a vector of innovations. If the economic variables are cointegrated, we can proceed to utilize the Vector Autoregression (VAR) representation. This VAR can be rewritten as follows:

$$y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma \Delta y_{t-1} + \beta x_t + \varepsilon_t$$

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VAR and Granger-Causality: The traditional Granger causality test uses the simple F-test statistics. Several studies such as Chow (1987), Darat (1996) have used the traditional (F-test) to test for causality.

Analysis and Findings

Unit root Test

The Result from table 1.1 provides strong evidence of non stationarity in levels. This can be seen by comparing the observed values (in absolute terms) of the ADF test statistics with the critical values (also in absolute terms) of the test statistics at the 1%and 5% and10 % level significance Therefore, the null hypothesis is accepted and it is sufficient to conclude that there is a presence of unit root in the variables at levels and all the variables were differenced one

Results of Unit Root Test

Table-1.1 Augmented Dickey-Fuller Stationary Test Results

Variables	ADF Stat at level	Critical Value	ADF Stat at First Difference	Critical Value	Remarks
Ln GDP at constant price	1.639431	1 % :-3.661661	-4.390273	-3.670170	Integrated of Order I
				-2.963972	
		5%:-2.960411			
		10%:-2.619160		-2.621007	
Ln Exports	-2.093840	1%-3.661661	-4.546010	-3.670170	Integrated of order I
		5%-2.960411		-2.963972	
		10%-2.619160		-2.621007	

Both variables become stationary at first difference.Hence both the variables are integrated of order(I)

Co-integration Result

Having confirmed the stationarity of the variables at I (1), we proceed to examine the presence or no presence of cointegration among the Unrestricted Cointegration Rank Test(Trace) variables. The next step is to test whether the stationary variables are cointegrated or not. Two criteria, Trace statistics and Eigenvalue are used for the cointegration test at 5% level of significance. It implies mining exports and GDP growth does not show a common trend and long-run equilibrium.

Table1.2

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.335404	12.51086	15.49471	0.1340
At most 1*	0.008417	0.253575	3.841465	0.6146
Trace test indicates no cointegration enq(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Table 3

Unrestricted Cointegration Rank Test (maximum Eigen Value)

Hypothesized No. of CE(s)	Eigenvalue	Max Eigen Value	0.05 Critical Value	Prob.**
None*	0.335404	12.25729	14.26460	0.1013
At most 1*	0.008417	0.253575	3.841465	0.6146
Max-Eigenvalue test indicates no cointegration enq(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Granger Causality in Table-4 shows Granger causality between mining exports, and economic growth. F- Statistic associated with the two variables. From the result, it could be noted that the null hypothesis that economic growth does not Granger causes mining exports is rejected implying that causality is running from economic growth to mining exports (LGDP→LEXPORT) . But the reverse null hypothesis i.e., exports does not granger cause economic growth is accepted at 10% level of significance.

Granger Causality Test Result

Table1.4

Null Hypothesis	Observation	F-statistic	Probability
LEXPO does not granger cause LGDP	30	3.03160	0.0662
LGDP does not granger cause LEXPO	30	0.49141	0.6176

This indicates there is a one-way causal relationship between mineral exports and GDP growth in the context of the Indian Economy.

Conclusion

This paper investigated the export-led growth hypothesis using the time series data running from 1987 to 2017for India. The paper tested the series for stationarity and found all series are non-stationary at level but stationary at first difference. Both Engel-Granger and the Johansen cointegration results found that there is no cointegrating equation The significance of F-statistics indicates no causal relationship running from mineral exports to economic growth but there is a uni-directional causal relation from GDP growth to exports of minerals This study has applied the Granger Causality model to investigate the causality between mining exports and real GDP growth. The empirical evidence shows there is neither long-run equilibrium relationship between exports of minerals and GDP nor causality exists between mineral exports and GDP growth. Rather, growth od GDP causes exports of minerals to rise.ot the other way round. So, the government policy should not emphasize on too much mining and exploitation of non-renewable resources to achieve high economic growth in the long-run. Mineral resources should be exploited reasonably for domestic industrialisation as well as for exports in a

responsible manner. The doctrine of public trust is the principle that certain resources are preserved for public use, and the government is required to maintain them for the public's reasonable use. So, government is the trustee and should conserve it on a sustainable basis. Since it is not the owner of the land, it has to carry out its responsibility of a responsible trustee.Physical capital and human capital have played a greater role than natural capital in triggering economic growth in India.

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