# Linkages in Mining and Quarrying Sector: What does it mean for Rajasthan Economy

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Abstract: inter-sectoral linkages play a crucial role in industrialisation and socio-economic development of any economy. Rajasthan being a mineral rich state has developed its secondary sector on vast mineral resources in the districts located in western region of the state. The study explores the association between mining sector and rest of the economy of Rajasthan using secondary data sources and econometric tools. The study uses time-series data from 1980-2019 and examines linkages between various sectors using granger causality and vector autoregressive technique based upon impulse response function and variance decomposition. The empirical results show a significant causal linkage from manufacturing and banking and insurance services to mining. Given the setting, section 1 presents a broad overview of mining sector in Rajasthan and the trends in major sectors of Rajasthan economy from 1980-2019 are discussed in section 2. Empirical association between mining sector and others are tested in section 3. The study is concluded in last section.

Keywords: economic growth, linkages, sectoral shares, time-series analysis

## Introduction

The causal relationship between different sectors and sub-sectors at the national level has been sufficiently explored in the Indian context (Banga R and Goldar 2004; Bathla 2003). Theoretically, sectoral linkages describe a sector'srelationship with the rest of the economy through its directand indirect intermediate purchases and sales. There are five types of resource linkages discussed in literature namely production, consumption, fiscal, spatial, and lateral linkages. The linkage concepthas been recognized as playing a crucial role and providing substantial contributions towards guiding the appropriatestrategies for the economy.Analysis of inter and intra sectoral linkages assume special significance in the context of regional economies for growth drivers are influenced by cumulative performance of different sectors.Mining and quarrying sector in Rajasthan assume special significance due to relatively higher share of the sector in NSDP of Rajasthan in 2018-19 (9.7%) as compared to the national average (2.7%).The increasing contribution of mining and quarrying sector is indicative of beginning of resource-led growth in the economy of Rajasthan where establishing backward and forward linkages for this sector. Literature suggests that a rather prominent resource sector in economy can become disconnected with the rest of the economy, in absence of effective linkages. The term 'resource curse' has been coined to explain the situation where natural resource windfalls have led to worsen developmental outcomes in a resource abundant economy as compare to economies with lesser resources(Sachs and Warner, 1995).

Given this setting, section 1 presents a broad overview of mining sector in Rajasthan and structure and growth of Rajasthan economy in section 2. Inter-sectoral linkages between major sectors are tested in section 3. The study is concluded in the last section.

The study is based on secondary data collected from the national income series of the Central Statistical Office. The study covers the period from 1960-61 to 2018-19. However, it is rather difficult to have a single series of Net State Domestic Product (NSDP) and by sectors with a single base year. In order to transform the NSDP series into a single base year of 2004-05, method of splicing is used. As can be seen from the second column, there exists a number of common years between two successive series. These common years are the key for constructing the comparable database. Change of the base year actually unleashes a scale effect on the concerned variable, the magnitude of which is the ratio of the variables corresponding to a particular point of time (common year), but from successive series. If we have more than one common year between the two series, the scale effect may be measured as the average of the mentioned ratios for each common year. This in effect gives us the adjustment factor that needs to be multiplied with the old series to make it comparable with the new one (Chowdhury, 2014).

The generalised methodology is as follows: Suppose,

$X_{ij}$ A = NSDP of state X from the $i^{th}$ sector for the $j^{th}$ year of series A

$X_{ik}$ B = NSDP of state X from the $i^{th}$ sector for the $k^{th}$ year of series B

The sectoral adjustment ratio (R) for the $i^{th}$ sector is given by,

$R_i$ = Average ($X_{ik}$ B / $X_{ij}$ A) for all j = k

To transform the SDP from sector '*i*' of series A to that of series B, we apply the adjustment ratio to the sectoral SDP of each non-common year of series A i.e.,

$R_i * X_{ij}$ A, for all $j \neq k$

So, for the $j^{th}$year, the comparable GSDP of state X= $\sum (R_i * X_{ij}$ A), $i = 1$ to N, where N is the number of sectors in the economy.

Using the above mentioned methodology, the data used for analysis is explained in table 1.

Table 1: Description of Data

| Variable | Source of data | Calculated for Analysis* |
|---|---|---|
| Agriculture & allied | www.epwrfits.in accessed on 15-11-2019, NSDP of sectors from 1980-2019 | Using splicing method with 2011-12 as base year |

| | | |
|---|---|---|
| activities | | |
| Mining & Quarrying | www.epwrfits.in accessed on 15-11-2019, NSDP of sectors from 1980-2019 | Using splicing method with 2011-12 as base year |
| Construction | www.epwrfits.in accessed on 15-11-2019, NSDP of sectors from 1980-2019 | Using splicing method with 2011-12 as base year |
| Manufacturing | www.epwrfits.in accessed on 15-11-2019, NSDP of sectors from 1980-2019 | Using splicing method with 2011-12 as base year |
| Banking | www.epwrfits.in accessed on 15-11-2019, NSDP of sectors from 1980-2019 | Using splicing method with 2011-12 as base year |
| Secondary Sector | www.epwrfits.in accessed on 15-11-2019, NSDP of sectors from 1980-2019; including sectors viz. manufacturing, construction, electricity | Using splicing method with 2011-12 as base year |
| Tertiary Sector | www.epwrfits.in accessed on 15-11-2019, from 1980-2019, including sectors viz. banking, real estate, trade, transport, public administration, other services | Using splicing method with 2011-12 as base year |

Note: * using methodology given in Choudhary (2014)

**Section 1: Mining Sector of Rajasthan**

The state of Rajasthan has unique geology, with rocks ranging in age from one of the oldest feature (more than 3,500 million years ago) to recent, displaying a wide range of rocks and mineral deposits. Mining and smelting of its base metal deposits are also one of the oldest in world, dating back to more than 2,500 years. Rajasthan is considered as a museum of minerals with deposits of renowned building stones and radioactive minerals, Lignite, Petroleum and Natural Gas. The State has 79 known minerals, out of which 57 are being produced. Its share is 9% in the country's total mineral production. The State is a leading producer of Lead, Zinc, Gypsum, Soapstone, Ball Clay, Calcite, Rock Phosphate, Feldspar, Kaolin, Copper, Jasper, Garnet, Wollastonite, Emerald, Silver in India. The Aravalli hills running across in the South-West to North-West direction divide the State into two natural divisions – The North-West division and South-East division. The North-West division have rich deposits of lignite, gypsum, steel/ cement/chemical grade limestone, fuller's earth, bentonite, bally clay and fire clay, potash, tungsten, sandstone, marble and granite. It also has immense potential for oil and natural gas. The Aravalli hill region has large deposits of base metals (lead, zinc and copper), rock phosphate, industrial minerals like limestone, quartz, feldspar, asbestos, soapstone, wollastonite, silica-sand, decorative and dimensional stones like sandstone, slate, marble and granite. It also has the potential for gold and other metallic minerals and precious and semiprecious stones. South-east division has vast deposits of sandstone, limestone, clays and silica sand. The State contributed about 18.54 percent to the total value of mineral production in the country and occupied leading position among the

States in 2017-18 (IBM,2019). It was the sole producer of lead and zinc ores and concentrate, selenite and wollastonite. Almost entire production of silver in the country was also reported from the State during 2014-15. The State possesses substantial share of the total resources of potash (94%), lead & zinc ore (89%), wollastonite (88%), silver ore (88%), gypsum (82%), ochre (81%), bentonite (75%), fuller's earth (74%), diatomite (72%), felspar (66%), marble (63%), asbestos (61%), copper ore (54%), calcite (50%), talc/steatite/soapstone (49%), ball clay (38%), rock phosphate (31%), fluorite (29%), and tungsten (27%) (IBM Year Book, 2018). Looking to the availability of metallic, non-metallic and fuel minerals, there is a huge potential of mineral based industries in the State.

**Section 2: Structure and Growth of Rajasthan Economy**

The established pattern of development paradigm pronounces a hierarchical order of development and growth of different sectors of the economy. The path of development process is initiated from primary production sector and moves onto the secondary and further to territory (Rostow 1960). However, regional economies have been confronted with the multi-task of ensuring balanced and sustained economic growth, not only among sub-sectors within, but also maintaining a pace of growth in tandem with the long-term national developmental goals. In the light of the above, it has been viewed in some academic and policy circles that stimulation to growth drivers of NSDP holds the key to develop social sectors in the economy of Rajasthan. However, the sweet spot for faster growth in NSDP of the state economy is likely to emerge from a judicious combination of balanced and synchronised performance of drivers in the material production sectors, viz., primary and secondary. The analytical taxonomy for the state of Rajasthan demands that the primary commodity production sector, especially crop production and animal husbandry, are crucial to ensure inclusiveness in the on-going growth trajectory, and mainstreaming the process of development from a perspective of providing equal opportunity to the socially and economically vulnerable sections. It underlines further that the strength and weakness as also the dynamism in every branch of the economy of Rajasthan need to be analysed to evolve effective intervention strategies for attainment of persistent, creative, and encompassing incrementalism in NSDP.

As mentioned elsewhere, the development literature underlines the systematic movement of the relative contribution of different sectors over the years. The relative contribution of different sectors in the economy of Rajasthan is presented in Fig. 1.

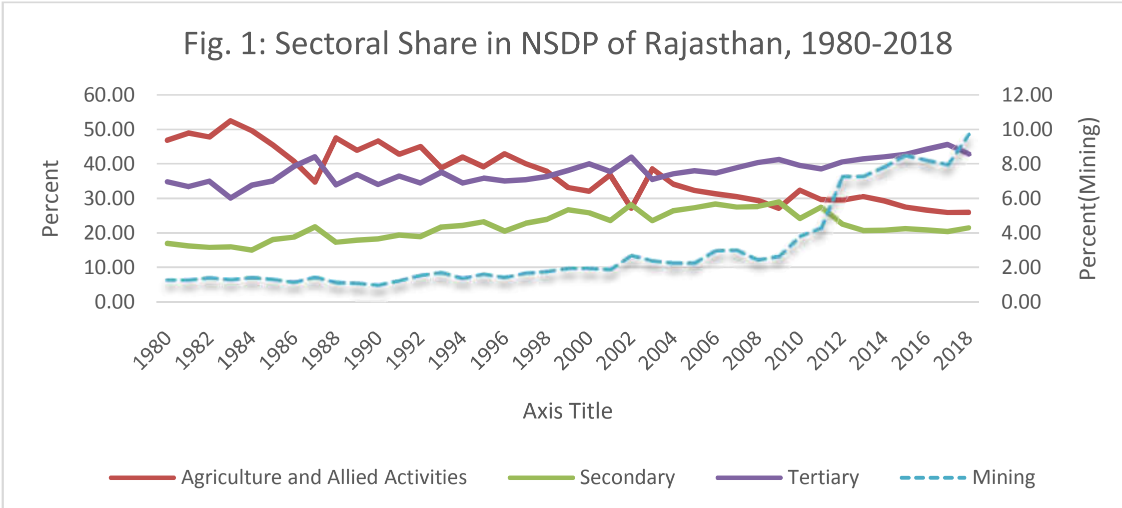



Fig 1. Highlights the sectoral share of agriculture and allied activities, secondary, tertiary and mining and quarrying sectors in NSDP of Rajasthan from 1980-81 to 2018-19. After 2000s, mining sector has shown sharp increase in the share of NSDP of Rajasthan.

Table 1: Sectoral share in NSDP of Rajasthan 1980-2019

| Year | Agriculture and Allied Activities | Secondary | Tertiary | Mining |
|---|---|---|---|---|
| 1980 | 46.90 | 16.96 | 34.88 | 1.27 |
| 1990 | 46.71 | 18.32 | 34.01 | 0.97 |
| 2000 | 32.15 | 25.88 | 40.02 | 1.94 |
| 2010 | 32.37 | 24.24 | 39.57 | 3.82 |
| 2011 | 29.69 | 27.42 | 38.61 | 4.29 |
| 2012 | 29.53 | 22.60 | 40.61 | 7.26 |
| 2013 | 30.57 | 20.71 | 41.43 | 7.28 |
| 2014 | 29.32 | 20.82 | 42.04 | 7.83 |
| 2015 | 27.51 | 21.21 | 42.80 | 8.47 |
| 2016 | 26.63 | 20.94 | 44.22 | 8.20 |
| 2017 | 25.95 | 20.47 | 45.64 | 7.94 |
| 2018 | 25.92 | 21.55 | 42.83 | 9.70 |

Source: compiled fromDomestic Products of States of India 1980-81 to 2018-19, http://www.epwrfits.in/ with 2011-12 base year. Accessed on 2-10-2019

Table 2. shows the growth rates for major sectors in Rajasthan. Mining and quarrying sector recorded highest growth rate in this decade with a growth of 15.66% followed by other services sector at 9.69%. The NSDP of Rajasthan grew at the rate of 5.70% for the same time period.

Table 2. Growth Rate by Sectors of Rajasthan, 1980-2019

| Sectors | 1980-89 | 1990-99 | 2000-09 | 2010-19 | 1980-2019 |
|---|---|---|---|---|---|
| **Primary** | **3.30** | **3.70** | **4.52** | **5.32** | **4.57** |
| Agriculture and Allied Activities | 3.29 | 3.43 | 4.16 | 3.03 | 3.46 |
| Mining and Quarrying | 3.65 | 11.35 | 9.60 | 15.66 | 2.26 |
| **Secondary** | **7.16** | **9.47** | **7.66** | **3.24** | **6.7** |
| Manufacturing | 6.10 | 8.41 | 8.15 | 5.39 | 6.19 |
| Construction | 6.57 | 8.30 | 9.26 | 2.34 | 11.08 |
| Electricity,Gas and Water supply | 16.63 | 16.74 | 0.72 | -6.71 | 22.34 |
| **Tertiary** | **6.68** | **6.63** | **6.41** | **7.40** | **6.29** |
| Transport Storage and Communication | 6.18 | 8.36 | 11.65 | 8.32 | 3.60 |
| Trade,Hotels and Restaurants | 10.22 | 7.03 | 7.21 | 7.40 | 6.85 |
| Banking and Insurance | 12.28 | 10.10 | 12.95 | 8.36 | 10.00 |
| Real Estate,Ownership of Dwellings and Business Services | 3.44 | 4.19 | 3.72 | 6.10 | 2.47 |
| Public Administration | 8.24 | 7.52 | 5.92 | 3.11 | 7.99 |
| Other Services | 8.89 | 9.07 | 5.07 | 9.69 | 8.36 |
| **NSDP** | **5.24** | **6.03** | **6.08** | **5.70** | 6.14 |

Source: Author's own calculation, Domestic Products of States of India 1980-81 to 2018-19, http://www.epwrfits.in/ with 2011-12 base year. Accessed on 2-10-2019

Note: Analysed using semi-log regression: Ln(NSDP) = $\alpha + \beta$ T, where T stands for time trend. A positive value of coefficient of time, $\beta$, for a particular sector indicates positive trend and vise-versa

### Section 3: Inter-sectoral Linkages

Inter-sectoral linkages assume special significance since the commencement of trade liberalisation drive in India in 1991. As the Indian economy moved out from its long run Hindu rate of economic growth and got it launched onto a higher growth plain with intermittent breaks, there is a possibility of break-up of the long established equilibrium relationships across sectors. Two notable characteristic features of the high growth path in the trade liberalisation drive were: (i) spectacular decline in the relative contribution of agriculture and allied sectors in the national income; (ii) increase in the relative size of construction, mining and quarrying and service sectors. The discussion assumes significance in the context of Rajasthan as more than 65% of the work force in the state still ekes out their living from agriculture. In the new growth paradigm since 1990s, two notable characteristic features were: (i) rate of growth of primary sector lagged far behind other sectors; and (ii) employment elasticity of high growth sectors was much on a lower side as compared to crop production sector. Inter-sectoral linkages have been explored in greater detail in the Indian context (Debnath and Roy 2012; Bathla 2003; Mishra 2010). The association between agricultural growth and poverty is a stylised fact with its positive association. Bathla observed that there exists a unidirectional causation between primary production sectors and service sector while there exists a bidirectional causal relationship between secondary and service sectors (Bathla 2003). There exists significant difference between short and long run equilibrium relationship across sectors in North East India. In the long run, there exists a fairly good degree of interdependence in output growth across sectors but it is unidirectional causality from material production sectors (agriculture and industry to service sector) while the causal relationship is bidirectional in the short run. The inter-sectoral linkages in north east India from 1981 to 2007 revealed that growth of service sector is largely depend on the performance of agriculture and industry (Debnath and Roy 2012).

There are various methodologies used in literature to analyse inter-sectoral linkages. According to Saikia (2011), input-output (I-O) tables, social accounting matrix, econometric modelling and computable general equilibrium approaches are the major techniques used in Indian context to establish structural inter-sectoral relationships. For the present study, Sims (1980) approach of vector autoregressive system's moving average representation is used to provide insights on dynamic interactions among variables in the system. The vector moving average representation is an essential feature of Sims's (1980) methodology in that it allows youto trace out the time path of the various shocks on the variables contained in the VAR system. Variance decomposition and impulse response function are used to examine relative impact of each variable on other variables.

**Model Specification**

Granger Causality: Causality tests between two stationarity series are based on Granger's (1969) definition for causality. The basic idea is that a time series $X_t$ Granger cause another time series $Y_t$ if $Y_t$ can be predicted significantly using the past values of $X_t$ than by using only the historical values of $Y_t$. Suppose that $Y_t$ and $X_t$ are manufacturing and mining sectors respectively, then testing causal relations between the two sectors can be based on the following bivariate autoregression:

$$Y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i X_{t-i} + \sum_{i=1}^{m} \beta_i Y_{t-i} + \varepsilon_{y,t} \quad (1)$$

$$X_t = \gamma_0 + \sum_{i=1}^{m} \gamma_i X_{t-i} + \sum_{i=1}^{m} \emptyset_i Y_{t-i} + \varepsilon_{x,t} \quad (2)$$

where $\alpha_0$ and $\gamma_0$ are constants; $\alpha_i$, $\beta_i$, $\gamma_i$, and $\emptyset_i$ are coefficients; and $\varepsilon_{y,t}$ and $\varepsilon_{x,t}$ are uncorrelated disturbance terms with zero means and finite variances. The null hypothesis that mining does not Granger cause manufacturing is rejected if the $\alpha_i$ coefficients in Eq. (1) are jointly significantly different from zero using a standard joint test (F-test). Similarly, manufacturing is said to Granger cause mining if the $\emptyset_i$ coefficients in Eq. (2) are jointly different from zero. If both coefficients are jointly different from zero, a bi-directional causality will form.

Vector Autoregressive (VAR) Approach: Vector autoregression consists of variance decomposition (VD) and impulse response function (IRF). Analysis based on VAR model enables someone to evaluate the strength of a causal relation. The moving average model of the shocks can be expressed as follows:

$$Z_t = \sum_{p=0}^{\infty} A_p\, \varepsilon_{t-p} \qquad (3)$$

where $Z_t$ is a 2 × 1 column based on Eqs. 1 and 2 and $\varepsilon_t$is a 2 × 1-column vector that contains shocks of $\varepsilon_{y,t}$ and $\varepsilon_{x,t}$. Equation 3 indicates that $Z_t$ is a linear combination of the current and past one-step ahead forecast error (shocks). Therefore, variance decomposition provides insightful information on unexpected variation in one variable with shocks from the other variable in the system. Impulse response function traces out the response of each concerned variable in the system to a shock from system variables. VAR provides insights into the dynamic linkages between mining, manufacturing, construction, and banking and insurance sectors and the model specification is as follows:

$$\begin{bmatrix} w_t \\ x_t \\ y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \\ b_{40} \end{bmatrix} + \begin{bmatrix} a_{11} & . & . & a_{1n} \\ . & . & . & . \\ . & . & . & . \\ a_{41} & & . & a_{4n} \end{bmatrix} \begin{bmatrix} w_{t-1} \\ . \\ . \\ w_{t-n} \end{bmatrix} + \begin{bmatrix} \delta_{11} & . & . & \delta_{1n} \\ . & . & . & . \\ . & . & . & . \\ \delta_{41} & & . & \delta_{4n} \end{bmatrix} \begin{bmatrix} x_{t-1} \\ . \\ . \\ x_{t-n} \end{bmatrix} + \begin{bmatrix} \rho_{11} & . & . & \rho_{1n} \\ . & . & . & . \\ . & . & . & . \\ \rho_{41} & & . & \rho_{4n} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ . \\ . \\ y_{t-n} \end{bmatrix} +$$

$$\begin{bmatrix} \sigma_{11} & . & . & \sigma_{1n} \\ . & . & . & . \\ . & . & . & . \\ \sigma_{41} & & . & \sigma_{4n} \end{bmatrix} \begin{bmatrix} z_{t-1} \\ . \\ . \\ z_{t-n} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ . \\ . \\ \varepsilon_{4t} \end{bmatrix} \qquad (4)$$

where $w_t$, $x_t$, $a_t$, and $z_t$ are endogenous that are mining, manufacturing, construction and banking, respectively. The lagged values of mining, manufacturing, construction and banking are captured in the vectors of *w, x, y,* and *z*, respectively, and α, δ, ρ, and σ are matrix of coefficient for the lagged endogenous variables and εis white noise.

**Results**

To avoid spurious regression caused due to presence of unit root, ADF test is employed to examine the stationary property of the variablesused in our study. The null hypothesis is thatthere exists a unit root or the underlying process is non-stationary. Table 3 shows the results for ADF test, where all the variables are stationary at level and there is no unit root. This fulfils the pre-requisite for Granger causality and VAR analysis techniques.

Table 3: Augmented Dickey Fuller unit root test results for NSDP of various sectors of Rajasthan

| Variable | t-statistics at level |
|---|---|
| Mining | -5.850740* |
| Manufacturing | -9.021088* |
| Construction | -7.173005* |
| Banking | -6.119191* |

* Denotes rejection of null hypothesis of unit roots for ADF test at 1% significance level

Next step is selection of lag-length for VAR. the lag-length selected for the analysis is 3, based upon Akaike information criteria (AIC) and final prediction error (FPE). The same lag length is used for pair-wise granger estimation. The test results for pair-wise Granger Causality tests are explained in table 4. The results show that there is unidirectional causality from manufacturing and banking and insurance services to mining. This is with tandem with Tandon et al. (2015) who have used I-O analysis from 2007-08 for India to establish linkages between major sectors.Mining and construction sector are independent of each other. Though there exists a unidirectional causality from construction to banking and from manufacturing to construction. To conclude, mining sector is a lagging sector, influenced by rise in demand for inputs from manufacturing sector. Though construction sector does not influence mining directly, it indirectly affects through manufacturing sector.

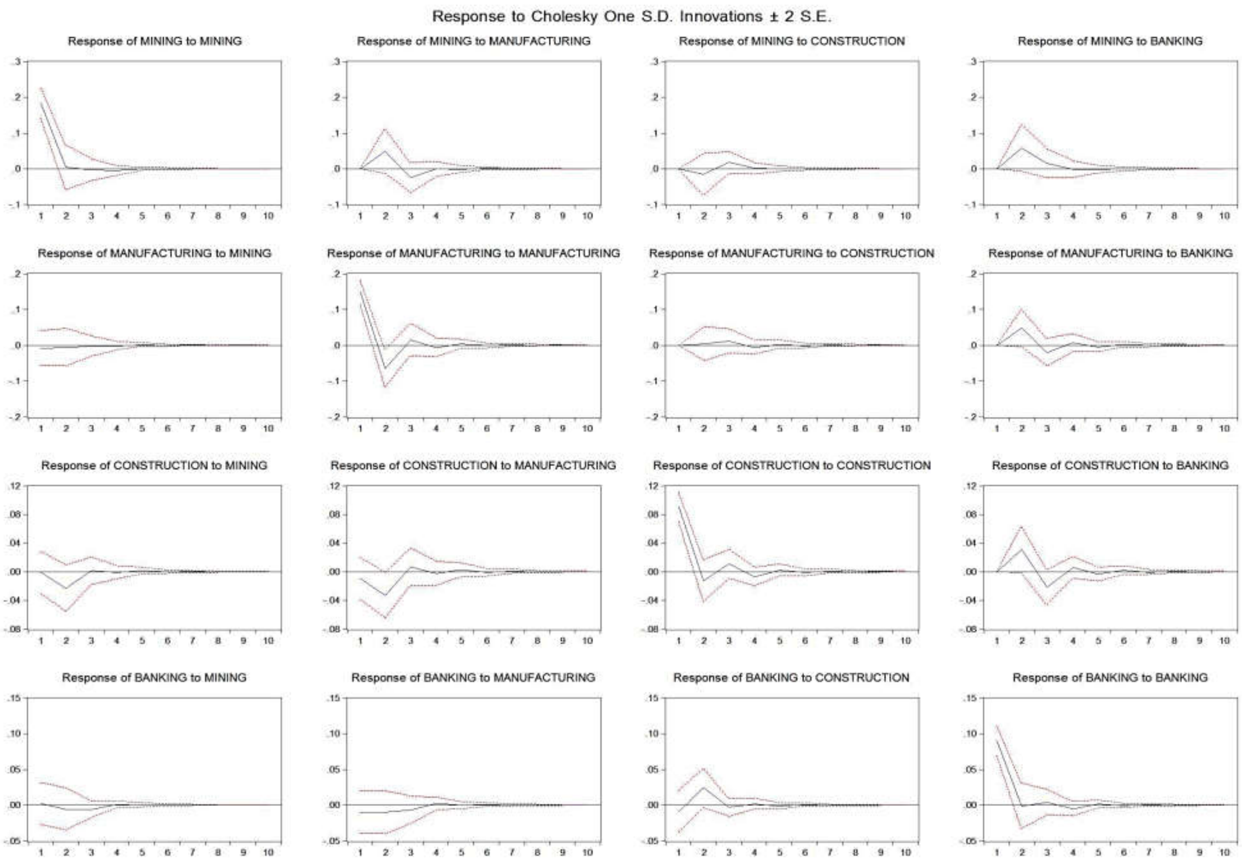
Table 4: Pair-wise Granger Causality Tests

| Null Hypothesis | F-Statistic | Probability | Direction |
|---|---|---|---|
| Construction does not granger cause mining | 0.08447 | 0.773 | Independent |
| Mining does not granger cause construction | 2.03833 | 0.1622 | |
| Banking does not granger cause mining | **3.71831** | **0.062*** ** | Unidirectional |
| Mining does not granger cause banking | 0.17373 | 0.6794 | |
| Manufacturing does not granger cause mining | **3.79023** | **0.054** ** | Unidirectional |
| Mining does not granger cause manufacturing | 0.07762 | 0.7822 | |
| Banking does not granger cause construction | 2.3159 | 0.137 | Unidirectional |
| Construction does not granger cause banking | **2.95711** | **0.0943*** ** | |
| Manufacturing does not granger cause construction | **3.62542** | **0.0652*** ** | Unidirectional |
| Construction does not granger cause manufacturing | 0.02007 | 0.8882 | |
| Manufacturing does not granger cause banking | 0.07491 | 0.7859 | Unidirectional |
| Banking does not granger cause manufacturing | **3.35838** | **0.0754*** ** | |

**, *** denotes rejection at 5% and 10% significance level respectively
Source: author's calculations

Fig 2 presents the impulse response function results. The first column shows the response to one standard deviation shock to mining, while the first row shows the response of mining as a result of shock in other sectors. The mining sector does not induce response in other sectors, rather shocks in other sectors influence response in mining. As a result of one standard deviation shock in banking and manufacturing, the response of mining is positive till 4th and 3rd year respectively and then negatively thereafter.

Fig. 2: Impulse Response Function Results




Variance decomposition results are explained in table 5. The variance decomposition of mining indicates that it is entirely explained by its own shock in 1 step ahead to time horizon. The explanatory power keeps on declining gradually over time. In three steps ahead the horizon time, the percentage of mining to total variance declines to 82.67% due to the relatively more explanation of variance by manufacturing, construction and banking with 7.3%, 1.4% and 8.7% respectively.

The variance decomposition of manufacturing shows that at 3-time period ahead, mining, construction and banking gain explanatory power with .4%, .5% and 9% total variation in manufacturing. Similarly, for construction and banking, total variations can be explained by other variables.

Table 5: Variance Decomposition Results

| Variance Decomposition of MINING: | | | | |
|---|---|---|---|---|
| Period | MINING | MANUFACTURING | CONSTRUCTION | BANKING |
| 1 | 100.000 | 0.000 | 0.000 | 0.000 |

| | | | | |
|---|---|---|---|---|
| 2 | 85.070 | 5.957 | 0.617 | 8.356 |
| 3 | 82.669 | 7.309 | 1.360 | 8.662 |
| 4 | 82.668 | 7.304 | 1.363 | 8.665 |
| 5 | 82.661 | 7.307 | 1.363 | 8.670 |
| Variance Decomposition of MANUFACTURING: | | | | |
| Period | MINING | MANUFACTURING | CONSTRUCTION | BANKING |
| 1 | 0.288 | 99.712 | 0.000 | 0.000 |
| 2 | 0.365 | 91.622 | 0.048 | 7.965 |
| 3 | 0.387 | 90.019 | 0.461 | 9.132 |
| 4 | 0.394 | 89.762 | 0.586 | 9.258 |
| 5 | 0.398 | 89.667 | 0.609 | 9.326 |
| Variance Decomposition of CONSTRUCTION: | | | | |
| Period | MINING | MANUFACTURING | CONSTRUCTION | BANKING |
| 1 | 0.018 | 1.099 | 98.883 | 0.000 |
| 2 | 4.906 | 10.927 | 75.634 | 8.533 |
| 3 | 4.650 | 10.733 | 72.539 | 12.077 |
| 4 | 4.624 | 10.712 | 72.409 | 12.255 |
| 5 | 4.629 | 10.744 | 72.292 | 12.335 |
| Variance Decomposition of BANKING: | | | | |
| Period | MINING | MANUFACTURING | CONSTRUCTION | BANKING |
| 1 | 0.048 | 1.184 | 0.935 | 97.833 |
| 2 | 0.450 | 2.213 | 7.287 | 90.051 |
| 3 | 0.822 | 2.717 | 7.318 | 89.143 |
| 4 | 0.824 | 2.750 | 7.324 | 89.103 |
| 5 | 0.823 | 2.749 | 7.349 | 89.079 |
| Cholesky Ordering: MINING MANUFACTURING CONSTRUCTION BANKING | | | | |

## Conclusion

Analysis of causal relationship across different sectors in Rajasthan during the last 38 years assumed importance from policy angles. Identification of the lead and lag sectors and their shift in relative contribution to NSDP is relevant in the present day context. Although the contribution of agriculture and allied sector to NSDP has been declining over the years, the pace of decline defined in terms of relative contribution to NSDP has been faster during 1980s and early 1990s. During this period, the service sector gained momentum. The rate of growth of mining and quarrying sector has been significantly higher during the last two decades. In the material production sector of the Rajasthan economy, mining and quarrying recorded the highest growth rate since 2000s. Mining sector is a lagging sector, influenced by rise in demand for inputs from manufacturing sector. The study concluded that the high growth phase in 2000s was environmentally costlier as compared to previous phases because of the higher growth in mining and quarrying sectors. Being a rising sector in state of Rajasthan, the policies should emphasise on development of backward linkages from mining sector such as provision of inputs to min operations by local companies and local value addition to ensure high skill spillover and development of local regions. Such provisions should be incorporated so that the negative effects of expansion of mining sector get minimised.

Appendix

Table a1: Annual Growth Rates in NSDP by sectors of Rajasthan with base year 2011-12, 1980-81 to 2018-19

| Year | MINING | CONSTRUCTION | BANKING | MANUFACTURING |
|---|---|---|---|---|
| 1980-81 | -0.15321 | 0.084662 | -0.03563 | -0.14019 |
| 1981-82 | 0.082168 | 0.081774 | 0.061654 | 0.085483 |
| 1982-83 | 0.104344 | -0.03622 | 0.252516 | 0.054503 |
| 1983-84 | 0.122113 | 0.047232 | 0.018363 | 0.304381 |
| 1984-85 | 0.021615 | -0.09497 | 0.098497 | -0.08882 |
| 1985-86 | -0.06642 | 0.176295 | 0.054989 | 0.016195 |
| 1986-87 | -0.06621 | 0.219272 | 0.326742 | -0.01045 |
| 1987-88 | 0.168091 | 0.156854 | 0.164134 | 0.158062 |
| 1988-89 | 0.100542 | 0.070992 | 0.010662 | 0.051775 |
| 1989-90 | -0.06829 | -0.08683 | 0.248401 | 0.128772 |
| 1990-91 | 0.034887 | 0.431492 | 0.024385 | 0.106241 |
| 1991-92 | 0.177407 | 0.006092 | 0.206969 | -0.08799 |
| 1992-93 | 0.438291 | 0.100305 | 0.03802 | 0.076986 |
| 1993-94 | 0.020409 | 0.075892 | 0.03839 | -0.04605 |
| 1994-95 | -0.06186 | 0.116413 | 0.047511 | 0.375903 |
| 1995-96 | 0.220719 | 0.044379 | 0.071711 | 0.115165 |
| 1996-97 | -0.01917 | 0.111151 | 0.275693 | -0.08976 |
| 1997-98 | 0.301971 | 0.167327 | 0.217761 | 0.291211 |
| 1998-99 | 0.111243 | -0.01872 | 0.025681 | -0.03678 |
| 1999-00 | 0.092274 | 0.165076 | 0.039993 | 0.195616 |
| 2000-01 | -0.03838 | -0.06892 | 0.067234 | -0.05972 |
| 2001-02 | 0.068449 | 0.129368 | 0.101755 | -0.08395 |
| 2002-03 | 0.266504 | 0.082622 | 0.171105 | -0.03168 |
| 2003-04 | 0.163107 | 0.256297 | 0.003068 | 0.028398 |
| 2004-05 | -0.08269 | 0.123164 | 0.067499 | 0.124688 |
| 2005-06 | 0.056386 | 0.111999 | 0.180899 | 0.118717 |
| 2006-07 | 0.450056 | 0.117123 | 0.265006 | 0.265754 |
| 2007-08 | 0.049941 | 0.007426 | 0.153783 | 0.010616 |
| 2008-09 | -0.12193 | -0.0055 | 0.177298 | 0.08776 |
| 2009-10 | 0.134475 | -0.00433 | 0.107774 | 0.156674 |
| 2010-11 | 0.678228 | 0.097377 | 0.171942 | -0.09786 |
| 2011-12 | 0.207942 | 0.024682 | 0.148101 | 0.625212 |
| 2012-13 | 0.748301 | -0.02714 | 0.079595 | -0.24135 |
| 2013-14 | 0.055177 | 0.040403 | 0.121496 | -0.11965 |
| 2014-15 | 0.14726 | 0.013787 | 0.102929 | 0.1525 |
| 2015-16 | 0.14257 | 0.051038 | 0.081472 | 0.12724 |
| 2016-17 | 0.029955 | 0.017 | 0.10214 | 0.079 |
| 2017-18 | 0.034079 | 0.036 | 0.10214 | 0.046 |
| 2018-19 | 0.297239 | 0.027722 | -0.10085 | 0.208829 |

Source: Compiled from www.epwrfits.in accessed on 15-11-2019, NSDP of sectors of Rajasthan, 1980-2019

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