

Iron-ore Exports and Goa's Economy, 1962-2012: A Time-series and Cross-sectional Analysis

Manasvi M. Kamat

Principal, SSPES's Goa Multi-Faculty College, Dayandnagar, Dharbandora-South Goa, Goa. 403000, India.

manasvikamat@gmail.com

Abstract

Background/Objectives: The changing contours for Goa State's iron-ore export industry, its markets and resultant impact on domestic economy is documented across the space and time heterogeneity for the period over 5 decades, beginning the liberation of the State in 1962 till the mining ban by the Hon. Supreme Court in 2012.

Methods/Statistical analysis: The data for the analysis is from 1962-2012 and is divided into four sub-periods; pre-statehood (1962-87), post-statehood period (1988-2012), pre-liberalization (1962-1992) and as post-liberalization (1993-2012) period respectively, and analyzed by fitting the semi-log and linear-trend regression models using time-dummies.

Findings: The study broadly suggests a diminishing contribution of the iron-ore export activity to Goan economy over-time, reflecting an underlying compositional shift in the Goan economy. The changing composition of the export markets of reveals the changing competitiveness of iron-ore export in the international markets due to various extraneous factors. Further it seems that Goa's iron-ore exports have eased concentration form Japan and are more headed towards the Chinese markets.

Improvements/Applications: The present study attempts an analytical inquiry of what is regarded as the "backbone" of Goa's economy through the analysis of trends in mining and export of iron-ore from India and Goa using data over a longer time-frame.

Keywords: Iron-ore Mining, Exports, Time-series, Cross-sectional Data, Trend Analysis, Market Composition, Economy, Goa.

1. Introduction

The export basket of the country in recent years also significantly differs from the traditional basket. More significantly since 1991 India has been gradually moving towards open economy using export-led growth as an effective alternate to inward-oriented strategy of development [1]. For long, India as such and particularly the State of Goa have reaped great export benefits from richly endowed industrial mineral resources like iron-ore, manganese ore, bauxite, limestone, and dolomite *etc* [2,3]. The chief minerals explored in the state of Goa are iron-ore, manganese-ore and bauxite. Over past decades, the mining industry has been the mainstay of Goa's economy and has been one of the largest contributors to the Goa foreign exchange earnings. In spite of industrial and tourism growth Goa has witnessed, this industry continues to be the predominant factor of Goa's economy. Though the presence of minerals ores in Goa was known since ancient times little attention was paid to the commercial exploration till a French firm by the name '*Compagnie des Mines de Fer de Goa*' undertook, at the beginning of the century, prospecting some of the iron-ore deposits in and around *Bicholim* taluka [4]. Some private entrepreneurs also made some efforts in early years of the century to explore manganese ore deposits in South Goa district. Goa which is one of the smallest State of India exports around 50% of the total iron ore exported from the whole country. Iron-ore comprises a share of 95% of total mining and quarrying sector in Goa [5] and this State exports around 50% of iron ore in India. However in value terms its contribution it is not so high due to the low prices of low grade iron. The exports which have been rising since 1970 with an amount of 10 million tonnes have been increasing dramatically since then with 54.5 million tons in 2010. However, since the suspension of iron-ore mining [6] and

exports in Karnataka on July 2011 and constraints imposed by Hon. Supreme Court in Goa in 2012 in the light of its exposed externalities [7,8,9], the exports have begun to decrease since then. This suspension was after the stir of the Public Accounts Committee report on Mining [10] and in the political [11] and geo-political issues [12,13,14] surrounding it.

One of the foremost studies on the iron-ore industry in Goa was conducted by the National Council for Applied Economic Research (NCAER) after liberation of the State in the year 1962 [15]. Other surveys like National Sample Survey calculated that the direct mining employment in 2004-05 would be 6,000 whereas the Fifth Economic Census report that people usually working in Goan mining are placed at 3,412 plus 3,161 hired workers, with a total of 6,573 direct employments. Fifty years after its first study the NCAER documented the economic growth and role of mining sector in the Goan economy [16,17]. In their study social cost benefit analysis was used to quantify the social benefits obtained from iron ore and to evaluate the social costs associated with this industry and estimated that the industry contributes 16.94% to GDP. The opportunity costs associated with giving up the iron ore industry in Goa was suggested to be greater by Rs 1,842.20 crore per year than costs to the environment associated with running the industry. It was also stated that direct mining employment in 2004-05 to be 19,000 employees out of a total labour force in Goa of 582,000. The employment multiplier effect was used to find the position of mining sector *vis-à-vis* other 59 sectors. Thirdly, regional and national competitive advantage analysis developed by Michael Porter in 1985 is used to gauge attractiveness of Goan iron-ore industry segment. These reports were subsequently contested by independent economists [18] where in it was also documented [19] that some taxes accounted on the NCAER report don't represent the real environmental cost that they create whereas another study in response to NCAER report and through its own calculation suggested that the total employment in 2008-09 would not exceed 21,873. The calculated direct employment which was accounted to be 5,416 and estimates that indirect employment to be 5,500 including transport specific to mining and quarrying. In a field-work [20] undertaken in Goa from October 2012 to January 2013 focused on interviews, data collection and visits to understand the importance of mining sector in Goa whereas through a comprehensive unit level of iron-ore exporting firms and using temporal-spatial analysis it was found that higher export instability and geographical market concentration characterize iron-ore exports from Goa State [21,22].

The Tata Energy Research Institute (TERI) in the year 1998 developed the Area Wide Quality Management Plan (AEQM) for the mining belt of Goa [23]. Similarly couple of studies [24,25] deal with environmental impact assessment and management strategies relating the same industry. Apart from above, the evolution of Goa's mining industry and its manifold contribution on state's economic environment has not been sufficiently researched. The present work attempts to quantify the contributing share of iron-ore exports of Goa to India and to the World. The study attempts to highlight the impact of four stages; pre and post-statehood, and pre and post-liberalization periods on the iron-ore export performance of Goa. By highlighting the share of Goa and India in Japan's imports which is a major market, we finally chart the way to analyze the changing composition of India's and Goa's iron-ore export market destinations. The present study thus attempts an analytical inquiry of what is regarded as the "backbone" of Goa's economy through the analysis of trends in mining and export of iron-ore from India and Goa by specification of appropriate models.

The rest of the paper is organized in three sections. The second section (2) briefly indicates the data sources and research techniques while the later (3) elaborates on the results and interpretations and is arranged into 7 sub-sections (3.1 through 3.7) whereas, the last section (4) concludes.

2. Materials and Methods

The present study thus attempts an analytical inquiry of what is regarded as the "backbone" of Goa's economy through the analysis of trends in mining and export of iron-ore from India and Goa by specification of appropriate models.

2.1.1. Data Sources

The data for the analysis on Goa's iron-ore exports is drawn from the 'Compiled Statistics on Iron-Ore Exports' published by the GMOEA. While the Department of Planning and Statistics, Government of Goa provides the data on contribution of mining to primary sector and to the Net State Domestic Product (NSDP). The data for the World and

India’s iron-ore exports is taken from Iron-ore Manual, published by TEX Reports, Tokyo- Japan. The data period for the analysis is from 1962-2012. For the purpose of trend analysis the data period is divided into four sub-periods; 1962-87 as pre-statehood, 1988-2012 as post-statehood period, 1962-1992 as pre-liberalization and 1993-2012 as post-liberalization period respectively. Simple averages and relative percentages are calculated over the sub-periods to derive the results while the Ranking method is used to highlight the changing composition of country wise destination of Goa’s and India’s export.

2.1.2. Statistical Analysis

In order to compute the Instantaneous Growth Rate and the Compounded Annual Growth Rate (CAGR) the Semi-log *i.e* the Log-Lin models is used and are computed using the following models.

If Y_t = Variable at time t and Y_0 = initial year value of the variable, simple compounding is explained as

$$Y_t = Y_0(1 + r)^t \dots\dots\dots(1)$$

Where r is the compound rate of growth of Y overtime and taking the natural logarithm (Ln) of eqn. (1), we can write

$$\ln Y_t = \ln Y_0 + t \ln(1 + r) \dots\dots\dots(2)$$

Now letting

$$\beta_1 = \ln Y_0 \dots\dots\dots(3)$$

$$\beta_2 = \ln(1 + r) \dots\dots\dots(4)$$

For simplicity one can write (4) as

$$\ln Y_t = \beta_1 + \beta_2 t \dots\dots\dots(5)$$

Adding the disturbance term to (5)we obtain

$$\ln Y_t = \beta_1 + \beta_2 t + u_t \dots\dots\dots(6)$$

The above model is like any other regression model in that the parameters β_1 and β_2 is linear. The only difference is that the regress and is the logarithm of Y and the regressor is “time”, which will take values of 1, 2, 3 etc. This model is referred to as semi-log, for only one variable (in this case the regress and) appears in the logarithmic form. In such models the slope coefficient measures constant proportional or relative change in Y for the absolute change in the value of regressor, *i.e* the variable t .

Multiplying the relative change in Y by 100, gives the percentage change, or the growth rate in Y for an absolute change in X , the regressor. That is, 100 times β_2 gives the growth rate in Y ; also referred to as the semi-elasticity of Y with respect to X . The coefficient of the trend variable β_2 in the growth equation 6, gives the instantaneous (at a point in time) rate of growth and the CAGR (growth over a period of time) can be computed from eqn. (4) by taking the antilog of the estimated β_2 , subtracting 1 from it and multiplying the difference by 100.

The semi-log model is used to compute the relative change in a given variable over time while the linear-trend model measures the absolute change or the trend. In case of linear -trend model, instead of regressing the log of Y on time, Y is regressed on time, where Y is the regress and under consideration and the time variable t is known as the trend variable as depicted in the following

$$Y_t = \beta_1 + \beta_2 t + u_t \dots\dots\dots (7)$$

If the slope of coefficient in the above model is positive, there is an upward trend in Y , whereas if it is negative, there is downward trend in Y .

To test for structural stability of regression model break due statehood (1987) and liberalization (1991/1992), we use simplest form of dummies to distinguish the pre/post-statehood (pre and post-1987) and the pre/post-reform (pre and post-1993) period in order to check whether there was a difference in the regression of exports on time between two periods. Generally the Chow Test is used is used to test for such structural stability. However on the

basis of the Chow test it is difficult to tell whether the difference in two regressions during two different periods is because of the difference in the intercept terms, or the slope coefficients, or both. The equation using the Dummy Variable Approach finds whether there is any difference between the pre and the post-statehood period and also between the pre and post-reform periods. Also, unlike the Chow test the dummy variable approach also pinpoints the source(s) of difference the intercept or the slope, or both differ in the two periods by pooling all observations and running just one multiple regression as shown below

$$\ln Y_i = \alpha_1 + \alpha_2 D1_i + \alpha_3 D2_i + \beta_1 X_i + \beta_2 (D1_i X_i) + \beta_3 (D2_i X_i) + u_i \dots\dots\dots (8)$$

Where X_i records the time and Y_i the independent variable (exports). The dummy $D1_i$ equals the value 1 for observations in the pre-statehood and 0 for observations in the post-statehood periods, and the dummy $D2_i$ takes the value 1 for observations in the pre-reform period and zero for observations in the post-reform period respectively. α_2 is the differential intercept and β_2 is the differential slope coefficient indicating how much the slope coefficient of the first period differs from the slope coefficient of the later period. The introduction of the dummy, variable D_i in the multiplicative form ($D1_i$ and $D2_i$ multiplied by X) enables to differentiate between slope coefficients of pre and post-statehood and pre and post-reform periods respectively.

Assuming that $E(u_i) = 0$, we obtain

$$E(Y_i | D1_i \text{ and } Y_i | D2_i=1, X_i) = (\alpha_1 + \alpha_2) + (\beta_1 + \beta_2) X_i \dots\dots\dots (9)$$

$$E(Y_i | D1_i \text{ and } Y_i | D2_i=0, X_i) = \alpha_1 + \beta_1 X_i \dots\dots\dots (10)$$

Which are, respectively, the mean functions for pre-statehood and pre-reform (eqn. 9) and post-statehood and post-reform periods (eqn. 10) respectively and can be used to test the following hypothesis: If the differential intercept coefficient α_2 is significant, but differential slope coefficient β_2 is statistically insignificant we may at least not reject the hypothesis that the two regressions have the same slope (the two regressions differ only in the intercepts) that is, two regressions are Parallel. If both, the differential intercept α_2 and the differential slope coefficient β_2 is statistically significant, indicates that the two regressions are completely different *i.e* Dissimilar. If differential intercept α_2 and differential slope coefficient β_2 are insignificant, then both regressions are Coincident and if the differential intercept coefficient α_2 is statistically insignificant and β_2 is statistically significant, we may accept the hypothesis that the two regressions have the same intercept that is the two regressions are Concurrent. Significance is checked at two-tail levels.

The time-trend for the full period and for the pre-statehood / reform and the post-statehood / reform period using dummies are computed using the following linear trend models respectively.

$$Y_t = \beta_1 + \beta_2 t + u_t \dots\dots\dots (11)$$

$$Y_t = \alpha_1 + \alpha_2 D1_{2t} + \alpha_3 D2_{3t} + \beta_2 t + u_t \dots\dots\dots (12)$$

Where t is variable X representing the time period and Y is the dependent variable under study. $D1_t$ equals 1 to represent the pre-statehood period whereas equals 0 to represent the post-statehood period similarly $D2_t$ equals 1 to represent the pre-liberalisation period whereas equals 0 to represent the post-liberalisation period .

Assuming that $E(u_i) = 0$, we obtain the following mean functions for the two periods as under

$$E(Y_i | X_i, D1_i \text{ and } Y_i | X_i, D2_i=1) = (\alpha_1 + \alpha_2) + \beta_1 X_i \dots\dots\dots (13)$$

$$E(Y_i | X_i, D1_i \text{ and } Y_i | X_i, D2_i=0) = \alpha_1 + \beta_1 X_i \dots\dots\dots (14)$$

Equations (13) and (14) are the mean functions for pre-statehood and pre-reform, and post-reform and post-statehood periods respectively.

Like all studies, this analysis too suffers from the limitations of relying on unavailability of sufficiently broader primary data and the bias thereof. Though the break points remain the same, the starting year of the various data-points used in analysis differs due to the non-availability of data.

3. Results and Discussion

The results are discussed in 7 parts, 3.1 through 3.7 and presented in that order:

3.1. Contribution of Mining Industry to the Goa's Economy

The Table 1 presents an analytical enquiry of what is regarded as the backbone of Goa's economy, by analyzing the contribution of state primary sector and mining industry in the composition of its Net State Domestic Product (NSDP) and in terms of mining industry's share in the primary sector, both in constant and current prices. Measured in constant and current terms as well, in the year 2012 compared to 1962 a drastic decrease by around 70% is evident in respect of the contribution of primary sector and the mining industry to the total output of the State. The average share of primary sector in Goa's NSDP halved from 33% to 19% in post-statehood periods compared to pre-statehood periods whereas the average share of mining industry decreased by 57% in the same periods. It is clearly evident that the contributed output of industries like agriculture, forestry along with mining and quarrying put together in the year 2012 contribute less than one third compared to that in the year 1962.

Table 1. Sub-Period Averages relating Role of the Primary Sector and Iron-ore Mining Industry in Goa's Economy, 1962 through 2012 (in Percentages)

Periods	Primary / NSDP	Mining / Primary	Mining / NSDP	Primary / NSDP	Mining / Primary	Mining / NSDP
	in Constant Prices			in Current Prices		
Pre-Statehood, 1962-1987	31.92	23.40	7.68	30.91	22.67	7.06
Post-Statehood, 1988-2012	17.42	23.66	4.70	19.68	27.40	4.99
Pre-Reform, 1962-1992	28.70	20.90	6.44	28.72	22.12	6.44
Post-Reform, 1993-2012	17.21	28.60	6.66	17.58	30.81	5.85
Full Period, 1962-2012	25.93	24.62	5.86	24.50	25.20	5.67

Notes:a. Primary / NSDP denotes the percentage share of Primary sector to Total Net State Domestic Product, b. Mining / Primary denotes the percentage share of Mining Industry to Primary sector c. Mining / NSDP is the share of Mining industry to Goa's Total Net State Domestic Product. **Source:** Computed from Goa Statistical Handbook, Directorate of Statistics, Government of Goa, Various Issues.

The primary sector contributes to a meager 12% of the State's total output in year 2012 compared to nearly 24% in the year 1993 and 43% in the year-end 1962, while the mining industry contributes only 4% compared to 5% and 12% in the same years. This decrease when compounded annually is to the extent of 3.53 and 2.33% in case of the primary sector's and mining industry's contribution to the economy respectively. The rate of decrease in post-liberalization period in both cases increases by 2.54% and 0.88% respectively. The sub-period averages computed in table 1 also demonstrate the magnitude of decrease in contribution of the primary sector in NSDP during the post-liberalization period. This contribution decreases nearly by half in the post-reform period, compared to that of the pre-liberalization periods. In the 1962-2012 periods, the primary sector has on an average contributed a quarter portion of total domestic product of the state whereas the iron-ore mining industry's average contribution is to the extent of 6% respectively.

Within the primary sector, average contribution of mining industry stands at 22% and 30% during latest year 2012, measured at constant and current prices respectively and an increase in its contribution is recorded in post-reform periods compared to the former periods. This increase is also evident when the CAGR's are computed for the same periods, in table 2.

Table 2. CAGR's relating Contribution of the Primary and Mineral Sector in Goa's Economy, 1962 through 2012 (in Percentages)

Period	Share of Primary Sector to NSDP	Share of Mining Industry to Primary Sector	Share of Mining Industry to NSDP
Pre-Statehood, 1962-1987	-3.49 (0.07)***	-0.72 (0.02)**	-4.18 (0.11)
Post-Statehood, 1988-2012	-4.58 (0.12)	3.35 (0.02)*	-1.40 (0.09)***
Type of Regression during Pre and Post-Statehood period	Parallel	Dissimilar	Concurrent
Pre-Liberalization, 1962-1992	-3.29 (0.04)**	-0.81 (0.12)	-4.08 (0.16)
Post-Liberalization, 1993-2012	-6.64 (0.03)**	1.57 (0.14)	-4.80 (0.14)
Type of Regression during Pre and Post-Reform period	Dissimilar	Coincident	Coincident
Full Period, 1962-2012	-3.55 (0.07)***	0.79 (0.15)	-2.82 (0.03)**

Notes: a. Figures in Parenthesis indicate Probability (P) values b. *, ** and *** indicate statistical significance at 1, 5 and 10% levels. Source: Same as in Table 1.

The post-statehood and post-liberalization period records an increase over 3% and 6% respectively compared to that of the pre-statehood and pre-liberalization periods respectively. This growth when measured annually, measured 0.73 points during the entire period. During the full period, the mining industry contributes over 21% to the primary sectors output with an annual growth rate of 0.73 points and clearly indicates the importance of the mining industry in the composition of primary sector. The regression model 1 when applied to the data measures CAGR's for pre/post-statehood period and pre/post-liberalization period using qualitative variables and also finds whether the two regressions are different in intercept, or the slope or both. The regression model for the primary sector to NSDP in the pre/post-statehood period has a statistically significant intercept and a statistically insignificant differential slope coefficient; we may at least not reject the hypothesis that the two regressions have the same slope *i.e.* the two regression lines are Parallel. The model for primary sector to NSDP in the pre/post-liberalization period and mining to primary sector in the pre/post-statehood period are completely Different, as they differ in intercept as well as the slope coefficient. The regression for mining to primary sector and mining industry to NSDP in the pre/post-liberalization period have the same differential intercept and slope coefficient thus we may accept the hypothesis that both regressions are Coincident, whereas for the later the differential intercept coefficient is statistically insignificant in the pre-statehood period, we may accept the hypothesis that the two regressions have the same intercepts, *i.e.* the two regressions are Concurrent.

Tables 1 and 2 bring to light the shift in composition of Goa's net output and the decreasing contribution of the mining industry in general. There seem to be a complete transformation of the State's economic activity from natural resource and labour oriented growth to manufacturing, capital and knowledge intensive (service sector-led) growth. The relative reliance on agriculture, forestry, fishing and mining and quarrying put together in the primary sector also decreases significantly though the mining industry has retained its relative importance in the primary sector. However, the mining industry's contribution to states output has reduced by 67% over the entire period 1962-2012. In spite of a negative growth rate of 4.8% in the NSDP during the post-liberalization period compared to pre-liberalization era the mining industry significantly improved its share in the primary sector (1.67% CAGR). Within the primary sector; this industry records an impressive growth rate of 17%.

3.2. Composition of Goa's Mineral Production

The number of leases worked, total production of minerals in tonnes, composition of minerals produced and the average production per lease over 1962 through 2012 sub-periods are reflected in table 3.

Table 3. Numbers of Lease Worked and Percentage Production of Mineral Ores in Goa, 1962 through 2012

Periods	No. of Leases Worked	Percentage to Total Production		
		Iron-ore & Black	Manganese Ore	Bauxite
Pre-Statehood, 1962-87	216.35	98.26	1.60	0.14
Post-Statehood, 1988-12	95.82	99.55	0.18	0.27
Pre-Liberalization, 1962-92	197.00	98.47	1.39	0.14
Post-Liberalization, 1993-12	98.09	99.54	0.13	0.33
Full Period, 1962-12	173.13	98.71	0.78	0.18

Source: Computed from the Statistics provided by the Goa Mineral Ores Exporter's Association, Panjim Goa, Various Issues.

Over the period of time, number of leases worked has reduced significantly from average 197 leases in the pre-reform period to mere 89 leases in the latest period 2006-07, but the average production per lease has increased tremendously by over 50% in the same periods demonstrating an inverse relationship; as the number of leases reduced the production per lease increased. This is the effect of higher technological efforts and enhanced labour productivity.

Deeper excavations, use of sophisticated machinery and higher demand for ore from foreign markets have led to larger average production per lease (increase of 173%) during the same periods. It is also evident from the same table that Goa's production of Iron Black is significantly large (98.71%) among other minerals produced during the 1962 to 2012 periods and the production of other minerals like the Manganese Ore and Bauxite remains very meager at 0.78 and 0.18% respectively.

Table 4. CAGR's relating Total Production of Mineral Ores in Goa, 1962 through 2012 (in Percentages)

Periods	Total Production	Avg. Prodn. per Lease
Pre-Statehood, 1962-1987	3.26 (0.13)	5.14 (0.16)
Post-Statehood, 1988-2012	2.66 (0.12)	4.33 (0.13)
Type of Regression during Pre and Post-Statehood period	Coincident	Coincident
Pre-Liberalization, 1962-1992	2.39 (0.14)	5.72 (0.19)
Post-Liberalization, 1993-2012	2.67 (0.11)	5.37 (0.13)
Type of Regression during Pre and Post-Liberalization period	Coincident	Coincident
Full Period, 1962-2012	2.29 (0.08)***	5.72 (0.09)***

Notes and Source: Same as in table 3.

The CAGR's as reported in table 4 reveal that in the full period the total production has increased by 2.29% and the average production per lease is also predominant, registering 5.7% growth. The sudden export demand in the recent years has triggered production expansion stretching existing facilities. The growth rate for the pre-statehood period is impressive by 3.26% than the post-statehood which stands at 2.66%. The average production per lease also show high positive growth rate in the pre-statehood liberalization period then in the later. The regressions for total production and average production per lease for pre/post statehood and liberalisation period have same differential intercept and slope coefficient we may accept the hypothesis that both the regressions are Coincident.

3.3. Classification of Goa's Iron-ore Exports

The Table 5 portrays that Goa has exported almost cent percent of their iron-ore production during the 1962-2012 periods. In some years the percentage of exports to production exceed hundred for the ore is procured from other states to meet the shortfall of export production and secondly due to the historical stocks being cleared in the subsequent financial years. The iron-ore exports from Goa are in three forms Lumps, Fines and Pellets.

Table 5. Percentage Classification of Goa's Iron-ore Exports, 1962 through 2012

Year	Lumps	Fines	Pellets	Exports to Production Ratio
1962-1987	16.55	80.24	3.21	96.05
1988-2012	17.43	82.01	0.56	105.34
1962-1992	16.11	81.30	2.59	97.06
1993-2012	19.42	79.81	0.77	106.43
1962-2012	17.23	82.63	2.04	99.69

Note(s): a. For the period 1962-63 to 1967-68, Fines include export of Lumps and therefore this period is excluded for calculating sub-period averages for Lumps and Pellets. b. The Export to Production Ratios exceeds 100 in certain years because surplus backup production of earlier years (closing stock) is exported in those years. Source: Same as in table 3.

The same table (5) confirms that the contribution of fines in iron-ore exports is significantly large. Over the full period 1962-2012, around 17% of the total iron-ore exports comprised of lumps, 83% comprised of fines which don't have domestic demand whereas the balance 2% is in form of pellets. The exports of iron-ore in form of lumps

increased marginally from 16 to 19% during the post-reform periods compared to the prior, whereas exports in the pelleted form decreased by 70% during the same periods. The high level of exports in form of fines are due to couple of reasons; one factor being non-availability of adequate steel making and agglomeration (sintering and pelletisation) capacity within India and secondly, due to higher prices of iron-ore in the international market driven by the demand from China making it economical to export even the historically accumulated dumps of lower grades of fines from Goa State and *Reddi* region of Maharashtra State. China uses more of fines because their steel production technology is through blast furnace route and the iron-ore which they use are of poor grades requiring beneficiation at high cost. Thus they seek to take advantage of lower prices of fines in the international market.

The inter-period percentage change demonstrates that the total exports have increased by 320% in 2012 compared to 1962 whereas exports to production ratio have increased by 15% during the same periods. Table 6 depicts that the CAGR of the State's iron-ore exports is significantly higher after the economic reforms stimulated by increase in world steel production. Output of iron-ore increased mainly in four major producing countries; namely China, India, Brazil and Australia with growth rate of 38% in China, 13% in India, 9% in Brazil and 6.8% in Australia in the year 2012 with the new iron-ore mining capacity reaching new heights in the same year, much higher than the corresponding previous years. The post-reform period due to the opening up of the new markets and removal of restrictions from trade has benefited Goa to export even the backup production of the previous years.

Table 6. CAGR's relating Goa's Total Iron-ore Production and Exports, 1962-2012 (in Percentages)

Sub-Period	Total Iron-ore Export Growth	Growth in Exports to Production Ratio
Pre-Statehood, 1962-1987	3.69 (0.18)	0.41 (0.12)
Post-Statehood, 1988-2012	3.44 (0.15)	0.76 (0.13)
Type of Regression during Pre and Post-Statehood period	Coincident	Coincident
Pre-Liberalization, 1962-1992	2.81 (0.11)	0.27 (0.14)
Post-Liberalization, 1993-2012	3.78 (0.14)	0.57 (0.13)
Type of Regression during Pre and Post-Liberalization period	Coincident	Coincident
Full Period, 1962-2012	2.67 (0.06)***	0.37 (0.05)**

Notes and Source: Same as in table 3.

The same table 6 also reports that the growth rate of exports to production is predominant during the post statehood and post-liberalisation period. Thus there is demonstrated growth in total exports of iron-ore from Goa fuelled by buoyant demand indicating rising steel and metallic production globally. All parts of the world experienced a strong growth in steel demand. Although China is leading the way, steel output in other regions like Europe, and North American Free Trade Association (NAFTA) and Japan is also growing and the rising steel and metallic production are indicative of growing demand for iron-ores. The regression estimate when eqn. (8) is fitted for total exports and exports to production ratio in the pre and post-statehood/ liberalization period have same differential intercept and slope coefficient, we may thus accept the hypothesis that both regressions are Coincident.

3.4. The Global, National and Regional Export Trend

The sub-period averages reflecting comparative share of India and Goa's exports to World's total iron-ore exports are summarized in table 7.

Table 7. Comparative Trends in Iron-ore Exports of World, India and Goa, 1962 through 2012

Periods	India to World Ratio	Goa to India Ratio	Goa to World Ratio
Pre-Statehood, 1962-1987	6.94	47.32	3.26
Post-Statehood, 1988-2012	8.01	46.81	3.91
Pre-Liberalization, 1962-1992	7.22	46.35	3.32
Post-Liberalization, 1993-2012	7.92	47.01	3.66
Full Period, 1962-2012	7.67	47.55	3.43

Source: Same as in table 3

In the latest year-end 2012, exports from India record an impressive growth of 175%, almost double compared to that of Goa's exports (87%) *visa-vie* year-end 1961. The global exports however mark a modest 52% rise when measured absolutely. The analysis of the inter-period percentage changes reveals a positive liberalization effect for Goa. The opening of new markets and removal of restrictions from trade has led to a potential benefit in terms of over 75 and 37% growth in exports from India and Goa respectively. Currently India is the 4th major global player in iron-ore with a contribution of over 11% in global production and ranks third in the world trade of iron-ore after Australia and Brazil.

Table 8. CAGR's Relating Iron-ore Exports of World, India and Goa, 1962 -2012

Sub-Period	India to World Ratio	Goa to India Ratio	Goa to World Ratio
Pre-Statehood, 1962-1987	3.07 (0.12)	-1.19 (0.11)	1.84 (0.13)
Post-Statehood, 1988-2012	0.62 (0.06)***	-0.20 (0.15)	0.44 (0.13)
Type of Regression during Pre and Post-Statehood period	Concurrent	Coincident	Coincident
Pre-Liberalization, 1962-1992	2.07 (0.02)**	-1.00 (0.11)	1.04 (0.12)
Post-Liberalization, 1993-2012	3.44 (0.11)	-2.85 (0.12)	0.32 (0.16)
Type of Regression during Pre and Post-Liberalization	Parallel	Coincident	Coincident
Full Period, 1962-2012	0.96 (.08)***	-0.37 (.04)**	0.70 (.09)***

Notes and Source: Same as in table 3.

The Table 8 reveals that the share of India in World's iron export measured in terms of CAGR show 1% growth in the full period and has consolidated its position after reforms, recording 1% increase in growth in the pre-reform compared to the later periods. It is evident that Goa's exports are becoming increasingly uncompetitive in terms of competition from other states and also in the world market [26], though the state currently contributes 47% in India's iron-ore exports and *approx.* 3% share in the world exports in absolute terms. When measured relatively, the growth rate compounded annually for full period is negative (negative 0.35 percentage points) and the decrease in the growth rate is more predominant in the post-reform period compared to pre-reform era (from negative 1 percent to negative 1.8 percent). The tendency of decreasing growth is also evidenced in case of contribution of the state to total world exports, both during the pre/post-statehood and pre/post-liberalization periods. Thus, though there is a global surge in growth of iron-ore exports over the period for India and Goa, growth in the contribution of Goa's trade in India's total exports and also Goa's share in the World trade is relatively decreasing. The regression eqn. 8 for Goa/India and Goa/World for pre/post-statehood and pre/post liberalization period has same differential intercept and slope coefficient we may accept the hypothesis that both regressions are Coincident. Whereas, the regression on India/World for the pre/post-statehood period have same differential intercepts but differ in slope coefficient we may accept the hypothesis that the two regressions have the same intercept but in case of pre/post-liberalization period the regressions differ only in the intercepts we may thus at least not reject the hypothesis that the two regressions have the same slope.

3.5. Destination-wise Exports of Indian Iron-ore

It is possible to interpret the extent of diversification of the international market for Indian iron-ore over the years from the available data. Table 9 depicts the changing composition of Indian ore markets and ranks them in the order of their relative significance over varying sub-periods and the full period as well. Among other importers, Japan has maintained its relative importance as the largest importer of Indian ore consecutively from 1976 through 2000 periods, however the percentage of Indian exports to Japan are increasingly shrinking in the recent years. The reason can be attributed to diversification of export market. At the international market scenario there are new opening and some old markets have withered off with time.

Table 9. Changing Ranks of Indian Iron-ore Export Markets at Varying Periods
(1st Rank = Country with Largest Export Market Share to 26th Rank = Lowest Market Share)

India's Export Markets	Pre Statehood	Post Statehood	Pre Reform	Post Reform	Full Period
Japan	1	1	1	1	1
S Korea	3	3	3	3	2
Rumania	2	6	2	6	3
China	12	2	7	2	4
Italy	6	4	5	5	5
Others	4	17	4	18	6
Iran	20	5	14	4	7
Netherlands	10	7	10	7	8
Germany	5	25	6	22	9
Taiwan	14	8	20	8	10
Pakistan	13	9	12	9	11
Other Eastern Europe	8	14	8	20	12
Czechoslovakia	7	24	9	22	13
Turkey	20	10	16	10	14
Belgium	19	11	15	11	15
Australia	20	12	17	13	16
Hungary	11	15	11	22	17
France	15	13	22	12	18
Yugoslavia	9	25	13	22	19
Other EU Countries	16	16	18	16	20
Bahrain	17	19	19	19	21
North Korea	18	21	21	20	22
Indonesia	20	18	24	17	23
UAE	20	20	25	14	24
Other Asia	20	21	25	15	25
Other Middle East	20	23	23	22	26

Source: Same as in table 3

As reported earlier, Japan maintains the number one position over the entire period and the sub-periods as well. One striking observation is about the countries that have higher rank in the earlier period are later placed at a lower rank of relative importance and *vice versa*. For example, Germany in the pre-statehood / liberalization ranks 5th and 6th as relative important foreign market but loses its significance in post-statehood / liberalization period by standing out 25th and 22nd respectively. Similarly countries like Rumania (from 2nd position in the pre-reform period to 6th in the subsequent periods), Others (from 4th to 18th), Eastern European countries (from 8th to 20th), Czechoslovakia (from 9th to 22nd), Yugoslavia (from 13th to 22nd) and Hungary (from 11th to 22nd) lost their market share over the years. On the contrary new markets like China emerged in the post-reform periods compared to the former (from 7th position in the pre-reform periods to 2nd in the later), Iran (from 14th to 4th), Netherlands (from 10th to 7th), Taiwan (from 20th to 8th), Pakistan (from 12th to 9th), Turkey (from 16th to 10th), Belgium (from 15th to 11th), Australia (from 17th to 13th), France (from 22nd to 12th), Other European Union (from 18th to 16th), North Korea (from 21st to 20th), Indonesia (from 24th to 17th), UAE (from 25th to 14th), Other Asia (from 25th to 15th), and Other Middle East (from 23rd to 22nd). Countries like that of South Korea, Italy and Bahrain retained their relative importance even after the period of structural break as stable export markets. The changing composition of relatively important export market reveals the changing competitiveness of iron-ore export in the international markets due to various factors like government policies of the concerned countries, changes in the demand for iron-ore, changes in the availability from other countries, the quality of iron-ore, the cost of transportation and the price of ore.

In all above tables, Japan is not included in Asia because Japanese market is the major market for India. The second largest market (continent) for Goa's Iron ore export is Europe and next to it is Rest of Asia. The trend shows that the export to Japanese market is decreasing drastically so also the European market. But a tremendous change is observed with reference to Rest of Asia.

Table 10. Destination-wise Iron-ore Exports of India, 1976 through 2012 (Sub-Period Average of Relative Percentages)

Year	Japan	European Union	Rest of Asia	Middle East	Turkey	Australia	Others
Pre-Statehood 1976-1987	67.11	20.16	9.70	0.11	0.00	0.00	2.91
Post-Statehood 1988-2012	56.10	10.68	27.38	3.71	1.01	0.80	0.33
Pre-Reform 1976-1992	66.14	18.30	11.96	0.78	0.33	0.27	2.23
Post-Reform 1993-2012	51.29	8.69	33.64	4.54	0.94	0.74	0.17
Full Period 1976-2012	61.39	15.23	18.89	1.98	0.52	0.42	1.57

Source: Same as in table 3

The Table 10 reveals that the relative export share to Rest Asia has increased from 12% in the year 1976 to 34% in the post-reform periods. A positive change is also observed for Middle East but is not very significant. It is revealed that Japanese market growth rate is negative for throughout the period. The growth rates in respect of European market is decreasing and it is more evident in the post-reform periods and could be attributed to restrictions and regional grouping in trade. Due to opening up of the new Asian markets and regional grouping in Asian it is seen that there is a positive growth rate throughout the period of analysis.

3.6 Destination-wise Iron-Ore Exports from Goa

Goa over the period 1962 through 2012 has witnessed diversified markets for its iron-ore exports. Due to changes in the policies of the different countries, trade liberalisation, increase production and exposure to markets have all led to the changing composition of the iron-ore market of Goa. It is revealed that in line with the trend for India, Goa's major export market is Japan but the contribution is diminishing due to reasons mentioned above. Goa is now more concentrated in exporting to China which is an expanding market for the State.

The Table 11 on composition of Goan iron-ore export market reports that similar to India Japanese market is ranked 1st throughout the period. A remarkable change is witnessed in respect of China, which was ranking 38th in pre-statehood / pre-liberalization, stands 2nd in the post-statehood / liberalization period, and third in the full period indicating the changing composition of foreign market. The reverse observation is with reference to Czechoslovakia as it stands as the 23rd in the post-reform era compared to its 5th position in pre-liberalization periods.

The sub-period averages of destination-wise exports of Goan iron-ore are reported in table 12 and reveals that Japan always has the highest relative percentage share of Goa's export of iron-ore. But here too like India, exports to Japan are decreasing over the period of time. The share has fallen considerably in the year 2012 whereas; the Rest of Asia the share is increasing. The period averages also reveal that in the full period the Japanese market share is 69.75% while that of the Rest Asia is merely 11.28%.

The CAGR's computed in reports negative growth rate throughout the period for the Japanese market and European market. In case of Europe, CAGR has fallen drastically in the post-statehood / liberalization period *i.e.* -4.77 and -6.86 respectively and is mainly because of the regional groupings and the impact of trade restrictions. Also Goan iron-ore grade is faltering as compared to the other competitors like Australia and Brazil. Rest of Asia shows a very impressive growth rate as a major export market in the post-statehood and post-liberalisation period, which again can be attributed to Regional Grouping, formation of ASEAN, SAARC and other Asian groups

Table 11. Changing Ranks of Goa's Iron-ore Export Markets at Varying Periods
Goa's Largest Export Market Share (1st Rank) to Lowest Market Share (26th Rank)

Goa's Export Markets	Pre- Statehood	Post- Statehood	Pre- Reform	Post- Reform	Full Period
Japan	1	1	1	1	1
S Korea	3	3	3	3	2
Rumania	2	6	2	6	3
China	12	2	7	2	4
Italy	6	4	5	5	5
Others	4	17	4	18	6
Iran	20	5	14	4	7
Netherlands	10	7	10	7	8
Germany	5	25	6	22	9
Taiwan	14	8	20	8	10
Pakistan	13	9	12	9	11
Other East Europe	8	14	8	20	12
Czechoslovakia	7	24	9	22	13
Turkey	20	10	16	10	14
Belgium	19	11	15	11	15
Australia	20	12	17	13	16
Hungary	11	15	11	22	17
France	15	13	22	12	18
Yugoslavia	9	25	13	22	19
Other EU	16	16	18	16	20
Bahrain	17	19	19	19	21
North Korea	18	21	21	20	22
Indonesia	20	18	24	17	23
UAE	20	20	25	14	24
Other Asia	20	21	25	15	25
Other Middle East	20	23	23	22	26

Source: Same as in table 3

Table 12. Sub-Period Percentages of Goa's Iron-ore Export Market Destinations, 1962-2012

Year	Japan	Europe	Rest Asia	Middle East	Others
1962-1987	77.60	17.93	3.43	0.59	0.46
1988-2012	58.19	18.15	22.82	0.78	0.06
1962-1992	75.99	18.61	4.44	0.58	0.38
1993-2012	54.13	16.53	28.37	0.88	0.08
1962-2012	69.75	18.02	11.28	0.67	0.30

Source: Same as in Table 3

Thus from the above findings, it is brought to light that there is shift in the changes in the composition of Goa's iron-ore export market destination. There seem to be a significant transformation of export market, *i.e* Goa's iron-ore exports have eased concentration form Japan and are more headed towards the Chinese markets. Chinese crude steel production represents over 34% of the total world production by end-2012 making it the topmost country in production of steel. It is also the largest importer of iron-ore, accounting for one-third of global imports. As far as global steel production is concerned, China has become the dominant source in the world at present. From a production of 89.54 million tonnes in the year 1993, China's crude steel production has gone up substantially to hit 423 million in 2012, recording a phenomenal growth in CAGR of over 16%. As compared to this, the growth in the overall world crude steel production has been modest with a CAGR of 2.9%. In fact China surpassed Japan, the world-wide leader in the industry producing 76 million tonnes of pig iron in the year 1992 itself. The unprecedented growth in China's steel production has fuelled a high iron-ore import demand growth. China's astonishing growth meant that large conglomerates located in Brazil and Australia, continued to invest large sums of money to increase production to meet Chinese demands. Present demand for iron-ore fines comes from small Chinese steel mills and is on spot

basis and hence cyclical. All the big steel plants in China, Japan and South Korea have long-term contracts with Australia, Brazil, India and South Africa for iron-ore supplies and China negotiates prices each year, much to the disadvantage of Indian iron ore exporters.

China due to its rapid depletion of iron ore reserves depends upon import of iron ore from Australia, Brazil and India, for its steel industry. Indian iron ore of middle grade is better than ore from Brazil and being cheap for Chinese steel industries, they have switched over to Indian ore, thereby increasing the exports from India. The steel requirement has also increased in China due to Olympic Games to be held in the year 2008. Hence it is anticipated that requirement of iron ore may reduce drastically after conclusion of Olympic Games in 2008 in China. However, China has steel manufacturing units for their domestic and export requirement and has also become by now world's top steel exporter, its exports being to the tune of one third of USA's total steel production. China will also play a major role in export of steel, as due to economic liberalization in China, the cost of production and labour is much cheaper over there, than in any other European countries. Thus considering all the facts, it does not seem, there will be an end to China's growth in steel production in coming years.

3.7. Share of Indian and Goan Iron-ore in Japan's Imports

It is evident from the data in table 13 that Japan is the most important market destination of iron-ore export of India and Goa and therefore it is of considerable importance that the market share of India and Goa in Japan's iron-ore imports be analyzed.

Table 13. Sub-Period Averages of Japan's Absolute and Relative Iron-ore Imports from India and Goa, 1974-2012

Periods	Import from India (%)	Imports from Goa (%)
Pre-Statehood, 1974-1987	13.81	7.02
Post-Statehood, 1988-2012	13.96	6.97
Pre-Liberalization, 1974-1992	14.45	6.90
Post-Liberalization, 1993-2012	12.93	7.15
Full Period, 1974-2012	13.89	6.99

Source: Same as in table 3

The comparative share of India and Goa's exports to Japan's total import of iron-ore over the period from 1974 through 2012 are reflected in table 13. In the year-end 2012 compared to 1974, export growth from India and Goa to Japan record a decreasing trend of -18.47% and -32.39% respectively. The total imports from Japan also decreased by -3.83 in the same periods. The openings up of the other potential markets like China and Europe and also imports from other countries by Japan has led to decrease in the market share of India and Goa to some extent. The share of India in Japan's iron-ore import measured in terms of CAGR reveal a negative growth rate in the full-period. In pre-statehood and pre-reform periods the growth rate was positive but their relative magnitudes have reversed significantly in the later periods. It is also evident that Goa's export has remained somewhat unimpressive with the growth rate of 0.07%. Thus over the period under study, the iron-ore exports of India and Goa to Japan are decreasing but India's share falters considerably to that of Goa.

4. Conclusions

Like for rest of the country, export is an important economic activity for Goa and since in Goa the major export is of iron-ore, and mining industry plays an important role in employment generation. Iron-ore mining industry in Goa has hundred percent orientations towards exports. The contribution of primary sector to the Goa's NSDP and the iron-ore export sector to primary sector has considerably decreased over the years, 1962-2012 underlying the decreasing contribution and the resultant compositional shift in the Goan economy. Though the absolute figures on mining industry's contribution to the State shown an increasing trend, it is on the decline when measured relatively because of progress made by other sectors of the Goan economy. State's iron-ore exports significantly improved after the economic reforms stimulated by increase in world steel production however Goa's exports are becoming

increasingly uncompetitive in terms of competition from other states and also in the world market, though the state currently contributes 47% in India's iron-ore exports and *approx.* 3% share in the world exports in absolute terms.

This study also brings to light that though concessions / leases of the iron-ore industry are decreasing, the average production per lease is increasing, indicating the effect of higher technological efforts and enhanced labour productivity. The production of iron-ore is increasing and the exports too are showing a rising trend with respect to India mainly because of many concessions and changes in the Mining Act of India and the relevant policy changes. The share of iron-ore export of India and Goa in the global iron-ore export market is remarkable and records a positive growth over the years but it is evident that the share of Goa in India's iron-ore export is decreasing. The changing composition of the export markets reveals the changing competitiveness of iron-ore export in the international markets due to various extraneous factors. There seem to be a significant transformation of export market, *i.e.* Goa's iron-ore exports have eased concentration from Japan and are more headed towards the Chinese markets. The direction of mineral ore exports of Goa is mainly to Japan, Europe, China, South Korea, Gulf countries, Kenya *etc.* the destinations of India as well as Goa's exports are changing and the main reasons can be attributed to trade restrictions, regional groupings, fall in the iron-ore grades, tough competition from the other suppliers *etc.*

The iron-ore mining sector is very important and presently contributes around 4-5% to Goa's NSDP. To develop the mining sector, the challenge is investing in prospecting, encouraging mining; enhancing the role of catalytic institutions; building capacity; ensuring easy access to mineral rights, and promoting research and development. The options that are available to meet the above challenges include providing adequate resources for basic mapping and survey work, providing a special package of incentives, undertaking more exploratory work to identify mineral deposits with economic potential, intensifying investment promotion and making available information on the activities of the sector, strengthening the institutional set up and developing human resources, providing necessary infrastructure, revising the Mines and Minerals Policy / Act [27] to make it more investor friendly, provide adequate funding for research in mining activities while addressing the concerns of local steel industry about inadequacy of iron-ore [28].

The present study thus explores time-trends in iron-ore exports of Goa for over 5 decades across heterogeneity of space and time, broadly suggesting a diminishing contribution of the iron-ore export activity to Goan economy.

5. References

1. S. Srinivasan. India's import-export scenario during 2004-2013. *Indian Journal of Economics and Development*. 2015; 3(1), 127-131.
2. P. Bhawan. Comprehensive industry document on iron-ore mining, Central Pollution Control Board, Ministry of Environment and Forests, Government of India. 2007.
3. TERI. Overview of mining and mineral industry in India, prepared for International Institute for Environment and Development, United Kingdom, ATA Energy Research Institute, Government of Goa. 2001.
4. Digital Goa. History of mining in Goa. http://www.digitalgoa.com/eg_disp.php?cid=25&typ=eg. Date accessed:21/05/2016.
5. R. Gokul. Iron and manganese ore reserve potential of Goa, Geological Survey of India, 2012.
6. P. Demello. Goa mining logjam. <http://iproxy.inflibnet.ac.in:2055/journal/2015/7/reports%C2%ADstates%C2%ADweb%C2%ADexclusives/goas%C2%ADmining%C2%ADlogjam.html#.2012>; Date accessed:21/06/2016.
7. R. Basu. Mining in Goa: Beyond forest issues. *Economic and Political Weekly*. 2012; XLVII. 3, 21st January.
8. T. Cardozo. Mining mess in Goa. *Goa Today*. 2012; 26-28.
9. T. Niranjana. Digging one's ore grave. *The Week*. 2012; 32-33.
10. AghorA. Goa public accounts committee blows the lid off mining scam, *Down To Earth*, <http://www.downtoearth.org.in/content/goa-public-accounts-committeeblows-lid-mining-scam>. 2011; Date accessed:10/05/2016.
11. Jain, S. Goa: Politics of Iron-gate. <http://www.ndtv.com/article/india/goa-politics-of-iron-gate-268066>. 2012; Date accessed: 20/05/2016.
12. N. Kamat. Environmental geopolitics of iron ore mining-II. *Goa Today*. 2012; Pages 15-18.
13. N. Kamat. Environmental geopolitics of ore mining –III. *Goa Today*. 2012; December, 1112-13.

14. N. Kamat. Environmental geopolitics of iron ore mining –IV. *Goa Today*. 2013; January. 31-32.
15. NCAER. Techno-economic survey of Goa. Daman and Diu, 1962; New Delhi.
16. NCAER. Role of mineral exports in economic development of Goa: A historical and economic enquiry. 2002; New Delhi.
17. NCAER. A study of contributions of Goan iron-ore mining industry. 2002; New Delhi.
18. R. Basu. NCAER on Mining in Goa: Inconvenient truths. *Economic and Political Weekly*. 2012.
19. R. Venkatesan. NCAER's Report on Goa: A Rejoinder. *Economic and Political Weekly*. 2012; Vol XLVII, 17th March.
20. L. Xavier, P. Miriam, P. Mireia, P. Eloi, S. Clara. Mining in Goa (India): An Interdisciplinary Study, Universitat Autònoma de Barcelona. 2013.
21. Kamat, Manasvi, Kamat Manoj. Inter-firm performance of iron-ore exports: analysis using micro-level data. *Indian Journal of Management Science*. 2016; V.1, 107-118.
22. Kamat, M. Manasvi. Iron-ore export instability and the market concentration: temporo-spatial analysis in a regional context. *Asian Journal of Research in Marketing*. 2016; June. 1-15.
23. TERI. Area-wide environmental quality management (AEQM) plan for the mining belt of Goa state, Energy environment Interface, TATA Energy Research Institute. 1998.
24. P. Mukhopadhyay, G. Kadekodi. Missing the woods for the ore: Goa's development myopia. *Economic and Political Weekly*. 2011; XLVI.45, November. TERI. Environmental & Social Performance Indicators and Sustainability Markets in Minerals Development: Ecosystem Health & Human Well-being, Phase III. 2006.
25. D. N. Bhargava. Strategy for environmental management in mining and associated operations, Indian Bureau of Mines, Ministry of Mines, Government of India, 2012.
26. T. J. Brown. World mineral production, British Geological Survey 2013, Keyworth Nottingham. <http://www.bgs.ac.uk/mineralsuk/statistics/worldStatistics.html>, Date accessed: 17/05/2016.
27. Government of India. National mineral policy 2008. http://mines.nic.in/writereaddata/filelinks/88753b05_NMP2008.pdf. Date accessed 30th April, 2013.
28. K. Das. India's iron-ore reserves insufficient for projected steel production. <http://www.miningweekly.com/article/indias-iron-ore-reserves-insufficient-forprojected-steel-production>. Date accessed: 21/05/2016.

The Publication fee is defrayed by Indian Society for Education and Environment (www.iseeadyar.org)

Cite this article as:

Dr. (Mrs.) Manasvi M. Kamat. Iron-ore Exports and Goa's Economy, 1962-2012: A Time-series and Cross-sectional Analysis. *Indian Journal of Economics and Development*. Vol 4 (7), July 2016.