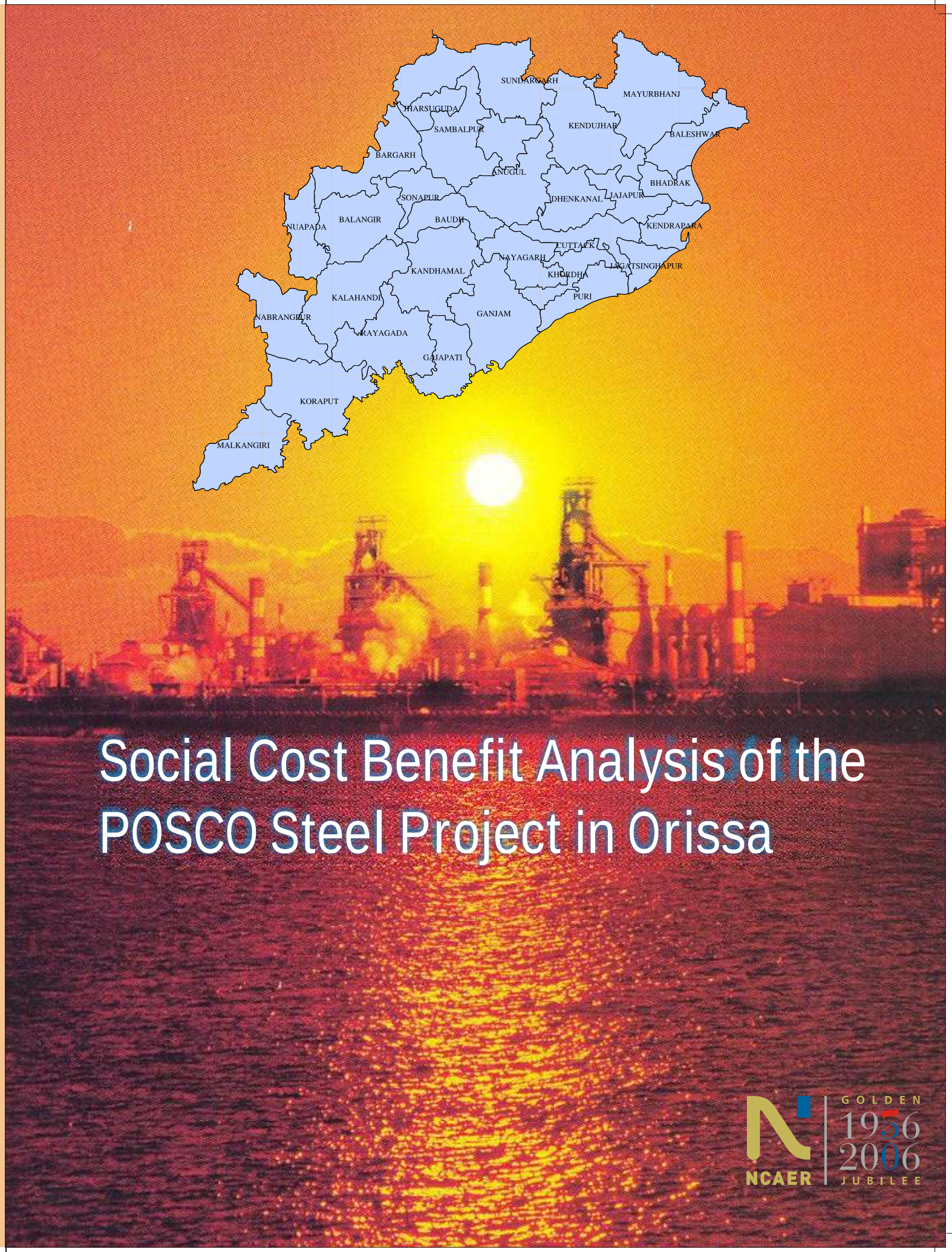


Social Cost Benefit Analysis of the POSCO Steel Project in Orissa

NCAER

GOLDEN 1956 2006 JUBILEE

Social Cost Benefit Analysis of the POSCO Steel Project in Orissa

January 2007

National Council of Applied Economic Research (NCAER)
Parisila Bhawan, 11, I.P. Estate
New Delhi- 110 002, INDIA
Tel: +91-11-2337 9861-63
Fax: +91-11-2337 0164
website: www.ncaer.org

Cover design & Inside page layout concept: Rakesh Kumar Srivastava (NCAER)

Preface

With the growth of the Chinese and Indian economies the Steel industry has been radically reshaped around the globe. India's high quality ore, growing domestic demand and more liberal attitude toward foreign investments has brought it within the sights of the global steel majors, including POSCO of Korea.

NCAER was approached to carry out a Social Cost Benefit Analysis of the POSCO project. Though NCAER's 50-year history contains numerous reports analysing the socio-economic profits of diverse industrial projects, this was to be the biggest ever considering the size of the investment and its long term implications for the Indian economy and the economy of the state of Orissa.

As is well understood, the social cost benefit analysis approach allows an assessment of the impact of a project on the national economy unlike financial analysis, which looks at the impact of the project on the finances of the investors. For a project to be economically viable, it must be financially sustainable, apart from being economically efficient. If a commercial project is not financially sustainable, economic benefits would not accrue. Therefore, essentially, the two complement each other. This report assesses the social yield of POSCO Steel Plant investments in the state of Orissa.

The study considered two alternatives; producing steel within the state of Orissa versus mining the iron ore and exporting it. Output and employment multipliers were calculated for both options. This made the construction of a state level input-output table necessary. This was followed by the estimation of depletion premiums or Opportunity Cost for using non-renewable resources.

A significant feature of this Report is the use of Least-Cost Analysis to identify the least cost project technology option for supplying output to meet the forecasted demand-supply gap. The Average Incremental Economic Cost for each technological alternative was estimated in order to identify the alternative with the lowest per unit costs. The significant finding of the report is:

- The EIRR for the POSCO project works out to 16.6 per cent. Sensitivity Analysis indicates that even in the worst case scenario — sales 10 per cent lower than estimated — the EIRR at 13.9 per cent would remain above the hurdle rate of 12 per cent. This implies that apart from representing the least cost technology, POSCO's project would yield attractive returns. The economic impact of the project is estimated at USD 2.5 billion at the test discount rate of 12 per cent.

It is NCAER's hope, the policy planners would find the report relevant and useful.

New Delhi
November 2006

Suman Bery
Director-General
NCAER

Study Team

Team Leader and Main Author
Mr. R Venkatesan
Senior Fellow & Head, Industry Programme Area, NCAER

Core Research Team and Co Authors
Dr. Wilima Wadhwa
Senior Consultant, Industry Programme Area, NCAER

Project Advisory Support and Consultation inputs
Prof. M.R. Saluja
Fellow, India Development Foundation

Core Research Team and Research Inputs
Mr Sujit Basu
Research Associate, NCAER

Research Assistant
Ms. Rashmi Rastogi
Research Associate, NCAER

Editor
Mr. Udayan Namboodiri

Contents

List of Tables & Figures

Executive Summary

- Rising international demand has made the steel industry buoyant again after many years of stagnation.
- The National Steel Policy (NSP-2005) lays stress on accelerating growth in domestic production and consumption of steel to achieve global competitiveness not only in terms of cost quality and product mix, but also to match global benchmarks of efficiency and productivity. It is committed to raise indigenous production to over 100 million tonnes by 2019–20 from the 2004–05 level of 38 million tonnes, including the export component of 26 million tonnes.
- POSCO, the world's third largest steel company with over 30 million tonnes per annum (mtpa) capacity and diversified operations in 16 countries, entered India in 2005.
- POSCO intends to set up a Special Economic Zone (SEZ) in Orissa to manufacture superior steel and export 6.3 million tonnes of its production. This would help in achieving the target for exports set by NSP – 2005 — annually 26 million tonnes by 2019.
- POSCO would invest in both the Domestic Tariff Area (DTA) as well the SEZ. Of the total investment of Rs 528.13 billion, Rs 77.9 billion will be in the DTA and the remaining Rs 450.23 billion in the SEZ. The investment would consist of the integrated steelworks with linked infrastructure in the SEZ, development of iron ore mines and related infrastructure in the DTA.
- NSP - 2005 has identified inadequate infrastructure and high cost of debt as the steel sector's weaknesses. POSCO's intended investments and operations would address these issues, with planned investments in roads, water, power, townships, etc.
- NSP -2005's goal of discouraging iron ore exports would not conflict with POSCO's production process since the proposed Finex technology uses non-coking coal.
- An increase in demand and therefore output of one sector leads to a multiplier effect in the economy. The Input-Output Table is used to estimate these multiplier effects.
- POSCO has two alternatives. It could either stop the project at the iron ore mining stage, or, it may go on to use the mined ore for making steel. Therefore, we study the impact of both options, by calculating the Output and Employment Multipliers, taking into account backward linkages of the iron ore and steel sectors.
- The Output Multiplier for iron ore is 1.40 while that for steel is 2.36. In other words, every Rs 1 lakh worth of output in the iron ore sector would result in Rs 1.4 lakh of output (including the Rs 1 lakh output of iron ore) in the economy. Similarly for each Rs 1 lakh output in the iron and steel sector, the economy would derive an output of Rs 2.36 lakh. The Employment Multiplier for iron ore is 0.35 and for steel it is 0.69. In other words, for every Rs 1 lakh of output, 0.35 man-year of employment is created in the case of iron ore while it is 0.69 man-year for every Rs 1 lakh output of crude steel. Therefore, in terms of both output and employment, steel has a larger impact.
- These multipliers imply that POSCO's iron ore project would create an additional employment of 50,000 person years annually for the next 30 years. This translates into Rs 20 billion of additional output for Orissa. In terms of value addition, the iron ore project would contribute 1.3 per cent to Orissa's State Gross Domestic Product (or SGDP) by 2016-17.

- On the other hand, if POSCO puts up the steel project to utilise the entire iron ore mined in the State, the impact on the economy would be much greater — 8,70,000 person years of additional employment each year over the next 30 years. This translates into Rs 298 billion of additional output for Orissa. In terms of value addition, the steel project would contribute 11.5 per cent to Orissa's SDP by 2016-17.
- Having established that steel production has a much larger impact on the economy in comparison to iron ore extraction, the next step would be to compare POSCO's Finex technology for steel production with the standard Blast Furnace technology. The comparison is done using Least Cost Analysis (LCA) at economic costs using conversion factors to convert financial costs into economic costs.
- In doing the LCA, we take into account the depletion premium for high and medium grade iron ore. The economic cost of iron ore is derived by increasing the cost of extraction by the depletion premium which is the average incremental cost of depletion premiums computed yearwise.
- High and medium grade iron ore reserves may not last more than 19 years even if exports of these grades are frozen at the current level or if the targets set out in the draft steel policy are to be met. The depletion premium is $ 10.18 for a steel producer located within Orissa and $ 27 for a raw mineral exporter from Orissa for value addition elsewhere. No such depletion premium has been applied for coking coal as its prices did not exhibit any trend prior to the recent steep price hike.
- The Average Incremental Economic Cost (AIEC) is used as the decision criterion to compare technology options, viz. the present value of investment and operation costs at economic prices, divided by the present value of quantity of output. The test discount rate used is the Economic Opportunity Cost of capital. The conversion factors (ratio between the Economic Price Value and the Financial Price Value for a Project Output or Input) are used to convert the constant price financial values of project benefits and costs to economic values.
- The AIEC for crude steel produced through the Finex process is $ 308 per tonne compared to $ 345 per tonne for the Blast Furnace process. AIEC can also be interpreted as the average price needed per tonne for the project to earn a 12 per cent Economic Internal Rate of Return (EIRR). Thus, POSCO's Finex process of steel making turns out to be the least cost option when compared to the Blast Furnace alternative.
- The AIEC of crude steel produced through both Finex as well as Blast Furnace processes is far lower than the forecasted steel slab price that is likely to prevail post 2006. This is estimated to be around $ 450 per tonne — indicating the cost competitiveness of Indian steel in the international market.
- Even though POSCO's Finex technology turns out to be the least cost option, we would still have to check whether it is an economically worthwhile project. In other words, we work out its EIRR and accept the project if it turns to be greater than the hurdle rate of 12 per cent
- The EIRR for the POSCO project works out to 16.6 per cent. Sensitivity Analysis indicates that even in the worst case scenario — sales 10 per cent lower than estimated — the EIRR at 13.9 per cent would remains above the hurdle rate of 12 per cent. This implies that apart from being the least cost technology, POSCO's project would yield attractive returns. The economic impact of the project is estimated at $ 2.5 billion at the Test Discount Rate of 12 per cent.
- Externalities associated with the POSCO project are in the infrastructure development area. POSCO-India is working on securing a safe transportation route for iron ore by participating in a public – private joint venture rail-link project for the Haridaspur – Paradip section.
- There is also a proposal for the construction of 6.7- km coastal road from Paradip to POSCO-India's SEZ site. POSCO-India also plans to construct 11- km access roads from the SEZ to NH-5A and SH-12. This connectivity would reduce the distance from NH-5A and SH-12 to the SEZ. It would make power receiving equipment like towers, cables and transmission hardware in the DTA.
- POSCO-India would build an "Indian township" and a "Korean township" with modern amenities to house all employees in the SEZ and the DTA.

- POSCO-India's project if set up in an SEZ area will contribute a cumulative tax revenue (indirect taxes on domestic sales and capital goods, corporate tax etc.) of Rs 174,970 crore, in nominal terms, to the state Government of Orissa (GoO) and the Government of India (GoI) over the useful life of thirty-five operating years per report of the Economic Law Practice firm *Das and Associates* prepared for *NCAER* .The GoO cumulative share would be Rs 77,870 crore on account of VAT inflow on domestic sales and the share accruing to the state government from the GoI on the tax revenue collected from the project.

  The opportunity cost incurred in granting SEZ status, viz., the revenue foregone by the central and state governments, has been computed as the difference in present values (PV) of possible tax inflows from the project assuming it is located in the DTA area rather than in an SEZ area. The present values have been calculated using a 12 per cent discount rate. The PV of the DTA location alternative at 12 per cent discount rate works out to Rs 22,092 crore (GoO share Rs 10,052 crore) vis-à-vis the SEZ alternative of Rs 18,403 implying that the opportunity cost incurred in awarding SEZ status would only be Rs 3689 crore, viz., US$ 0.8 billion. This works out to be around 33 per cent of the net social benefits the project would confer on the Orissa state and Indian economy.

  Besides, as elaborated earlier, based on the results of I-O Table, in view of the high output-multiplier effects (2.36), any partial waiver of tax on steel output produced within the state boundaries gets compensated by additional tax inflows to the extent of 136 per cent from input supplying industries assuming that steel and input supplying intermediates' industries have similar tax rates. Thus, it would be beneficial for the state economy to offer incentives to lure investments to set up steel plants over the alternative of collecting the depletion premium of US$ 27 per tonne of ore exported from the state for processing elsewhere.

Approach for Least–Cost and Economic Analyses-POSCO Steel Project in Orissa

CHAPTER

1

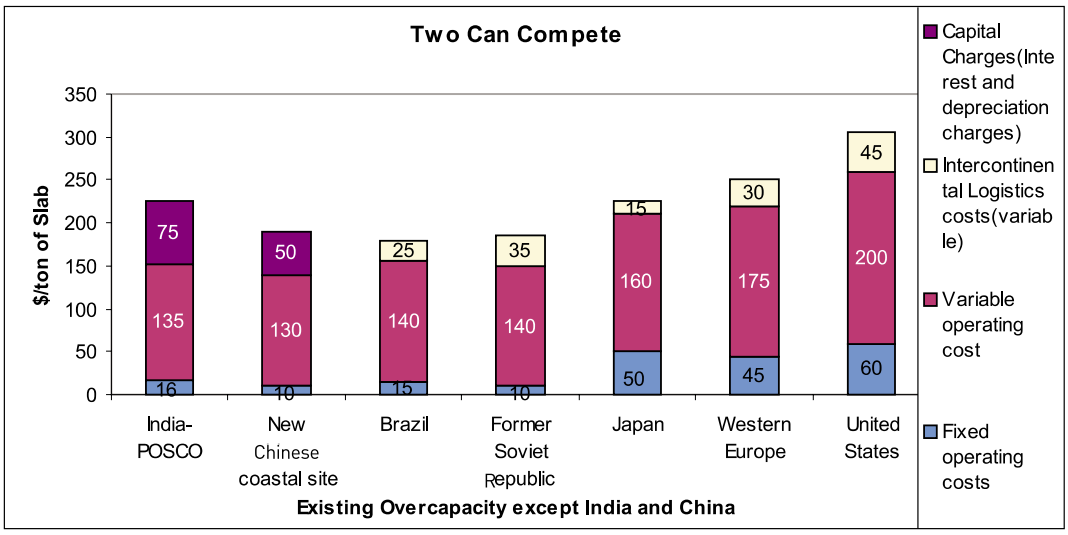
Approach for Least–Cost and Economic Analyses-POSCO Steel Project in Orissa

Introduction

The preamble to the draft National Steel Policy-2004 and the implicit preamble to the strategic goal in the current NSP-2005, recognises the importance of steel as the universal intermediate for building the industrial and infrastructure base of an economy. It also acknowledges that India has the necessary resource base, skills and capability to become a leading, quality supplier of steel to the world. It further recognises the dividends that would accrue to India from the process of restructuring and adjustment now evident in world industry resulting in relocation of production centres across the globe.

The NCAER team's research findings indicate that, given the significant Output and Employment Multiplier effects, countries prefer to locate production centres within their economies even at a small cost disadvantage. According to Mc Kinsey (2004), India's new investments could be more attractive in meeting demand than from existing overcapacities in Japan, Europe and USA. Operating costs, including capital recovery charges per tonne of crude steel in India and China, are lower than operating costs (excluding capital recovery charges) in Japan, Europe and USA as shown in the figure.

Figure 1: Cost competitiveness in steel production from India and China's new investments vis – a –vis existing overcapacities elsewhere- (India POSCO's capital recovery includes capital recovery for infrastructure investments unlike the Chinese new investments which includes only steel works investments.)



Sources: India - POSCO Feasibility Report; Rest Mc Kinsey Quarterly, 2004

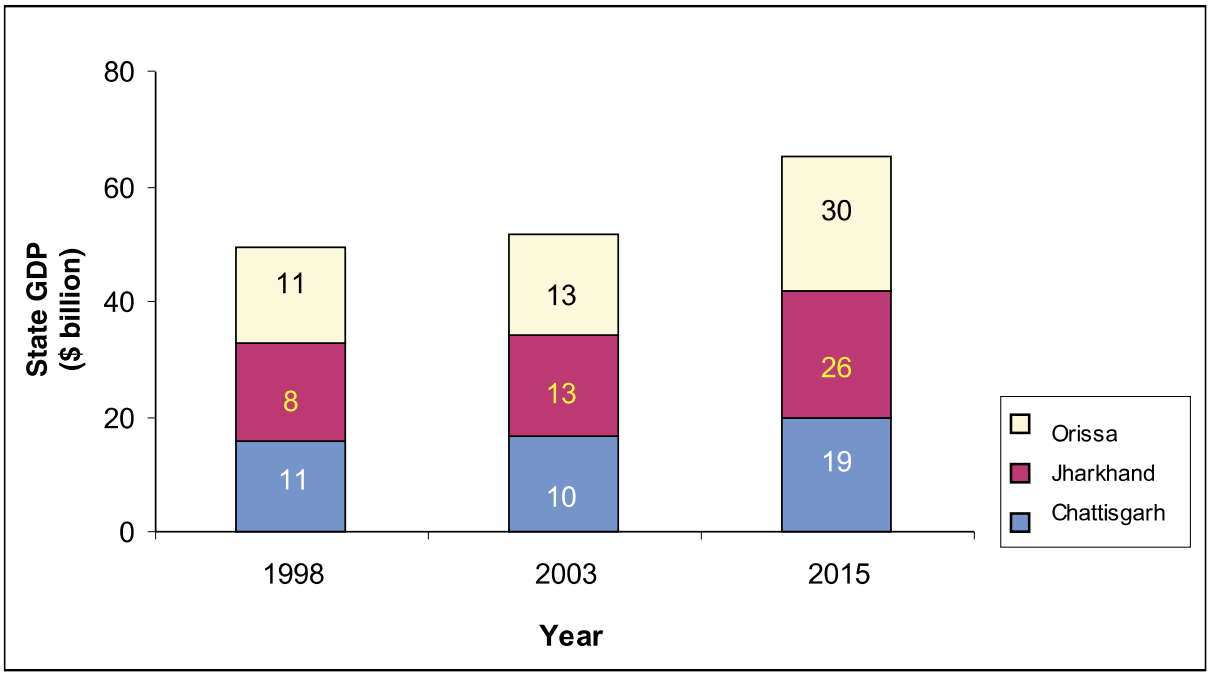
The main obstacles in realising the potential, according to the national policy document, are shortfalls in infrastructure and paucity of R&D inputs. POSCO's proposal to build a 12 million tonne steel plant at an investment of around $ 12 billion with the necessary accompanying infrastructure using the Finex process which overcomes the dependence on coking coal, fulfills all the aspirations spelt out in the strategic goal of NSP - 2005. It also suggests the steps that would be required for India to overcome bottlenecks in realising its potential.

The purpose of this report is to examine whether the Finex technology is the LCA to obtain economic EIRR. An analysis that compares the costs of technically feasible but mutually exclusive alternatives for supplying output to meet a given forecast demand is the purpose of LCA. The analysis should be carried out using discounted values over the life of a project, using the opportunity cost of capital as the discount rate. Such an analysis is used in this report to identify the LCA for meeting project demand.

Financial and Economic Analysis

The economic analyses of projects is similar in form to financial analyses. Both appraise the profits of investments. But the concept of financial profit is not the same as economic profit. The financial analysis of a project estimates the profit accruing to the project-operating entity or to the project participants, whereas economic analysis measures the effect of the project on the national economy. For a project to be economically viable, it must be financially sustainable, apart from being economically efficient. If a project is not financially sustainable, economic benefits would not accrue. Financial analysis and economic analysis are, therefore, two sides of the same coin and complementary.

Figure 2: Metals and Minerals sector's share of state GDP - Eastern States



Source: McKinsey Quarterly, 2005 Special Edition

Both types of analysis are conducted in monetary terms, the major difference lying in the definition of "costs" and "benefits". In financial analysis all expenditures incurred under project and revenues resulting from it are taken into account. This form of analysis is necessary to:

- assess the degree to which a project will generate revenues sufficient to meet its financial obligations;
- assess the incentives for producers, and,
- ensure demand or output forecasts on which the economic analysis is based, a consistent with financial charges or available budget resources.

Economic analysis attempts to assess the overall impact of a project on improving the overall economic conditions of the country concerned. It assesses a project in the context of the national economy, rather than for the project participants or the project entity that implements the project. Economic analysis differs from the financial in terms of both (i) the breadth of the identification and evaluation of inputs and outputs, and (ii) the measure of benefits and costs. To identify project costs and benefits, the situation "without the project" should be compared with the situation "with the projects". The "without-project" situation is not the same as the "before-project" situation – it could sometimes be represented by the present levels of productivity of the relevant resources.

The recent McKinsey research on unearthing India's mineral wealth in eastern India cites the finding that the contribution of the minerals and metals sector to Orissa's SGDP could go up from the current level of 13 per cent (2003) to 30 per cent by 2015 at the Compounded Annual Growth Rate (CAGR) of 7.1 per cent from the current, abysmal 3 per cent. That, however, would hinge on MNC projects that support economic development of the region by combining mineral production (e.g. iron ore) with downstream value addition (e.g. production of steel within the State) by bringing in substantial foreign investment. The research has cited the proposed POSCO project as one such combination that promises to serve Orissa's economic development.

China Factor in Global Steel Market

McKinsey, in a research entitled *China factor in Global Steel* (2004, Volume 2 of McKinsey Quarterly), has stated that China's soaring demand for steel has raised hopes of a new and profitable era for this long-suffering global industry. It says:

Aided by regional consolidation among European and US producers, the worldwide outlook for profits is positive. Moreover, steel companies listed on the world's major stock exchanges began 2004 with a total market value that was up 77 per cent from the levels of the previous year. Thus, it would appear that the new investments scheduled for 2006 are likely to see assured markets.

In other words, according to McKinsey, the world steel market witnessed structural changes in 2004, thereby setting up new scenarios for producers of iron ore and coking coal. Industry analysts from India cite the interest Chinese domestic producers exhibit, notwithstanding the fact that their iron ore is quite low-grade (less than 55 per cent iron or Fe content) just for the sake of reaping the tremendous "output multiplier" effects to the Chinese economy. On the other hand, India, which has high-grade iron ore reserves (+65 per cent Fe) and medium grade iron ore (62 to 64 per cent) which would last only for around 19 years at the projected rate of consumption (details computed and cited elsewhere in the report) would be advised to be prudent. It ought to realise the output and employment multiplier effects by utilising these high and medium grade ores to produce steel because of the cost competitiveness of Indian steel in the world market.

The Least Cost Analysis - Object and Approach in Brief

The Least Cost Analysis (LCA) aims at identifying the Least Cost Project Option for supplying output to meet the forecasted demand-supply gap in both the domestic and international markets. After determining the scope of the project based on the strategic goal of NSP- 2005, the projected demand-supply gap and having identified economic costs and benefits, the next logical step would be to compare costs of various mutually exclusive and technologically feasible options before, eventually, selecting the one with the lowest cost.

The decision rule is to choose the alternative with the lowest "Average Incremental Economic cost" (AIEC)

for each alternative. The AIEC is the present value of all incremental investment and operation costs with and without the project alternative divided by the present value of incremental output. This has been carried out to examine whether the proposed POSCO Finex process project alternative is the least-cost option. Subsequently, the economic analysis of the chosen option is carried out to measure the impact of the project on the national economy.

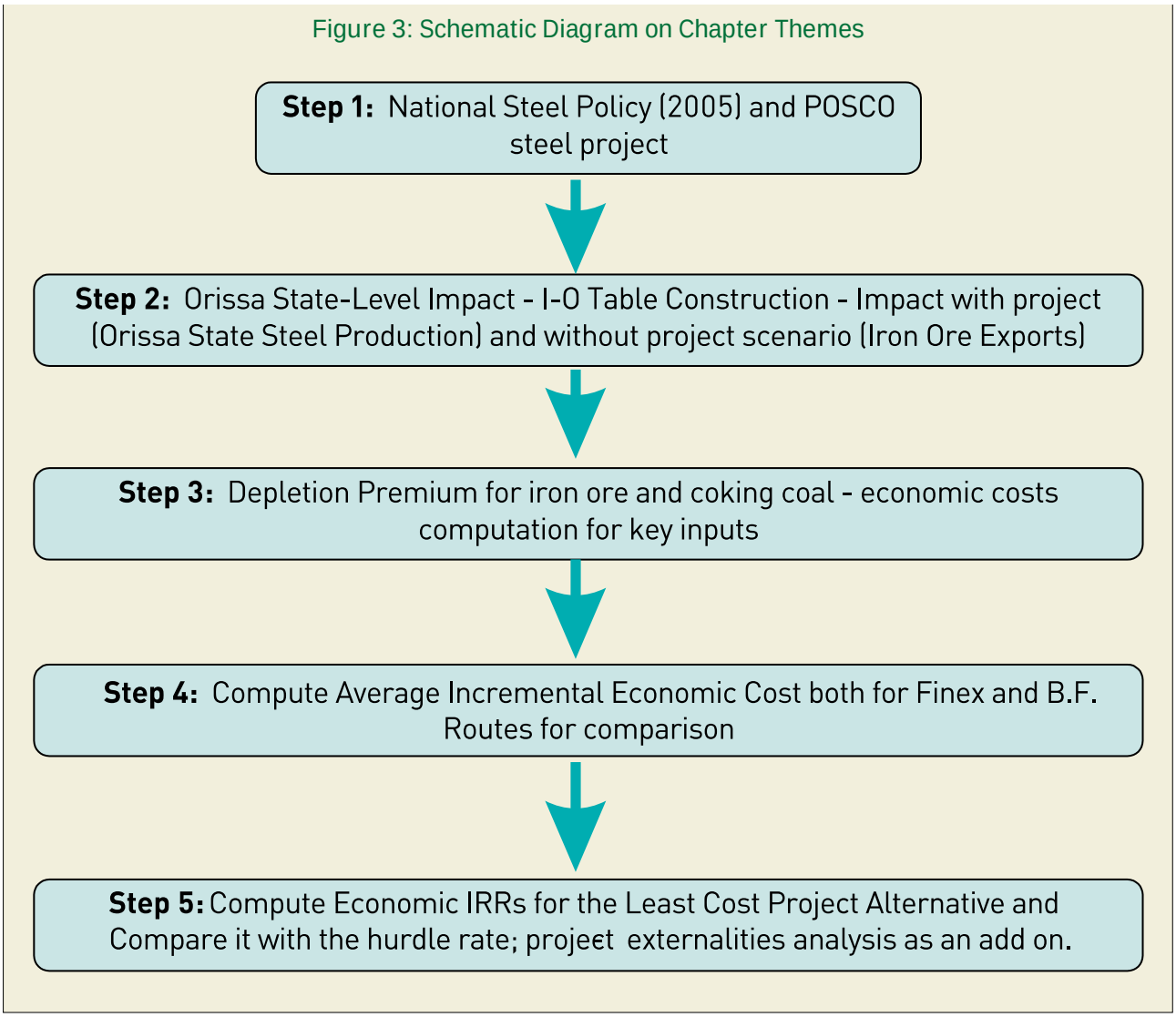
The POSCO project outputs would be "incremental outputs" as the output displaces expensive steel supplies in the international market or is projected to meet the estimated demand/supply gap apart from meeting the growing domestic demand for steel. It could also displace the scarce high- grade iron ore exported from India (which is currently exported without any charge of depletion premium) which forms the basis for cost-competitiveness of those steel producers (using the high-grade Indian iron ore) in the international market.

In economic analysis, the distinction between project outputs between basic and non-basic becomes crucial as their effects on the economy are valued differently.

Let us briefly examine why these distinctions are relevant. For instance, in economic analysis, the incremental outputs would be valued at the demand price or the willingness of new users to pay for the new source of supplies. Also, the project may be termed as non-basic in the sense that the economically viable projects are accepted one by one when submitted for approval, provided the EIRR is beyond the threshold level, the project is conceived in conformity to NSP - 2005 guidelines and is seen to contribute to the strategic goal outlined therein. Since these economic benefits may only be realised when the project is financially viable and stable, both economic and financial analyses need to be carried out simultaneously. As the project authorities have already examined the financial viability in greater detail (Financial IRR 13.9 per cent), the object of this report is to carry out the LCA of various technology options and to determine the EIRR for comparison with the threshold limit.

Thus, the starting point for the LCA is an examination of the draft NSP and the project contours of the proposed POSCO project to examine whether the conceived project is in tune with the strategic goal of NSP - 2005. The next logical step would be to examine the benefits of the "with project" alternative (of producing steel) to Orissa vis-à-vis the "without project" option (of exporting iron-ore) through construction of the State Input-Output Table. This would be followed by the estimation of depletion premiums (opportunity cost for using non-renewable resources) and the grade-wise composite economic costs for the key inputs. Then, the key technology options chosen for analyses would be identified and for each chosen technology option the AIEC would be computed. The approach is shown schematically below:

Figure 3: Schematic Diagram on Chapter Themes



National Steel Policy (2005) and POSCO Steel Proposal

CHAPTER

2 National Steel Policy (2005) and POSCO Steel Proposal

Objective

Strategic Goal: The long-term goal of NSP - 2005 is that India should have a modern and efficient steel industry of world standards, catering to diversified steel demand. The focus of the policy would, therefore, be to achieve global competitiveness not only in terms of cost quality and product-mix, but also in terms of global benchmarks of efficiency and productivity. This would require indigenous production of over 100 million tonnes (mT) per annum by 2019-20 from the 2004-05 level of 38 mT implying a compounded annual growth of 7.3 per cent per annum.

The above strategic goal is justified on the ground that global steel consumption, around 1000 mT in 2004, is expected to grow at 3 per cent per annum to reach 1,395 mT in 2015, compared to 2 per cent per annum in the past fifteen years. China would continue to have a dominant share of the world steel demand. At home, the Indian growth rate of steel production over the past 15 years was 7 per cent per annum. The projected Indian growth rate of 7.3 per cent per annum compares well with the projected national income growth rate of 7-8 per cent per annum, given an income elasticity of steel consumption of around 1.

SWOT Analysis of India's Steel Industry

The strengths, weaknesses, opportunities and threats for the Indian steel industry have been tabulated below. NSP-2005 lays down the broad roadmap to deal with all of them.

Strengths	Weaknesses
1. Availability of iron ore and coal 2. Low labour wage rates 3. Abundance of quality manpower 4. Mature production base	1. Unscientific mining 2. Low productivity 3. Coking coal import dependence 4. Low R&D investments 5. High cost of debt 6. Inadequate infrastructure
Opportunities	**Threats**
1. Unexplored rural market 2. Growing domestic demand 3. Exports 4. Consolidation	1. China becoming net exporter 2. Protectionism in the West 3. Dumping by competitors

Strategy

A multi-pronged strategy, as laid down in NSP – 2005, is directed at a long-term policy goal. On the demand side, the strategy would be to create incremental demand through promotional efforts, generate awareness and strengthen the delivery chain, particularly in rural areas. On the supply side, the strategy would be to facilitate the creation of additional capacities, remove procedural and policy bottlenecks in the availability of inputs, make higher investments in R&D and HRD, and, encourage the creation of physical infrastructure.

Financial Resources: In order to achieve the strategic goal of 110 mT of steel production by 2019-20, the Indian steel sector would need additional capital to the tune of Rs 2,30,000 crore. In addition, funds would be

required for technological upgrade of existing facilities. However, the outstanding advances of the banking sector to the industry at the end of 2003-04 was only Rs 26,295 crore. The cost of capital in India is among the highest as shown in Table 1.

Table 1: Cost of Capital (% per annum)

Japan	USA	Germany	China	S. Korea	Brazil	India	World
1.4	4.1	4.2	5-6	6	9.75	**11**	5

Source: World Bank Report, 2004

To mobilise such vast resources, foreign direct investment should be encouraged. In addition, external commercial borrowing norms need to be reviewed periodically to facilitate smooth inflows of debt and bring down the cost of capital. Steel is one of the six sectors that figure in the index of industrial production for "infrastructure." However, the fiscal incentives available to other infrastructure projects are not available to steel. Therefore, suitable incentives need to be devised for the steel industry.

We now examine the POSCO project outline in relation to NSP – 2005's strategic goals and a SWOT analysis of the Indian iron and steel industry. In the next section, we would consider the select policy initiatives set forth in NSP – 2005 to identify the existence / non-prevalence of convergences with the POSCO plan.

POSCO: One of the leading modern firms

POSCO, which is the world's third largest steel company with over 30 million tonnes per annum (mtpa) capacity, having diversified operations in 16 countries, played a significant role in sustaining the growth of the economy of Korea. Established in 1968, POSCO runs two ultramodern steelworks: Pohang Steelworks (13 mtpa) and Gwangyang Steelworks (17 mtpa), both in Korea.

After several rounds of expansion, POSCO was privatised in 2000. A high degree of corporate transparency and a sound financial structure contributed to make it a top global player. It pursues sustainable management that lays emphasis on economic profitability, environmental soundness and social responsibility. In 2005, it produced 30.5 million tonnes of crude steel and generated sales of $26 billion and net earnings of $ 4 billion.

POSCO's Entry into the Indian Steel Sector

India's steel industry is in a transitory stage. Yet, it is one which is seeing exceptional growth thanks to the overall expansion of the economy. It is also witnessing the injection of foreign investment.

The overall growth projection of the steel-consuming industries of India and Korea is pretty optimistic. Much the same is true of southeast Asian countries like Indonesia, Malaysia, Vietnam and Thailand. In such circumstances, India is bound to witness huge investments in its steel industry and see unprecedented competition in the race for control over essential raw materials, namely, iron ore, chrome ore and coal.

POSCO Project In Light of NSP – 2005

NSP - 2005 encourages investment in creation of an additional modern mine. It also asserts that the policy of giving leases to the private sector for captive mining would continue. With the wide credibility of POSCO's mining technology, the Korean major is deemed quite capable of investing the required amount of capital for producing iron ore. The most interesting fact is that Project POSCO dovetails well with the vision of NSP - 2005. The current policy emphasises that following investments into iron ore mining and beneficiation for domestic consumption of iron and steel, there is likely to be a decline in the exports of iron ore.

As soon as POSCO engages in iron ore mining, it would introduce value addition to mined iron ore by producing steel within the State. Under the Blast Furnace method (with which Indian steel makers are familiar) the import of coking coal is necessary for making high-grade lumps. But now POSCO would be bringing to India a new form of steel making called the Finex method which dispenses with the use of coking coal

altogether. Therefore, it removes one of the basic weaknesses of India's steel sector. Another lacuna is the abysmal level of R&D investment, which NSP – 2005 rues. However, POSCO would be introducing technology based on its own R & D. India is a capital scarce country and consequently the cost of debt is high. Hence, Indian industries suffer from a high cost of debt. It is quite natural that POSCO, through its FDI in India, is not going to suffer from this hindrance. On the other hand, POSCO would score over the key weaknesses identified in NSP - 2005.

POSCO Project: A Brief Outline

On June 22, 2005, POSCO and the Government of Orissa signed a Memorandum of Understanding (MoU) for construction of a mega integrated steel plant and modernisation of Orissa's iron ore mines. According to the MoU, POSCO would invest Rs 52,813 crore to build a 12-mtpa capacity steelworks and develop mines and linked infrastructure over three phases from 2007 to 2016 on the sea coast of Jagatsinghpur district of Orissa.

During the first phase (2007- 2010), it would produce 4-mtpa and expand the final production volume to 12-mtpa by 2016. In the MoU, the Government of Orissa has promised to provide adequate land, water, power, attached minor port, iron ore mines, SEZ recommendation, issue various clearances and facilitate assistance, and, generally, promise continuous and committed support to POSCO's venture in Orissa.

NSP's Export Projection and Role of POSCO

NSP - 2005 estimates that India's steel production would reach approximately 110 million tonnes by 2019. To realise this dream and to catapult India into a steel superpower, POSCO would contribute 12 mtpa from its greenfield steelworks in Orissa. Further, NSP - 2005 has set an export target of 26 million tonnes by 2019, which would exceed imports by 20 million tonnes. POSCO's steelworks, located in a SEZ in Orissa, would manufacture superior steel and export 6.3 million tonnes to target markets in southeast Asia, west Asia and western Europe where commercial slabs and HR coils would be required in huge quantities for construction, home appliances and automobiles. Table 2 presents the export target set in NSP, 2005 by the Government of India.

Table 2: Indian Government's Steel Forecasts

(Unit: million tonnes)

	Product	Import	Exports	Consumption
'19/ '20	110	6	**26**	90
'04/ '05	38	2	**4**	36
CAGR*	7.3%	7.6%	13.3%	6.3%

Note: * Compounded Annual Growth Rate
Source: Ministry of Steel- GoI Nov 2005

The Action Plan related to the identified thrust areas in promoting exports, facilitating coal import and encouragement of public-private partnership (PPP) in NSP - 2005 are discussed in the next couple of sections for comparison with the POSCO project outline

Exports- Action Plan Contemplated-NSP

(a) The Ministry of Steel (MOS) shall periodically undertake detailed studies on the incentives/subsidies/ promotional aids available to steel exporters of other countries;

(b) Support shall be provided in the creation of a comprehensive information/database in the following areas:

(i) The MOS will assess, on a continuing basis, the transaction costs incurred due to poor infrastructure and also the impact of cross subsidisation of other sectors by the steel industry and convey the same to other Ministries (e.g., Ministries of Commerce and Finance) for necessary measures for neutralisation; (ii) Multi-lateral/bi-lateral dialogue shall be encouraged and initiated to boost regional trade and co-operation in steel, especially in

steel-deficient neighbouring countries. (The POSCO project has this specific dimension of exports to steel deficient neighbouring countries); (iii) Efforts shall be made to prioritise allocation of infrastructure (especially ports) for steel exports on grounds of value addition and high growth potential. (A dedicated port would be built in Orissa by POSCO); (iv) Support will be provided to public-private partnership in the creation of common infrastructural facilities for expansion of exports. (e.g. POSCO's public-private partnership in construction of rail lines); (v)Expand/maintain market access through full utilisation of the various provisions of WTO statutes on 'special, differential and more favourable treatment for developing country exports' (e.g. POSCO project's SEZ area provisions)

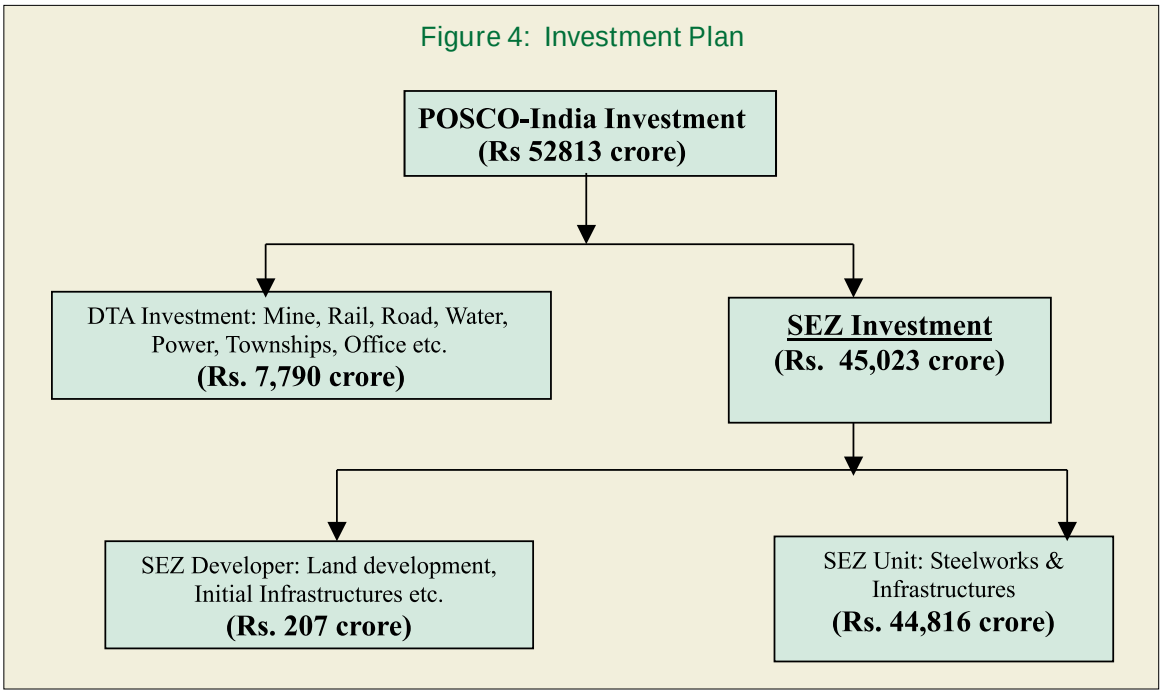
Infrastructure :NSP – 2005 Plan

- **Inland transportation:** It is estimated that every tonne of steel production is followed by transportation of 4 tonnes of material. In a globally integrated economy, minimization of the overall cost of transportation becomes an important instrument of maintaining the competitive edge in both the domestic and overseas markets.
- **Railways:** The share of Railways in transporting finished steel has declined from 71.9 per cent in 1991-92 to 34.4 per cent in 2001-02. The decline has been largely on account of railway's competitive weakness in the face of challenges from other modes of transport. Replacement of the "equalized railway freight" by "freight ceilings" is also partly responsible for the modal switch. On the basis of the present share of Railways and roads in the movement of raw materials and finished/saleable steel, the expected traffic originating in the steel sector to be handled by the Railways in 2019-20 is 263mT in total, whereas by road it is expected to be 177 mT in total. Based on the average lead distance it is estimated that the total traffic generated for railways originating due to the iron and steel industry would be around 120 billion tonne kilometers by 2020. The total traffic for railways including export of iron ore will be around 150 billion tonne kilometers. The Railways' facilities, therefore, would need to be expanded substantially in view of the renewed investor interests in the creation of additional steel capacities – both in green-field and brown-field projects.
- **Roads:** The steel plants and mines need to be integrated with the on-going programmes of national highway development and also with the proposed rural road schemes for expanding the delivery chain of steel across the country, especially the rural areas. Geographical coverage of the country by road transportation remains woefully low despite the quantum jump in construction of roadways across India in recent years. Moreover, the performance of the Indian road sector is poor in terms of effective sustained velocity of movement. The steel industry would be encouraged to create links to the nearest available highways. But the task of expanding the highway network would continue through public-private partnerships.
- **Ports:** Keeping in view the strategic goal of achieving a production of 110 mT of steel per annum and an annual export level of 26 mT by 2019-2020, the port facilities would need to be expanded substantially. In the current policy, steel producers would be encouraged to develop port and berth facilities so as to improve productivity, hasten the turn around time and augment capacity to handle larger vessels and other operational parameters of efficiency.

Investment Plan

POSCO-India would collectively invest Rs. 52,813 crore to construct a 12-mtpa steel plant and develop iron ore mines and physical infrastructure such as railways, roads, a dedicated port, a captive power plant, townships, etc. in both the DTA and the SEZ. Figure 4 presents overall investment plan of POSCO-India.

Figure 4: Investment Plan



Investment Components in Tune with NSP- 2005's Infrastructure Action Plan

Even though POSCO-India's investment is collectively directed towards its 12-mtpa steelworks, it is multi-dimensional and multi-locational rather than concentrated at a single location. Sectors within POSCO-India's operations, like the development of iron ore mines in Keonjhar and Sundergarh (280 km from the proposed SEZ steelworks site), the water facility at Jobra Barrage on the Mahanadi River (90 km from the proposed SEZ site), a railway line from the SEZ to access points on the main railway line, the roads from the SEZ to NH-5A and SH12, headquarters and other offices and townships. However, parts of the investment, like the port and the power plant, would be concentrated around the steelworks. In other words, parts of POSCO-India's investment would lie in the DTA and parts of it would lie in the SEZ.

Thus, POSCO-India has two investment components: (a) Integrated steelworks with linked infrastructures in SEZs, and, (b) Mines and infrastructure in DTA. This would be in accordance with the SEZ Act, 2005 and SEZ Rules, 2006 which divides SEZ investments into two categories: Investment as developer and Investment as entrepreneur.

No net export of iron ore by POSCO – (Draft NSP – 2004 had contemplated to permit efforts to export in lieu of Coking Coal Imports while NSP 2005 does not explicitly state this.)

Clause 6 (ii) of the MoU between Government of Orissa and POSCO expressly and categorically says that there would be no net export of iron ore. POSCO-India may swap certain quantities (not exceeding 30 per cent of the total requirement) of iron ore with high alumina content with equal quantities of low alumina content iron ore of equivalent or better Fe content imported for blending, in order to produce superior steel and conserve energy.

The swap of iron ore will be allowed only after an equivalent quantity of ore has been imported for the plant. Application of Finex technology would further bring down the swap ratio. Also, the Finex process uses non-coking coal and thus the iron-ore that could be swapped for avoided import of overseas coking coal could be an additionality provided the clause specified in the Draft 2004 policy stands good in spirit in 2005 policy.

I-O Table for Orissa

CHAPTER

3 I-O Table for Orissa

The interactions or linkages among different sectors of an economy are of crucial significance in understanding the growth trajectory of any industry. Industries are linked to one another – a fact that should be taken into account while deciding on a development strategy. An increase in demand for one sector's output leads to, apart from increasing output, additional income and employment in that sector plus greater demand for raw materials. This sparks off demand in other sectors with the concomitant increases in output, income and employment in those sectors as well. And so on.

Therefore, an increase in demand for one sector's output sets up a chain reaction in the economy resulting in increases in output, employment and value added that are multiples of the original sector's stimulus. The Input- Output table allows the estimation of the direct as well as indirect requirements of producing an additional unit of any sector's output. To quantify the economic impact of increase in output of any one sector, two measures, namely, the Output Multiplier and Employment Multiplier effects are analysed. The impact analysis is performed at two levels – the effect on the Orissa economy as a whole and its spinoffs on individual sectors of the state's economy.

Backward Linkage

The term "linkage" implies the existence of interdependence among sectors through intermediate consumption or production. Backward linkage of a sector reveals the interrelationship of that particular sector with all other sectors of the economy that supply inputs to it. Policy makers interested in accelerating growth emphasise industries with strong backward linkages, because it is these industries that stimulate production in a large number of additional sectors. Growth in a sector with high backward linkages provides stimulus to other sectors by requiring more inputs. The extent of prevalent backward linkage is measured by the Output Multiplier.

Output and Employment Multipliers

The Output Multiplier, also known as the Leontief Multiplier, is a measure that provides the over all impact of a sector on the output generation in the entire economy as well as for the individual sectors of the economy. It is defined as the total increase in output generated for one unit increase in final demand of a particular sector. Sectors that exhibit strong linkages with other sectors of the economy are found to have high Output Multipliers.

The Employment Multiplier may also be analogously calculated. The detailed methodology of calculating Output and Employment multipliers is spelt out in Annex II.

This section deals with the Output and Employment Multipliers of all sectors of the Orissa economy.

Estimates of Employment and Output Multiplier- Orissa State 2003-04

The I-O model for Orissa:

In Table 3 below we present the Employment and Output Multiplier extracted from the Input-Output table of Orissa for 2003-04 (the I – O table is given in Annex. IV). From the table the impact of the Project POSCO can be derived.

Table 3: Sectoral Output and Employment Multipliers for Orissa based on Input-Output 2003-04

Sector Name	Sector no	Employment multiplier	Output multiplier
Food Crops	1	10.86	1.72
Cash Crops	2	2.75	1.43
Plantation Crop	3	3.52	1.40
Other crops	4	0.68	1.35
Animal Husbandry	5	4.15	1.45
Forestry and logging	6	1.22	1.45
Fishing	7	0.71	1.16
Coal and lignite	8	0.51	1.49
Crude petroleum, natural gas	9	0.02	1.00
Iron ore	10	0.35	1.40
Other Minerals	11	2.11	1.33
Food Products	12	5.36	2.24
Beverages, tobacco, etc.	13	3.23	2.08
cotton+wool+art silk+textile products	14	7.93	1.93
Wood, furniture, etc.	15	13.68	1.79
Paper & printing, etc.	16	1.68	2.41
Leather and leather products	17	3.71	1.65
Rubber, petroleum, plastic, coal.	18	0.74	2.12
Chemicals, etc.	19	1.12	2.97
Non-metallic products	20	4.06	2.21
Iron & steel	21	0.69	2.36
Non ferrous metals	22	0.47	1.84
Metal products except mach. And tpt. Equipment	23	3.29	2.44
Tractors, agri. Implements, industrial machinery, other machinery	24	1.06	2.50
Electrical, electronic machinery and applications	25	0.99	2.83
Transport equipments	26	0.97	2.45
Miscellaneous manufacturing industries	27	2.85	2.34
Construction	28	1.79	2.15
Electricity	29	0.55	2.27
Gas and water supply	30	0.68	1.59
Railway transport services	31	0.67	1.94
Other transport services	32	0.95	2.05
Storage and warehousing	33	1.00	1.80
Communication	34	0.76	1.48
Trade	35	1.15	1.37
Hotels and restaurants	36	2.74	2.11
Banking	37	0.32	1.37
Insurance	38	0.42	1.53
Ownership of dwellings	39	0.42	1.15
Education and research	40	0.89	1.24
Medical and health	41	1.13	2.48
Other services	42	1.26	1.96
Public administration	43	0.64	1.00

It is clear from Table 3 that the Employment and Output Multipliers are higher for iron and steel than those for iron ore. An iron ore Employment Multiplier of 0.35 and Output Multiplier of 1.40 implies that every Rs.1 lakh output of iron ore mined in Orissa creates 0.35 man-years of employment and also has the potential to generate a cumulative output of Rs 1.40 lakh including the Rs 1 lakh output of iron ore. On the other hand, iron and steel has a greater impact on the economy. If steel of Rs 1 lakh is produced in Orissa, it would create 0.69 man-years of employment and a cumulative output of Rs 2.36 lakh.

The national level multipliers are similar for iron ore. Here we see an Employment Multiplier of 0.34 (compared to 0.35 for Orissa) and an Output Multiplier of 1.54 (1.40 in Orissa). In the case of iron and steel and ferro alloys, the Employment Multiplier is 0.56 and the Output Multiplier is 2.36 (compared to 0.69 and 2.36 respectively for Orissa).

Results from the Orissa I-O model are summarised below:

Table 4: Orissa State-Level Output and Employment Multipliers

Sectors	Output Multiplier	Employment Multiplier – Employment in man – year per Rs 100,000 output
Iron Ore	**1.40**	**0.3543**
Iron & Steel	**2.36**	**0.6920**

Using these multipliers the actual impact in terms of employment and output to be created by POSCO project may also be calculated.

Total iron ore production envisaged by POSCO is 19.46 million tonnes. According to a McKinsey study (2005 special edition of the *Quarterly*) the FOB port value of Bailadilla iron ore is $16.32, (viz. factor cost) i.e., Rs 734.30 per ton (USD 1= Rs 45). Therefore, the total value of iron ore production in Orissa from the POSCO project is estimated at Rs 1428 crore (Rs 14.28 billion).

In other words employment generated from iron ore production for POSCO project would be 1,42,800 x 0.3543 = 50,540 man-years say 50, 000 man-years. This would last for 30 years. So, if POSCO were to call it a day after implementing its stand-alone iron ore project, it would do so after generating 50,000 man-years of permanent employment opportunity.

Given an output multiplier of 1.40, the Orissa economy would be stimulated to the extent of 1,428 x 1.40 = Rs 1,999 crore say Rs 2,000 crore (Rs 20 billion) of output at factor cost.[1]

Table 5: POSCO Project Output Impact- Employment

Stage / Scenario	Annual production at factor cost, Rs billion	Cumulative employment generation, man years each year for 30 years (Permanent jobs created for 30 years)	Cumulative production in the state of Orissa, Rs. billion
POSCO terminates its projects at iron ore mining stage output 19.46 million tonnes per annum	14.3	50, 600 say 50, 000 jobs	20
POSCO processes iron ore to steel products in Orissa	126	872,657 say 870, 000 jobs	298

[1] The difference between factor cost and market prices are net indirect taxes; in the case of steel it is obtained as the sum of cost of goods sold including depreciation (US$ 2.5 billion for 12 million crude steel plan) and Interest expenses(US$ 0.298 billion for 12 million crude steel plant); in the case of iron ore it is obtained as the FOB port value (US$ 16.32/tonne)of production.

Now, if the iron ore is converted to steel by POSCO the employment created would be 12,61,000 x 0.6920 = 8,72,610 man-years, or rounded off, 8,70,000. There would also be a permanent employment opportunity for 30 years.

The economy would be stimulated to the extent of 12,610 x 2.36 = Rs 29,760 crore (say Rs 298 - 300 billion) of output at factor cost when the level of production of steel is estimated at Rs 12,610 crore at factor cost.

The SGDP of Orissa at current prices in 2003-04 based on the published data by the state is Rs 53,830 crore. The state GDP at current prices had between 1993-94 through 2005–06 exhibited a CARG of 9.91 per cent between 1993 – 94 through 2005 – 06. The State GDP at constant 1993-94 prices exhibited a CARG of 4.7 per cent between 1993-94 through 2005-06.

As seen in the I-O Table, the Gross Output of iron ore in 2003-04 was Rs 663 crore and the Gross Value Addition for the same period was Rs 523 crore. Therefore, every rupee of iron ore produced in the State creates a value addition of Rs 523/663 = Rs.0.79. Therefore, the total value added generated by Project POSCO, should it cease production at the iron ore stage, would be Rs (0.79x1428)= Rs 1,128 crore per year. The rest of the economy supplying iron ore would contribute an output of Rs 571 crore (Rs 1,999 —Rs 1,428 crore) which would mean a rough value addition of around Rs 280 crore[2].

The combined value addition of Rs 1408 crore would correspond to 1.34 per cent of the SGDP at current prices, assuming that the State GDP grows by 2016 – 17 at the rate of 4.7 per cent annually (SGDP by 2016-17 works out to Rs 105046 crore at constant 2005-06 prices based on 4.70 per cent CARG to base level 2005 – 06 SGDP values of Rs 63,382 crore).

The Gross Output of iron and steel during 2003-04 from the I-O table was Rs 6,624 crore and Gross Value Addition during the same period was Rs 1,861 crore. Therefore, every rupee of iron and steel output generates a value addition of Rs 1,861/6,624 = Rs 0.28. Therefore, the total value added would be 0.28 x Total value of iron and steel, i.e., Rs (0.28 x 12,610) = Rs 3530.8 crore per year during the year 2016- 17. The rest of the economy supplying the iron and steel sector would add Rs 17,150 crore (difference of Rs 29,760 crore and Rs 12,610 crore or a value addition of Rs 8,575 crore[2]. The combined effect of Rs 12,106 crore value addition on the State economy would be around 11.5 per cent in State GDP at constant 2005-06 prices assuming that the State GDP exhibits a CARG of 4.7 per cent to GDP to reach a SGDP level of Rs 105046 crore by 2016-17 at 2005-06 prices. Therefore, in terms of value addition, steel has a much larger impact than iron-ore.

Table 6: POSCO Project Impact on State GDP by 2016 – 17

	POSCO project terminated at iron ore mining	**POSCO project integrated till steel making stage**
POSCO project impact on State GDP by 2016 – 17 Assuming that state GDP grows @ 4.7 per cent per year (at constant 2005-06 prices)	+ 1.34 per cent State GDP by 2016 - 17	+ 11.5 per cent State GDP by 2016 - 17

[2] Average value addition for sectors other than iron ore and iron and steel is assumed at 50 per cent based on I –O Table (Annex IV)

Sector wise Break up 50,000 man years

Iron Ore- Details on Employment Generation	Leontief Inverse	Output Stimulus in Rs Lakh	Employment Coefficient Man Years per lakh of output	Employment from the Sector in No.s	Percentage Share of Employment of Sectors
Sector Impacts Traced		**L.Ix142800**		**O.SxE.Coeff**	
Foodcrops	0.0004824	69	9.4223	649	1.28%
Cash Crops	0.00053351	76	2.3602	180	0.36%
Plantation Crop	0.00092643	132	3.1925	422	0.83%
Other crops	0.00393598	562	0.2000	112	0.22%
Animal Husbandry	0.00068573	98	3.6357	356	0.70%
Forestry and logging	0.00074187	106	0.9001	95	0.19%
Fishing	0.00003943	6	0.4527	3	0.01%
Coal and lignite	0.00857517	1225	0.1754	215	0.42%
Crude petroleum, natural gas	0.02865148	4091	0.0214	88	0.17%
Iron ore	1.0003439	142849	0.1280	18284	36.13%
Other Minerals	0.00192121	274	1.9452	534	1.05%
Food Products	0.00048011	69	3.0665	210	0.42%
Beverages, tobacco, etc.	0.00008341	12	2.0632	25	0.05%
cotton+wool+art silk+textile products	0.00245717	351	6.4054	2248	4.44%
Wood, furniture, etc.	0.00175375	250	12.4328	3114	6.15%
Paper & printing, etc.	0.00376354	537	0.5996	322	0.64%
Leather and leather products	0.00013088	19	2.8335	53	0.10%
Rubber, petroleum, plastic, coal	0.05256086	7506	0.3096	2324	4.59%
Chemicals, etc.	0.0465241	6644	0.0839	558	1.10%
Non-metallic products	0.00099677	142	2.9919	426	0.84%
Iron & steel	0.0144279	2060	0.0585	121	0.24%
Non ferrous metals	0.0047626	680	0.0248	17	0.03%
Metal products except mach. And tpt. Equipment	0.02830128	4041	2.5493	10303	20.36%
Tractors, agri. Implements, industrial machinery, other machinery	0.00637632	911	0.2457	224	0.44%
Electrical, electronic machinery and applications	0.00320358	457	0.0399	18	0.04%
Transport Equipments	0.00245513	351	0.1785	63	0.12%
Miscellaneous manufacturing industries	0.00359933	514	2.1452	1103	2.18%
Construction	0.00586639	838	0.5022	421	0.83%
Electricity	0.05131525	7328	0.0741	543	1.07%
Gas and water supply	0.00086786	124	0.1861	23	0.05%
Railway transport services	0.01174119	1677	0.2797	469	0.93%
Other transport services	0.02767869	3953	0.3917	1548	3.06%
Storage and warehousing	0.0001562	22	0.4322	10	0.02%
Communication	0.00505413	722	0.4990	360	0.71%
Trade	0.0283524	4049	0.9004	3646	7.20%
Hotels and restaurants	0.00167499	239	0.6694	160	0.32%
Banking	0.01881155	2686	0.0965	259	0.51%
Insurance	0.00307105	439	0.1052	46	0.09%
Ownership of dwellings	0	0	0.2905	0	0.00%
Education and research	0.0000224	3	0.6968	2	0.00%
Medical and health	0.00012557	18	0.2762	5	0.01%
Other services	0.02199169	3140	0.3326	1044	2.06%
Public Finance	0	0	0.6442	0	0.00%
	1.40	199269		50600	100.00%
				Say 50,000 man-years	

Sector wise break up of 870,000 man years job creation = Iron & Steel sector

Iron and Steel Details on sources of employment	Leontief Inverse	Output Stimulus in Rs Lakh	Employment Coefficient Man years per lakh of output	Employment from the Sector in Nos	Adjusted Employment by splitting sector 21–A Matrix	Adjusted Employment by splitting sector 21–A A Matrix (%)
Sectors Impacts Traced		**L.IX 1261000**		**O.SxE.Coeff**		
Food crops	0.0009	1158	9.4223	10912	10912	1.25%
Cash Crops	0.0014	1825	2.3602	4308	4308	0.49%
Plantation Crop	0.0018	2321	3.1925	7410	7410	0.85%
Other crops	0.0053	6649	0.2000	1330	1330	0.15%
Animal Husbandry	0.0013	1598	3.6357	5809	5809	0.67%
Forestry and logging	0.0018	2252	0.9001	2027	2027	0.23%
Fishing	0.0001	111	0.4527	50	50	0.01%
Coal and lignite	0.0742	93550	0.1754	16406	21459	2.46%
Crude petroleum, natural gas	0.0566	71386	0.0214	1527	1527	0.17%
Iron ore	0.0208	26204	0.1280	3354	14742	0.38%
Other Minerals	0.0166	20912	1.9452	40678	40678	4.66%
Food Products	0.0008	975	3.0665	2990	2990	0.34%
Beverages, tobacco, etc.	0.0002	199	2.0632	411	411	0.05%
cotton+wool+art silk+textile products	0.0079	9989	6.4054	63984	63984	7.33%
Wood, furniture, etc.	0.0043	5460	12.4328	67889	67889	7.78%
Paper & printing, etc.	0.0089	11221	0.5996	6728	6728	0.77%
Leather and leather products	0.0003	426	2.8335	1206	1206	0.14%
Rubber, petroleum, plastic, coal	0.1047	132079	0.3096	40894	40894	4.69%
Chemicals, etc.	0.0485	61125	0.0839	5131	5131	0.59%
Non-metallic products	0.0029	3696	2.9919	11058	11058	1.27%
Iron & steel	1.3758	1734939	0.0585	101555	85314	9.78%
Non ferrous metals	0.0300	37846	0.0248	938	938	0.11%
Metal products except mach. And tpt. Equipment	0.0559	70521	2.5493	179777	179777	20.60%
Tractors, agri. Implements, industrial machinery, other machinery	0.0116	14640	0.2457	3597	3597	0.41%
Electrical, electronic machinery and applications	0.0080	10040	0.0399	400	400	0.05%
Transport Equipment	0.0080	10053	0.1785	1794	1794	0.21%
Miscellaneous manufacturing industries	0.0100	12593	2.1452	27014	27014	3.10%
Construction	0.0096	12066	0.5022	6060	6060	0.69%
Electricity	0.0889	112130	0.0741	8307	8307	0.95%
Gas and water supply	0.0022	2738	0.1861	509	509	0.06%
Railway transport services	0.0496	62489	0.2797	17478	17478	2.00%

Iron and Steel Details on sources of employment	Leontief Inverse	Output Stimulus in Rs Lakh	Employment Coefficient Man years per lakh of output	Employment from the Sector in Nos	Adjusted Employment by splitting sector 21–A Matrix	Adjusted Employment by splitting sector 21–A A Matrix (%)
Other transport services	0.0574	72406	0.3917	28363	28363	3.25%
Storage and warehousing	0.0008	977	0.4322	422	422	0.05%
Communication	0.0074	9354	0.4990	4668	4668	0.53%
Trade	0.1407	177397	0.9004	159734	159734	18.30%
Hotels and restaurants	0.0026	3256	0.6694	2179	2179	0.25%
Banking	0.0783	98724	0.0965	9531	9531	1.09%
Insurance	0.0089	11258	0.1052	1184	1184	0.14%
Ownership of dwellings	0.0000	0	0.2905	0	0	0.00%
Education and research	0.0001	119	0.6968	83	83	0.01%
Medical and health	0.0005	630	0.2762	174	174	0.02%
Other services	0.0591	74520	0.3326	24784	24784	2.84%
Public Finance	0.0000	0	0.6442	0	0	0.00%
	2.3647	2981830		872657	872657	100.00%
				Say 870, 000 man-years	Say 870, 000 man	

Least- Cost Analysis- Finex and Blast Furnace Processes

CHAPTER

4 Least- Cost Analysis- Finex and Blast Furnace Processes

Project Alternatives

Two project alternatives, using the two major steel making technologies- Finex process and Blast Furnace Process- have been considered for choosing the least cost option.

Shadow Prices for Inputs (economic costs) in the Least-Cost Analysis

The capital costs used in the analysis excludes transfer payments such as taxes as well as provisions for physical contingency. The valuation of depletable resources requires the inclusion of an explicit Opportunity Cost component for depletion, in addition to the Marginal Extraction Cost or the normal domestic market price. This Opportunity Cost is referred to as the Depletion Premium.

In general the Depletion Premium for a particular year (DP_t) can be defined as:

$$\frac{(PS_T - CS_t)\,(1+r)^t}{(1+r)^T}$$

where DP_t is the Depletion Premium at Time *t*;
PS_T price of substitute at Time *T*
CS_t is the Extraction Cost of present resource, assumed to be constant throughout the project life-cycle
r is the Discount Rate (here assumed as 12 per cent)
T is the time for substitution/ exhaustion to take place

Computation of Depletion Premiums for Iron Ore and Coking Coal

The basic assumptions and data for calculation of Depletion Premium in the case of iron ore and coking coal are as under:

1. The iron ore market witnessed structural changes during end-2003 and early 2004. The trend growth rate in prices, which was 1.4 per cent, witnessed a dramatic upsurge to witness a growth rate of more than 33 per cent during the early 2000s. This may have been caused by the explosive growth of steel consumption and production in China which is not expected to continue. According to IISI, the trend growth rate in world crude steel production is likely to be around 4.2 per cent and we have assumed that the acceleration in iron ore prices is likely to revert to the pre- 2000 era of 1.4 per cent. The iron ore market, and consequently the prices for high quality (Fe 65 per cent) Bailadilla ore, which had remained stagnant in nominal dollar terms from 1992-93 (lumps $ 22.15/tonne and fines $17.7/tonne) through 2002-03 (lumps $22.77/tonne and fines $17.7/ tonne), witnessed price increases to a level of $ 50 for lumps in 2005-06 and $ 60.02 during 2006-07 for Bailadilla ore. According to the UNCTAD report on iron ore statistics and from in-depth interviews with experts in the iron ore export market, it is learnt that the prices negotiated for 2006-07 were around 19 per cent higher than what ruled in the previous year - $60.02 for lumps (penalty/bonus for Fe content $ 2.96 per tonne) and for fines is $ 46.57 per tonne (penalty/bonus for Fe content 0.72 per tonne). Since the Orissa ore for the POSCO project will average 62 per cent, the applicable current rate for lumps would work out to $51.14 and for fines $ 44.3. (see the detailed section on price forecasts for iron-ore);

2. India's high-grade ore (+ 65 per cent Fe content) reserves, proven and probable, amount to only 0.58 billion tonnes. And even if we were to factor in

indicative and inferred reserves (probable/feasible reserves) the total reserves (proven and possibly future potential) would be only 0.92 billion tonnes;

3. India's medium-grade ore (+62 per cent Fe to — 65 per cent Fe) reserves, proven and probable, is only 1.3 billion tonnes. Here too, if we factor in indicative and inferred (probable/feasible and pre feasibility estimated) reserves, the total reserves (proven and possibly future potential) will be only 2.8 billion tonnes. India's high-grade and medium-grade iron ore reserves would not last more than 20 years;

4. The Applicable Depletion Premium for export of iron ore works out to $ 27 per tonne for the raw mineral exporter. It works out to $ 10.18 per tonne if the steel plant is located within the State. These Depletion Premiums are computed for the purpose of economic analyses.

Other basic assumptions that went into the process of calculation of Depletion Premium are succinctly traced below:

- Current production rate of iron-ore in million tonnes (2004-05) factoring in exports of 78 Million tonnes is 143 million tonnes;
- Envisaged production rate by 2010 for the national target of 110 million tonnes for production of steel and iron-ore exports frozen at the present level would be 254 million tonnes;
- The useful life of high and medium-grade iron ore at the projected level of iron ore consumption works out to a mere 15 years;
- The useful life of high and medium-grade iron ore at the average consumption level (average of current and projected consumption levels) is only 19 years;
- The Economic Discount Rate has been assumed to be 12 per cent;
- No Depletion Premium has been assumed for coking coal and hence the projected price is the 2006 level of coking coal prices. The logic for this conclusion is shown in the section on projection of coking coal prices.

Computations are shown in the section that follows forecast of prices.

Forecasting Prices

Iron-Ore

We had historical data (Figure 5) for iron-ore prices from 1976 to 2006. As is clear from the figure, there is very little trend discernible in prices till 2004, when they dramatically shot up. A model was fitted to the historical data, which explained about 85 per cent of the in-sample variation (Figure 6). Assuming that the massive growth in prices would not continue after 2006, the historical trend rate of about 1.4 per cent was applied to the 2006 forecasted price to forecast iron ore prices till 2040 (Figure 7). As a result, the price in 2040 is projected to be 163 cents/DLTU as compared to about 100 cents/DLTU in 2006.

Figure 5: Iron Ore Prices — Japanese Import Price of Hamersley Lump, cent/DLTU FoB

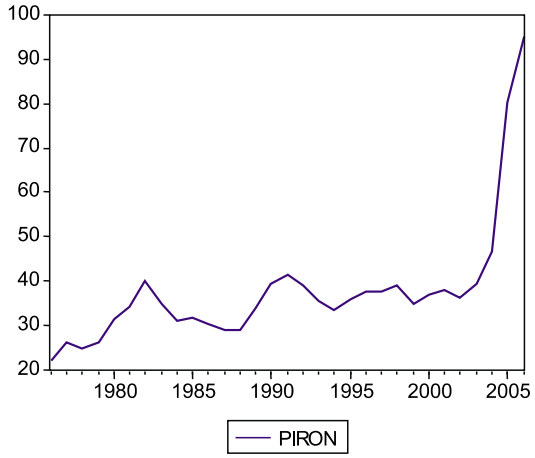


Figure 6: Iron Ore Prices — In-sample forecasts: 1975-06

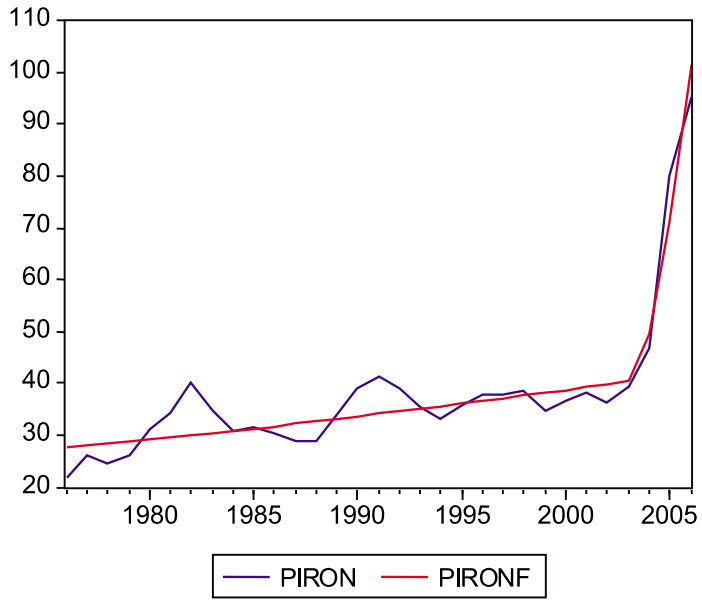
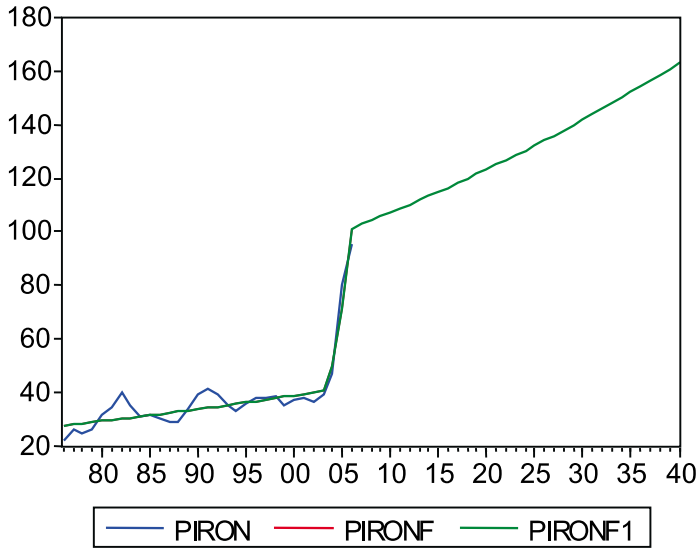


Figure 7: Iron Ore Prices — Out-of-sample forecasts: 2006 – 2040



Coking Coal

For coking coal we had historical data from 1985 to 2006. The data was available on an annual frequency (Figure 8). As is clear from the data, there was no clear trend detectable in coking coal prices till 2002. Between 2002 and 2006, prices rose sharply at an average annual rate of about 15 per cent. In contrast, the average rate of growth for the period before 2002 was negative. Apart for a short period between 1989 and 1991, coking coal prices have generally been falling during the period for which we have data. This is also clear from the in-sample model projections (Figure 9). Therefore, it becomes difficult to project as far into the future as 2040. The best assumption in this scenario would seem to be to take as a given that coking coal prices are static. We, therefore, assume that they would remain at the 2006 level - i.e., $ 95 per unit.

Figure 8: Coking Coal Prices — $ per unit: 1985-2006

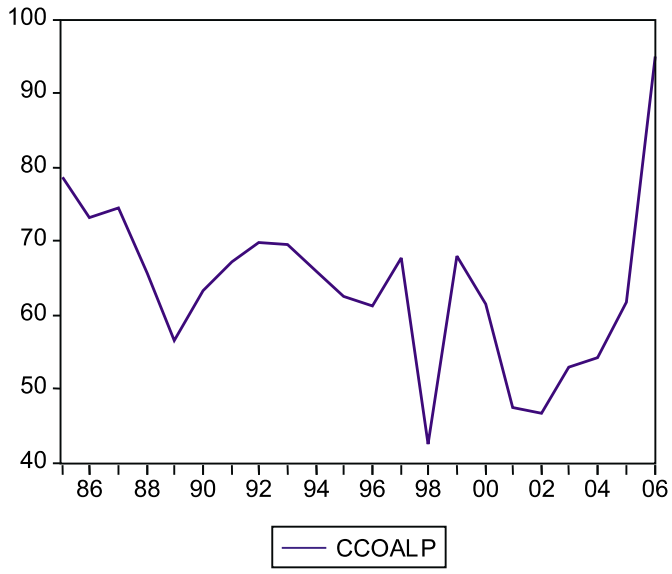
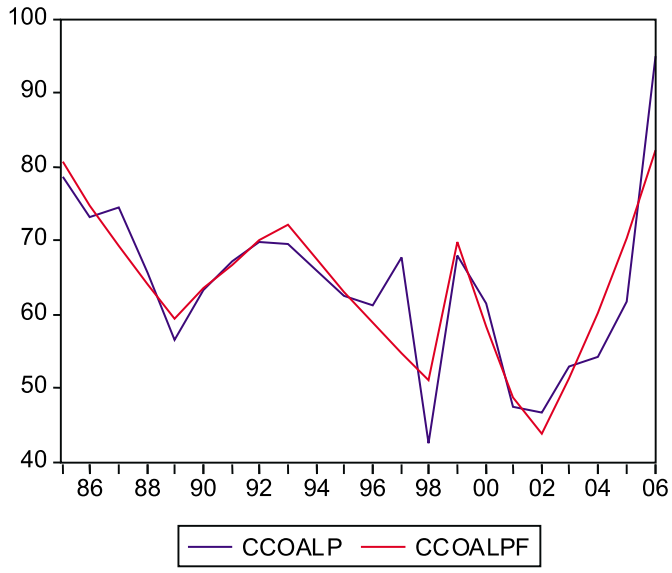


Figure 9: Coking Coal Prices — In-sample forecasts: 1985-06



Slabs

We use Latin American FoB export price for slabs. The data available is at a monthly frequency from January 1995 to August 2006. Prices were more or less constant till March 2004 (Figure 10). After March 2004, slab prices fluctuated widely, rising sharply till May 2005, falling briefly after that and finally rising sharply once again after March 2006. The model fitted to the monthly data reflects this (Figure 11). If we ignore the period after March 2004 when prices fluctuated considerably, the long term trend seems to be one of constancy of prices. Therefore, our 2040 projections assume that slab prices would be equal to average 2006 price, i.e., about $450 - this was the average price in 2006 (Jan – Aug) to benchmark AIEC.

Figure 10: Slab Prices — Latin American Export FoB: Jan, 1995— Aug, 2006

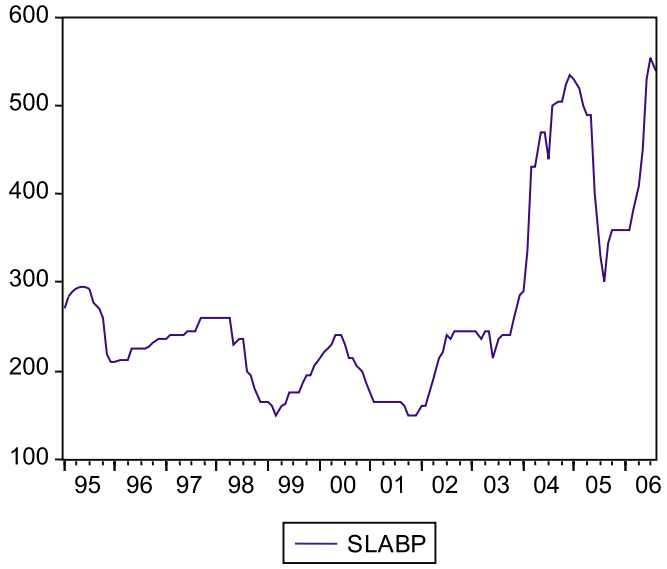


Figure 11: Slab Prices — In-sample forecasts: Jan, 1995- Aug, 2006

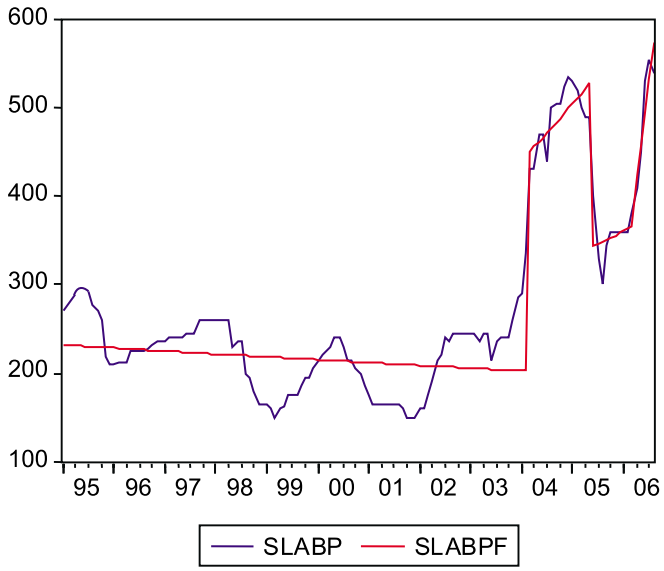


Table 7: Depletion Premium for Iron Ore

Year	Depletion Premium in $ per tonne of iron ore	Iron ore extraction cost in $ per tonne	Total Economic cost Iron ore per tonne in $
2006	2.59	14.14	16.73
2007	2.90	14.14	17.04
2008	3.25	14.14	17.39
2009	3.64	14.14	17.78
2010	4.08	14.14	18.22
2011	4.57	14.14	18.71
2012	5.12	14.14	19.26
2013	5.73	14.14	19.87
2014	6.42	14.14	20.56
2015	7.19	14.14	21.33
2016	8.05	14.14	22.19
2017	9.02	14.14	23.16
2018	10.10	14.14	24.24
2019	11.31	14.14	25.45
2020	12.67	14.14	26.81
2021	14.19	14.14	28.33
2022	15.89	14.14	30.03
2023	17.79	14.14	31.93
2024	19.93	14.14	34.07
2025	22.32	14.14	36.46
2026	25.00	14.14	39.14
2027	28.00	14.14	42.14
2028	31.36	14.14	45.50
2029	35.12	14.14	49.26
2030	39.34	14.14	53.48
2031	44.06	14.14	58.20
2032	49.35	14.14	63.49
2032	55.27	14.14	69.41
2033	61.90	14.14	76.04
2034	69.33	14.14	83.47
2035	77.65	14.14	91.79
2036	86.96	14.14	101.10
2037	97.40	14.14	111.54
2038	109.09	14.14	123.23
2039	122.18	14.14	136.32
2040	136.84	14.14	150.98
Average Incremental Economic Iron ore cost in $ per tonne	**Steel producer located within the State**		**24.32**
Depletion Premium per tonne in $	**Steel producer located within the State**		**10.18**

Least Cost Option – Decision Criterion- Minimum AIEC Unit Cost- Approach

Least Cost Analysis (LCA) aims at identifying the least cost project option for supplying output to meet Forecast Demand- Supply gap. LCA involves comparing the costs of the various mutually exclusive, technically feasible projects options and selecting the one with the lowest unit cost.

The Average Incremental Economic Cost (AIEC) for each alternative has been estimated with the aim of identifying the alternative with the lowest per unit costs. The AIEC is the present value of Incremental Investment and Operation Costs, with and without the Project Alternative, divided by the present value of Incremental Output, with and without the Project Alternative.

$$\text{Average Incremental Cost} = \sum^{n}_{t=0} (Ct / (1 + d)^{t}) / \sum^{n}_{t=0} (O_t / 1 + d)^{t})$$

Where C_t is Incremental Investment and Operation Cost in year *t*

O_t is Incremental Output in year *t*

n is the project life in years

and *d* is the discount rate.

Computations on cost of goods sold in economic values for the Finex and B.F.processes are summarised below:

Finex Process

Cost of goods sold computations- economic costs	Quantity in Million tonnes	Unit rate	Unit Price per tonne of material in US$	Total Amount in $ Million
Iron Ore	18.48	1.54	14.14	261.3072
Depletion Premium	18.48	1.54	10.18	188.1264
Other Raw materials				784.8928
Other materials				123.6
Labour expenses				198.57
Outsourcing expenses				24.36
Manufacturing expenses				480.017
Depreciation not considered Steel works COGS in economic costs				2060.873

Blast Furnace Process

Cost of goods sold computations- economic costs	Quantity in Million tonnes	Unit rate	Unit Price per tonne of material in US$	Total Amount in $ Million
Iron Ore	18.48	1.54	14.14	261.31
Depletion Premium	18.48	1.54	10.18	188.13
Coking coal	9.648	0.804	95.10	917.52
Other raw materials				300.98
Other materials				123.60
Labour expenses				198.57
Outsourcing expenses				24.36
Manufacturing expenses				480.02
Depreciation not considered				
Steel works COGS in economic costs				2494.50

After computing the economic cost of goods sold in the above fashion, the conversion factors for the Cost of Goods Sold (COGS) through the Finex and Blast Furnace (BF) processes are deduced. This is applied to the financial COGS computations year-wise to obtain year-wise economic values. The conversion factors work out to 0.82 for the Finex process and 1 for the BF process. In a similar manner, the conversion factor for capital cost is arrived at as 0.87 for both Finex and BF processes. The conversion factor is obtained by considering capital cost net of taxes and duties and including investments on mines and steel works only. Once these conversion factors are frozen, the AIEC for the Finex process per tonne of crude steel (slab) is arrived at as **$ 308** including capital recovery per tonne to yield 12 per cent IRR. The AIEC for slab works out to **$ 345** per tonne through the BF route as shown below:

Table 8:Computations of AIEC for Slabs Finex and BF Processes

(US$ Million Unless otherwise mentioned)

Year	Finex Process				Blast Furnace Process			
	Economic Capital Cost-Steel works+mines	Cost of Goods sold economic cost	Fixed Expenses-economic cost	Crude steel output in Million tonnes	Economic Capital Cost- Steel works+mines	Cost of Goods sold Economic cost	Fixed Expenses-Economic cost	Crude Steel Output in million tonnes
2006	116	0	7.04	0	116	0	7.04	0
2007	206	0.00	7.04	0	206	0	7.04	0
2008	1047	0.00	7.04	0	1047	0	7.04	0
2009	1372	0.00	7.04	0	1372	0	7.04	0
2010	938	0.00	7.04	0	938	0.00	7.04	0.00
2011	1007	884.68	39.38	4	1007	1075.11	39.38	4.00
2012	1482	833.89	39.04	4	1482	1013.40	39.04	4.00
2013	629	784.72	35.76	4	629	953.64	35.76	4.00
2014	1345	1598.25	73.32	8	1345	1942.29	73.32	8.00
2015	1797	1517.60	71.51	8	1797	1844.28	71.51	8.00
2016	322	1449.57	69.03	8	322	1761.61	69.03	8.00
2017		2345.88	103.17	12		2850.86	103.17	12.00
2018		2233.77	100.62	12		2714.61	100.62	12.00
2019		2139.17	98.37	12		2599.66	98.37	12.00
2020		2060.88	96.38	12		2504.51	96.38	12.00
2021		1988.60	94.62	12		2416.66	94.62	12.00
2022		1926.52	93.06	12		2341.22	93.06	12.00
2023		1873.17	91.68	12		2276.40	91.68	12.00
2024		1827.31	90.45	12		2220.66	90.45	12.00
2025		1783.21	89.36	12		2167.07	89.36	12.00
2026		1749.06	88.40	12		2125.56	88.40	12.00
2027		1719.10	87.54	12		2089.16	87.54	12.00

Table 8 (Contd.) :Computations of AIEC for Slabs Finex and BF Processes

Year	Finex Process				Blast Furnace Process			
	Economic Capital Cost- Steel works+mines	Cost of Goods sold economic cost	Fixed Expenses- economic cost	Crude steel output in Million tonnes	Economic Capital Cost- Steel works+mines	Cost of Goods sold Economic cost	Fixed Expenses- Economic cost	Crude Steel Output in million tonnes
2028		1694.44	86.78	12		2059.18	86.78	12.00
2029		1669.69	85.93	12		2029.11	85.93	12.00
2030		1647.04	85.08	12		2001.58	85.08	12.00
2031		1630.49	84.61	12		1981.47	84.61	12.00
2032		1610.25	84.13	12		1956.87	84.13	12.00
2033		1595.12	83.72	12		1938.49	83.72	12.00
2034		1587.54	83.39	12		1929.28	83.39	12.00
2035		1570.01	83.07	12		1907.97	83.07	12.00
2036		1558.17	82.79	12		1893.59	82.79	12.00
2037		1555.67	82.56	12		1890.54	82.56	12.00
2038		1553.41	82.35	12		1887.80	82.35	12.00
2039		1549.17	81.87	12		1882.65	81.87	12.00
2040		1545.96	81.52	12		1878.75	81.52	12.00
PV at 12% Rate	5008	6960	355	40	5008	8459	355	40
Average Incremental Economic cost in US$ per tonne of crude steel				**308**	**Average Incremental Economic cost in US$ per tonne of crude steel**			**345**

Concluding Remarks

The major conclusions that emerge out of the LCA are:

1) High and medium-grade iron ore serves will not last more than 19 years even if exports of these grades are frozen at the current level and if the targets set out in NSP-2005 are to be met. This necessitates computation of Depletion Premium for iron ore to carry out economic analysis. The Depletion Premium works out to $ 10.18 for a steel producer located within the State and 27 for raw mineral exporters from the State for value addition elsewhere. No such depletion premium has been applied for coking coal as the prices did not exhibit any trend prior to the recent steep price hike;

2) The AIEC for crude steel produced through the Finex process works out to $ 308 per tonne vis-à-vis the BF route AIEC of $ 345 per tonne. AIEC can also be interpreted as the average price needed per tonne of slab for the project to earn 12 per cent EIRR. Thus the least cost option is the Finex process of integrated steel making;

3) The AIEC of crude steel produced through both Finex as well as BF processes are far lower than the forecasted steel slab price that is likely to prevail during the post- 2006 period estimated at around $ 450 per tonne- indicating the cost competitiveness of Indian steel in the international market;

Economic Analysis-POSCO Project Alternative

CHAPTER

5 Economic Analysis- POSCO Project Alternative

In the previous chapter, we examined whether the proposed POSCO Finex project alternative is the least cost option by comparing it with the alternative, technically feasible project alternative- the BF process. In this section, the economic analysis of the chosen option, Finex, is carried out.

Economic Evaluation

Economic Internal Rate of Return

Economic Internal Rate of Return (EIRR) measures the profitability of a project from the perspective of the whole economy rather than the project itself. In other words, it stipulates the project's net contribution to the economy. It has been standard practice for the Asian Development Bank (ADB) to use the EIRR criterion of 12 per cent as the minimum rate of economic return. It was also the standard practice for the Indian Planning Commission to adopt 12 per cent as the applicable hurdle rate (Ref. ADB Guidelines (1998), PAD Guidelines for Project Evaluation, etc.).

This note assumes the 12 per cent as the applicable hurdle rate for the EIRR. The methodology adopted follows the one advocated in the ADB guidelines, which in basic philosophy does not differ from the original Planning Commission approach, except that recent trends in project appraisal making, such as the computation of Depletion Premiums and the concept of using AIEC for the LCA, have been adopted.

Economic Costs

Economic costs are at 2005 constant prices and are expressed in units of equivalent US Dollars. Tradable commodities are valued at border prices. Non-tradable commodities are valued through shadow prices viz. in 2005 Dollar terms ignoring transfer payments. Both the capital costs and operating costs are adjusted to reflect Real Costs (constant 2005 prices); the transfer payments such as taxes, etc. as well as the interest during construction have been netted from the Gross Capital Cost. Economic Costs for major raw material, iron ore, has been worked out in conformity to the ADB methodology as already briefed in the section on the computation of AIEC.

The EIRR at 16.6 per cent is higher than the ADB hurdle rate of 12 per cent

Table 9: EIRR for POSCO Project- Base Case

(In $ Million unless otherwise mentioned)

Finex Process

Year	Economic Capital Cost- Steel works+mines	Cost of Goods Sold Economic Cost	Fixed Expenses- Economic Cost	Sales Realisation in $ Million	Net Cash Flow in $ Million
2006	116	0	7.04	0	-122.81
2007	206	0.00	7.04	0	-212.96
2008	1047	0.00	7.04	0	-1054.05
2009	1372	0.00	7.04	0	-1379.06
2010	938	0.00	7.04	0	-945.36
2011	1007	884.68	39.38	1325.68	-605.16
2012	1482	833.89	39.04	1325.68	-1029.62
2013	629	784.72	35.76	1325.68	-123.67
2014	1345	1598.25	73.32	2845	-171.92
2015	1797	1517.60	71.51	2845	-541.52
2016	322	1449.57	69.03	2845	1004.45
2017		2345.88	103.17	4573.5	2124.45
2018		2233.77	100.62	4573.5	2239.11
2019		2139.17	98.37	4573.5	2335.96
2020		2060.88	96.38	4573.5	2416.24
2021		1988.60	94.62	4573.5	2490.28
2022		1926.52	93.06	4573.5	2553.92
2023		1873.17	91.68	4573.5	2608.65
2024		1827.31	90.45	4573.5	2655.74
2025		1783.21	89.36	4573.5	2700.93
2026		1749.06	88.40	4573.5	2736.04
2027		1719.10	87.54	4573.5	2766.86
2028		1694.44	86.78	4573.5	2792.28
2029		1669.69	85.93	4573.5	2817.88
2030		1647.04	85.08	4573.5	2841.38
2031		1630.49	84.61	4573.5	2858.40
2032		1610.25	84.13	4573.5	2879.12
2033		1595.12	83.72	4573.5	2894.66
2034		1587.54	83.39	4573.5	2902.57
2035		1570.01	83.07	4573.5	2920.42
2036		1558.17	82.79	4573.5	2932.54
2037		1555.67	82.56	4573.5	2935.27
2038		1553.41	82.35	4573.5	2937.74
2039		1549.17	81.87	4573.5	2942.46
2040		1545.96	81.52	4573.5	2946.02
PV at 12 % Discount Rate in US$ Million	5008	6960	355	14801	2478
Economic IRR					**16.55%**

Sensitivity Analysis

The robustness of project's economic returns are normally determined through a Sensitivity Analysis. The Sensitivity Analysis carried out on the POSCO project indicates that the EIRR is 16.6 per cent for the base case scenario and even in the worst case scenario it is 13.9 per cent, significantly above the hurdle rate. The ENPV ranges between $ 2.5 billion for the base case and for the worst case scenario it still works out to $ 1 billion at 12 per cent discount rate.

Table 10: Sensitivity Analysis

Scenario	EIRR in per cent	ENPV in $ Billion at 12 per cent discount rate
Base case	16.6%	$ 2.5 Billion
Base case but capital cost higher by 10 per cent	15.4%	$ 2.00 Billion
Base case but economic cost of goods sold higher by 10 per cent	15.3%	$ 1.80 Billion
Base case but sales realisation lower than the estimates in the feasibility report b y 10 per cent	13.9%	$ 1.00 Billion

POSCO Project - Externalities

Related Infrastructure

POSCO-India's investment will result in large-scale basic infrastructure development in Orissa as detailed under:

Railway (DTA)

The railway in reference to POSCO-India's SEZ will play an important role in transporting the required quantity of iron ore from the mines located in the DTA (Keonjhar and Sundergarh) to the steelworks in SEZ. The railway will serve not only as a means for procuring coals and auxiliary materials from various sources, but would also serve as a distribution channel for finished products and slag. The existing railway on the mine- to-SEZ route can handle the transport of materials only during the first (2007-2010) phase. However, in order to transport the required material after the second (2010~2012) phase, there will be a need to build an additional line connecting Banspani, Jajahpura, Haridaspur and Paradip.

Due to an increase in the number of steel projects in Orissa, the Central Government is planning to construct a double line connecting Banspani-Jakhapura as well as a third line connecting Jakhapura- Haridaspur. Other ways to augment the increased railway transport capacity are being examined. It is foreseen that when the Haridaspur-Paradip railway is completed, not only would distances shorten but more economical use of the route would also be possible.

POSCO-India is working on securing a safe transportation route for iron ore by participating in a public – private joint venture rail-link project for the **Haridaspur-Paradip section.** For this purpose, POSCO-India has already submitted the Expression of Interest to the Rail Vikas Nigam Limited (RVNL). As a principle, the access railways branching off from the main line to the mines and steelworks for their own use are to be built by private users.

Road (DTA)

The roads in reference to POSCO-India's SEZ project would play an equally important role in transporting the required quantity of construction materials and equipment from the nearby port, quarry and stations to the SEZ steelworks. It would also serve as the communication media for the workers and other local people. There is a proposal for the construction of a 6.7 -km coastal road from Paradip to POSCO-India's SEZ site. The road would benefit the transportation of construction materials and equipments through Paradip port. It would provide easy access during the development of the SEZ as well as the construction of the dedicated port. Feasibility and alignment of the coastal road have been finalised. This road would be constructed together by three (Paradip Port Trust , Indian Oil Corporation Limited and POSCO-India) companies. POSCO-India also plans to construct 11-km access roads from the SEZ to NH-5A and SH-12. This connectivity would reduce the distance from NH-5A and SH-12 to SEZ and make easy transportation of construction materials as well as help in delivering the services easily and quickly. In this regard, feasibility and alignment of these access road are underway.

Power Transmission Facility (DTA)

POSCO-India's SEZ would receive power from the Paradip GRIDCO sub-station. It plans to make power receiving equipment like towers, cables and transmission equipments in the DTA. The extension from the Paradip GRIDCO sub-station to POSCO-India's receiving sub-station in the SEZ is about 20- km long. Two transmission lines may be used for receiving power. The class of receiving voltage will be 220kV. Figure indicates the power transmission route from the Paradip GRIDCO sub-station to POSCO-India's receiving sub-station in SEZ.

Social Infrastructure (DTA)

POSCO-India will also get into social infrastructure development by building an Indian township and a Korean township with modern amenities and facilities to provide residential facility to every employee of POSCO-India in the SEZ as well as the DTA. Both the the townships will be located over 200 acres at some distance from the SEZ.

Environment Conservation

The POSCO Group has a track record of being ecologically sensitive and supports environmental protection policies. It places a priority on investments in environment-preserving facilities. Accordingly, POSCO-India would develop a clean and green SEZ notwithstanding intensive manufacturing activity. The concept of enhancing corporate value through environmental management is a fundamental agenda of the POSCO-India project. It has incorporated environmental preservation as one of the core values. In line with this strategic consideration, the environment-related activities of POSCO-India have been standardised to ensure that every business activity satisfies the requirements for environmental preservation. The air pollutants generated from the steelmaking processes includes dust, Sulphur Oxide (SO2) and Nitrogen Oxide (NO2) and POSCO-India would invest in technology for reducing their amount and concentration. It would eliminate fugitive dust by including the installation of a roof dust collection system at the steelmaking plant, along with other dust prevention facilities. Further, it would apply methods of spraying water and crusting agents on the raw material yard to prevent the escape of dust particulates. Moreover, POSCO-India's Finex process has a reputation for being eco-friendly. The emission amounts of SOx, NO x and dust are merely 8 per cent, 4 per cent and 20 per cent respectively in comparison to the BF process.

Resettlement and Rehabilitation (R&R) and CSR

POSCO-India has already prepared a Draft R&R package for those who would be displaced as per the Orissa R&R Policy, 2006. The R&R package will be complete after the SES which is being conducted through the Tata Institute of Social Sciences. POSCO-India has been interacting with the local people by initiating friendly activities like job training. The Government of Orissa has formed the Rehabilitation and Periphery Development Advisory Committee (RPDAC). The R&R Action Plan and design for construction of Rehabilitation Habitat will be resolved in the RPDAC meeting.

Annex

ANNEX

Input-Output Model as the Economic Model For Assesing the Economic Impact of Iron Ore Project vis-à-vis Steel Production in Orissa

The I-O table through its Leontief Inverse enables us to arrive at estimates of Cumulative Output in the economy for Unitary Output in the concerned sector (Output Multiplier) as well as the Employment Multiplier, cumulative employment generated in man-years (direct and indirect) due to its backward linkage in Orissa. For comparison purposes, corresponding figures to the national I-O table would be discussed in brief while the State level I-O table has been specially derived by NCAER for the POSCO project.

3.1 I-O Table Basic Steps

To understand the basic of I-O table, the six basic steps involved are briefly stated below:

Step 1: Flow Matrix tracing the flow of output from one industry to another and from industries to final users. In the Flow Matrix, each row shows output allocated according to uses (including final demand), whereas each column shows the costs and profit of producing the output.

Step 2: Coefficient Matrix - When flows are converted into ratios column-wise the resultant matrix is the Coefficient Matrix (also known as the "A Matrix"). These fixed coefficient production functions are often called Leontief production functions.

Step 3: Leontief Inverse Matrix $(I-A)^{-1}$ also known as the Total Requirements Matrix (sometimes referred to as the Leontief Inverse of A) captures the total (Direct and Indirect) input requirements needed to produce one additional unit of output by each industry.

Step 4: Output Multiplier is defined as the total increase in output generation for one extra unit of final demand in a particular sector and is derived from Leontief Inverse Matrix.

Step 5: Employment Multiplier has also been specified in man-years of additional employment created for an increased output of Rs 1 lakh of the concerned sector indicating the intangible economic advantage of using domestic inputs in executing exports. The basis for this is also the Leontief Inverse Matrix.

The basic assumption of this model that technology matrix which gives input coefficients, ratios of value added to total output etc. that is used in the I-O table, pertains to the I-O table as brought out by the NCAER with reference to 2003-04 parameters, which is expected to continue through the project useful life.

Rationalé for Using the Aforesaid Economic Model

The I-O Model traces Direct and Indirect Output linkages between industries as well as between industry and end customers:

Outputs are counted when there is a transfer from one industry to another or from industries to final users within the border of the State or across States. This can be deduced from the Leontief- Inverse/ Total Requirements Matrix of the I-O Table for the economy of Orissa. Outputs to target industry and on inputs to inputs to target industry etc. in a geometric progression can be captured by computation of Output Multipliers from the Leontief

Inverse Matrix. Thus, the I-O Model is the only scientific basis for tracing the direct and indirect linkages in a systematic fashion for all sectors in Orissa.

Hypothetical Illustration of Input Output Table:

Thus, for any level of output of the four industries, which we now label X_1 through X_4, the amount of X_1 required would be

$$X_1 = a_{11} X_1 + a_{12} X_2 + a_{13} X_3 + a_{14} X_4 + F_1$$

This says that enough X_1 must be produced to cover the input needs of each of the producing sectors, given by the input-output coefficients times the level of output, or $a_{ij} X_j$, plus the amount of X_1 needed for final demand F_1. The same is true for each of the other products, so the complete model is

$$X_1 = a_{11} X_1 + a_{12} X_2 + a_{13} X_3 + a_{14} X_4 + F_1$$
$$X_2 = a_{21} X_1 + a_{22} X_2 + a_{23} X_3 + a_{24} X_4 + F_2$$
$$X_3 = a_{31} X_1 + a_{32} X_2 + a_{33} X_3 + a_{34} X_4 + F_3$$
$$X_4 = a_{41} X_1 + a_{42} X_2 + a_{43} X_3 + a_{44} X_4 + F_4$$

F_1 through F_4 are the final goods required for the economy. The above set of equations may be put in the matrix form as given below:

$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \end{bmatrix} = \begin{bmatrix} a_{11} X_1 + a_{12} X_2 + a_{13} \\ a_{21} X_1 + a_{22} X_2 + a_{23} \\ a_{31} X_1 + a_{32} X_2 + a_{33} \\ a_{41} X_1 + a_{42} X_2 + a_{43} \end{bmatrix} \begin{bmatrix} X_3 \\ X_3 \\ X_3 \\ X_3 \end{bmatrix} + \begin{bmatrix} F_1 \\ F_2 \\ F_3 \\ F_4 \end{bmatrix}$$

where $X = A X + F$

X = Gross Output Vector

F = Final Demand Vector

A = Technology matrix (also known as direct requirements matrix)

aij = quantity of good i require directly in the production of one unit of commodity j.

The Total (Direct and Indirect) Input requirements needed to produce one additional rupee of output by each industry is obtained from the total requirements matrix.

Using the following identities

$X = (I-A)^{-1} F$

$X = (r_{ij}) F$

Where r_{ij} is known as Leontief inverse or total requirements matrix.

Assume the Total Requirements Matrix to be as follows:

Table A1: Leontief Inverse- Total Requirements Matrix-General Formulation

		Producing Industries			
		Industry 1	Industry 2	Industry 3	Industry 4
Supplying Industries	Industry 1	r_{11}	r_{12}	r_{13}	r_{14}
	Industry 2	r_{21}	r_{22}	r_{23}	r_{24}
	Industry 3	r_{31}	r_{32}	r_{33}	r_{34}
	Industry 4	r_{41}	r_{42}	r_{43}	r_{44}
	Output multipliers	Σr_{i1} where i=1,2,3,4	Σr_{i2} where i=1,2,3,42	Σr_{i3} where i=1,2,3,4	Σr_{i4} where i=1,2,3,4

For the hypothetical A matrix given above, the Leontief Inverse is as follows:

Table A2: Leontief Inverse- Total Requirements Matrix-Hypothetical Example

		Producing Industries			
		Industry 1	Industry 2	Industry 3	Industry 4
Supplying Industries	Industry 1	1.10	0.36	0.33	0.06
	Industry 2	0	1.11	0	0
	Industry 3	0.21	0.41	1.49	0.08
	Industry 4	0.19	0.21	0.40	1.25
	Output multipliers	1.50	2.09	2.22	1.39

The column total gives the Output Multiplier for that industry. The Tax Multiplier can be obtained by multiplying the Output Multiplier of the industry with the average tax for that particular industry. This gives us the total incidence of taxes as a summation of geometric progression of indirect taxes on inputs to the target industry, then indirect taxes on inputs to the industry producing inputs and so on.

Estimates of Output Multiplier and Employment Multiplier

The Output Multiplier traces the backward linkage in producing a commodity, which is important for understanding the trajectory of any industry. The Output Multiplier can be defined as a total (Direct and indirect) increase in output generation for one unit increase of final demand for a particular sector. In the instance of backward linkage, use of a particular commodity induces demand for increased production of inputs which in turn require second stage inputs. These second stage inputs would require further inputs. The geometric progression of "output" at each stage is summed up as a geometric progression to obtain the output multiplier effect.

ANNEX II

Induced Multiplier Effect

There are direct and indirect effects on the output levels of different sectors as a result of one unit increase in the final demand of a sector. It is assumed that private consumption is independent of the changes in the output of different sectors. In fact, as the output levels of different sectors change, the incomes of the households also change. This affects private (household) consumption and in turn impacts the final demand which would affect the outputs of the different sectors. This is called the Induced Effect due to the change in household expenditure and should be considered while estimating the Output Multipliers. Base on Prowess database, the proportion of dividends payment and salaries to Gross Value added works out to around 0.3. The Output Multiplier for iron and steel for Orissa is 2.81. This implies an Induced Multiplier Effect of Rs 2.81 lakh on the economy for every Rs 1 lakh output of iron and steel produced.

Limitations

Keynesian Multiplier

The concept of Keynesian Multiplier is applicable for those parts of the Model which are exogenously or autonomously determined, i.e., not for any endogenous variable. In Keynesian analysis, Government expenditure is autonomously determined but private investment is a function of rate of interest, i.e., an endogenous part.

There are two parts of investment. The autonomous part is Government Expenditure and the endogenous part is Private Investment. Here we are concerned about Private Investment which crucially depends on yield of capital. So it is not possible to calculate its multiplier effect within the Keynesian framework.

This analysis is mainly based on the I-O model. The I-O analysis is not based on the analysis of management propensity to consume by different income groups. Therefore, in a single project these two analyses do not fit well simultaneously. In Keynesian analysis, MPC is higher for lower income groups, i.e., multiplier effect will be high if people of lower income groups get involved. Otherwise MPS will be high and the multiplier effect will be low. Therefore, the Induced Multiplier Concept is neither practical nor accepted by Indian policy planners. Hence it is only mentioned in the Annex as a requirement for POSCO.

Another very important fact for not considering the Keynesian analysis insofar as Project POSCO is concerned is that it is oriented to supply side economics whereas the Keynesian analysis is mainly concerned with demand side economics. The Keynesian approach is more suited for the model of demand constrained economy.

ANNEX

II

Input-Output Table - Detailed Sectors Specification

S. No.	Sectors	Subsectors
1	Food Crops	Paddy, rice milling, Wheat, flour milling, Jowar, Bajra, Maize, Gram, Milled and unmilled tur, urad, moong, matar, masur and gram dal including flour.
2	Cash Crops	Sugarcane, gur (indigenous production), Groundnut, Raw jute, Raw cotton, Tobacco plantation.
3	Plantation Crop	Tea plantation, Coffee plantation, Rubber plantation, Coconut, Copra.
4	Other crops	Other cereals and their milling sesamum, rape and mustard, linseed, castor, mesta, sannhemp, dry chillies, black pepper, dry ginger, turmeric, indigo, opium, potato, sweet potato, tapioca, banana, cashewnut, arecanut, cardamom, citrus fruits, grapes, mangoes, other fibbers, other oilseeds, other sugars, other dyes and tanning materials, other drugs and narcotics, other condiments and spices, other fruits and vegetables, fodder, grass, rice bran, rice husk, straw and stalks, badges, cane trash and miscellaneous food and non-food crops.
5	Animal Husbandry	Milk consumed as such, ghee, butter, lassi, Agricultural animal services by rural bullocks and camels, Production of meat, mutton, pork and glands, other meat products, raw hides and skins, animal hair, bristles, wool, eggs, poultry meat, honey, silk worm cocoons, bones, horns, hoofs, dung fuel and manure, increment in livestock.
6	Forestry and logging	Planting, replanting, conservation of forests, production of fuel including charcoal, felling and cutting of trees, hewing or rough shaping of poles, blocks etc. And transportation of longs up to the permanent lines of transport, industrial wood (timber, match and pulp wood) bamboo, sandal wood, gathering of uncultivated materials such as gums, lacks, resins, forest grown fruits, nuts, herbs, barks and cane
7	Fishing	Rearing and catching of fish, seaweeds, shells, pearls, sponges etc. Fish curing viz.; salting and sundrying of fish.
8	Coal and lignite	Coal and lignite mining.
9	Crude petroleum, natural gas	Crude petroleum, natural gas.
10	Iron ore	Iron ore mining.

S. No.	Sectors	Subsectors
11	Other Minerals	Manganese ore mining, Bauxite mining, Copper ore mining, Chromite, lead and zinc ore, silver ores, gold ores, ilmenite and rutile, Lime stone mining, Mica mining, Dolomite, apatite, asbestos, barytes, chinaclay, gypsum, kyanite, magnesite, diamond, calcite, ochre, garnet, graphite, feldspar, fireclay, flourite, quartz and silica, sillimanite, steatite, minor minerals, salt mining and quarrying, sand and stone quarrying, mining of clay, sandpits, chemicals and fertilizer, mineral, precious and semi precious stone mining.
12	Food Products	Manufacture and refining of sugar, Boora, candy and khandsari, Hydrogenated oils, vanaspati ghee, Edible oils such as linseed oil, mustard oil, sesamum oil, coconut oil, groundnut oil, cotton seed oil, til oil, mahua oil, Blended and unblended black tea leaf grade, dust and waste, coffee curing, roasting and grinding, Preservation, processing and canning of meat, milk foods and manufacture of dairy products, manufacture of fruit juice, jams, jelly, pickles and canning and bottling of fruits and vegetables, canning, preserving and processing of fish, crustacean and similar foods, manufacture of bakery products, production of common salt, manufacture of cocoa, chocolate, sugar confectionery and sweetmeats, cashewnut drying, shelling, roasting, salting etc., Manufacture of ice, prepared cattle, poultry and other animal feeds, starch processed from maize, tapioca, tamarind, potato etc., Manufacture of malted foods, grinding and processing of spices, papads, appalam, egg powder, semi-processed foods and instant food processing activities.
13	Beverages, tobacco, etc.	Distilling, rectifying and blending of spirits, wines, beer, malt, liquours, other malt country liquor, toddy, manufacture of aerated drinks, aerated natural flavoured syrups, synthetic flavoured syrups, fruit juices and beverages n.e.c., Tobacco stemming, redrying grading etc. And manufacture of bidi, cigars, cigarette, cheroots, cigarette tobacco, chewing tobacco, zarda and snuff.
14	cotton+wool+art silk+ textile products	Cotton spinning in charkha, khadi weaving and finishing of cotton textiles in handlooms, Cotton ginning, cleaning and baling, spinning, weaving and finishing of cotton textiles in mills and power looms, printing, dyeing and bleaching of cotton textiles, cotton textiles n.e.c., Wool cleaning, balling and pressing, wool spinning weaving etc.(handloom, powerlooms and mills), dyeing bleaching and manufacture of woollen blankets, shawls, felts and others. Spinning, weaving, finishing, printing, dyeing and bleaching of silk textiles, Spinning, weaving and finishing of synthetic fibers, rayons nylons etc., Printing dyeing and bleaching of synthetic textiles, other silk and synthetic fibre textiles, Pressing, baling, spinning and weaving, finishing of jute, mesta, hemp and other coarse fibre, dyeing, printing and bleaching of jute textiles, manufacture of jute bags and other jute textiles, Weaving carpets, rugs, durries and others, Readymade garments, and tailoring, made up textile goods, curtains, bed covers, furnishing, mosquito nets, Miscellaneous textile products.
15	Wood, furniuture,etc.	Wooden,bamboo, cane furniture and fixtures and repair of such furniture, Manufacture of veneer, plywood and their products, sawing and planing of wood, container made of wood, cane, bamboo, reed etc., structural wooden goods such as beams, posts etc., wooden industrial goods, cork and cork products and miscellaneous wood, bamboo and cane products.

S. No.	Sectors	Subsectors
16	Paper & printing, etc.	Manufacture of machine made and made pulp, paper and paper board including newsprint, containers and boxes of paper and paper board, miscellaneous pulp products, paper and paper board articles, Printing and publishing of newspapers, periodicals, books, journals, atlases, maps, sheet music, directories, bank notes, currency notes, postage stamps, security passes, engraving, etching, block making, book binding, allied activities like envelope printing, picture post card printing, embossing.
17	Leather and leather products	Manufacture and repair of leather footwear, leather-cum-rubber/plastic cloth footwear, Tanning, curring, finishing, embossing and japanning of leather, manufacture of wearing apparel and consumer goods of leather and substitutes of leather, scrapping curving and tanning, bleaching, dyeing of fur and other pelts, manufacture of wearing apparel, rugs and other articles of fur and pelts.
18	Rubber, petroleum, plastic, coal.	Rubber tyres and tubes for motor vehicles, tractors, a air….scooters, motor cycles and cycles and other rubber plastic footware, rubber surgical and medical equipment rubber contraceptives, rubber pipes, balloons, rubber industrial and domestic goods and misc. rubber products, Plastic moulded goods and such as containers sheets, cords, polythene bags, spectacles frames, industrial accessories, domestic goods and miscellaneous products, Products of petroleum refineries, Coke and other coal tar products.
19	Chemicals, etc.	Basic heavy organic chemicals, Inorganic, organic, mixed and other fertilizers, Insecticides, fungicides, weedicides and pestic formulations, Paints, varnishes, lacquers and dyestuffs, waxes polishes, Drugs and medicines - allopathic, ayurvedic, homeopathic and others, Soaps, perfumes, cosmetics, toothpastes, soap and other toilet aids, glycerine and detergents, Turpentine, resin, synthetic resin plastic materials synthetic fibres like celluloid nylon, terylene miscellaneous products of fermentation industries than alcohol, Inedible vegetable oils including solvent extracted..animal oils and fats, matches, explosives, ammunities safety fuses, fire-works, photochemical materials, films and paper, fine chemicals, drug and intermediaries, glue and galatine, shellac, synthetic sweeteners, textile chemical auxiliaries and other chemical products.
20	Non-metallic products	Structural clay products such as fire bricks, refractor tiles and others, Cement, Manufacture of glass and glass products, earthenware and pottery, chinaware, sanitaryware, porcelainware, insulators, lime and plaster, mica products, structural stone goods, stoneware, stone dressing and crushing, earthern and laster statues and products, asbestos cement and its products, slate products, cement and concrete products, abrasives, graphite products, mineral wool, silica products and a other non-metallic products.
21	Iron & steel	Iron and steel, special steel and ferro-alloys, Iron and steel castings and forgings, Iron and steel structurals, pipes, plates, wire drawing, tools and others.
22	Non ferrous metals	Melting, refining, rolling into basic forms, wire drawings etc. of non-ferrous basic metals and alloys.

S. No.	Sectors	Subsectors
23	Metal products except mach. And tpt. Equipment	Hand tools, bolts, nuts, locks, metal chains, agricultural hand tools and implements, general hardware, Metal containers, steel trunks, safes, vaults, sanitary and plumbing fixtures and fittings of metal, stoves, hurricane lanterns, welded products, enamelling, galvanising, plating and polishing of metal products, metal utensils, cutlery and kitchenware, metal furniture and fixtures, blades, springs, art metal ware, other metal products.
24	Tractors, agri. Implements, industrial machinery, other machinery	Tractors and other agricultural machinery, equipment and implements, Rice, dal, flour and oil mill machinery, sugar machinery, tea machinery, textile machinery and jute machinery, Pharmaceutical machinery, chemical machinery, paper machinery, mining machinery, cement machinery, Automatic, capstans, turrets and lathes, boarding, broaching, drilling and threading machines, milling, planing, shaping, gear cutting and slotting machines, grinding, lapping, honing and polishing machines, sawing, filling and cut-off machines, metal forming machinery and other metal work machine tools, Computing and accounting, office copying machines, calculating machines, typewriters, duplicators, postal franking machines addressing machines, weighing machines, Other non-electrical machinery.
25	Electrical, electronic machinery and applications	Generators, transformers, switch gears, electric motors, Insulated cables and wires, Storage batteries, dry cells, Electrical fans, lamps, fluorescent tubes miniature lamps, household appliances like iron, heaters etc. And their repair services, Manufacture of wireless communication apparatus, manufacture radios, teleprinters, telephones, telegraph equipment, phonographs and record changers, manufacture of parts and accessories and other including public address equipment, Manufacture and repair of radiographic X-ray apparatus and tubes and parts, manufacture of light fittings, emergency lighting equipment, flash lights, stage lighting equipment, electric furnaces and oven telescopic aerials and parts and accessories, Manufacture of television sets, electronic computers, electronic control instruments, other parts and accessories.
26	Transport Equipments	Making of the ships and other vessels drawn by power, boat building, and their repairing, Manufacture of diesel locomotives, steam locomotives, electric locomotives, railway coaches, wagons, parts and accessories, Manufacture of motor cars, buses, trucks, jeeps, station wagons and parts and repair of motor vehicles, Manufacture of motor cycles, scooters and scooterettes parts and accessories and their repair, Manufacture of cycles, cycle rickshaws and repair of bicycles and cycle-rickshaw, Manufacture of other rail-road equipment, tramway works, bullock carts, push-carts, hand carts and transport equipment not elsewhere classified.
27	Miscellaneous manufacturing industries	Manufacture of clocks, table time pieces, watches and their parts and repair of watches and clocks, Manufacture of surgical, medical, laboratory scientific and mathematical instruments water meter, steam meters and electricity meters, recording and regulating devices for pressure, temperature, weight, level etc. Photographic and optical goods (excluding photochemical, sensitised paper and film), jewellery goods and play equipment, musical instruments, stationery article like fountain pens, pencils, pens, pin cushions, tags, hair brushes, dusters, feather articles, signs and advertising displays, mechanical toys, other toys, bones, ivory, horns and similar products, wigs, costume and imitation jewellery novelties, lampshades, presentation articles, badges and others, manufacture of aircraft and parts and repair of enterprises not elsewhere classified.

S. No.	Sectors	Subsectors
28	Construction	Construction and maintenance of buildings, aerodromes, roads, railways, bridges, tunnels, pipelines, ports, harbours, runways communication systems, waterways, water reservoirs, hydro electric project and industrial plants and activities allied to construction.
29	Electricity	Generation and transmission of electric energy and its distribution to households, industrial and commercial and other users.
30	Gas and water supply	Manufacture of gas in gasworks and distribution through mains to households, industrial and commercial and other users, LPG, gobar gas, Collection, purification and distribution of water.
31	Railway transport services	Government railways and Private railways.
32	Other transport services	Buses, tramways, trucks, taxies, auto-rickshaws, animal services, urban bullock, urban buffalo, horses and other animals drawn carts, cycles, hand pulled rickshaw and pack animals, shipping transport by boats, steamer, terry etc. By cannal or rivers and unorganised water transport by sea, air transport and services incidental to these transports.
33	Storage and warehousing	Warehousing, cold storage and storage and warehousing not elsewhere classified.
34	Communication	Postal, telephones, telegraph services rendered by postal and telegraph department and overseas communication services.
35	Trade	Wholesale and retail trade.
36	Hotels and restaurants	Services rendered by hotels, boarding houses, eating house, cafes, restaurants, canteen etc.
37	Banking	Commercial banks, banking department of RBI, other financial companies, industrial development and financial corporations, post office saving banks, cumulative time deposit accounts, cooperative credit societies.
38	Insurance	Life insurance corporation, postal life insurance, employees state insurance and non-life insurance such as fire, marine, accidents etc.
39	Ownership of dwellings	Residential houses.
40	Education and research	Education, scientific and research services.
41	Medical and health	Medical and health services.
42	Other services	Real estate, religious, legal, information and broadcasting, recreation and entertainment, domestic laundry, cleaning and dying, barbers and beauty shops and other personal services, sanitary services etc. Wrapping packing and filling of articles and information and broadcasting services.
43	Public Finance	Public administration and defence.

ANNEX

IV Input-Output 'A' Matrix for Orissa 2003-04

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
Food Crops	58283	0	0	18684	4365	0	0	1	0	0	1	37699	115
Cash Crops	89	1309	0	577	606	0	0	0	0	0	102	52735	2310
Plantation Crop	9	0	112	25	0	0	0	0	0	0	1	15402	1
Other crops	275	0	1	6770	54651	39	27	1	0	0	1	74442	1640
Animal Husbandry	25011	1682	1115	41845	234	0	0	1	0	0	1	33807	18
Forestry and logging	2	0	0	16	69	1562	0	0	0	0	1	232	1393
Fishing	13	0	0	38	1	0	1058	0	0	0	0	3904	1
Coal and lignite	4	0	0	12	5	0	0	619	0	0	2	1542	145
Crude petroleum, natural gas	3	0	0	8	6	0	0	0	0	0	0	1283	36
Iron ore	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Minerals	0	0	0	0	2	0	0	2688	0	0	0	47	0
Food Products	176	0	0	377	4389	0	299	1	0	0	1	39464	861
Beverages, tobacco, etc.	1	0	0	24	0	0	0	0	0	0	0	257	1489
cotton+wool+art silk+textile products	1196	5	1	612	752	413	2275	4	0	0	3	1824	98
Wood, furniture, etc.	13	0	0	21	4	20	314	1531	0	45	78	1495	284
Paper & printing, etc.	121	4	0	111	7	833	0	381	0	39	37	2663	1451
Leather and leather products	0	0	0	0	24	0	0	0	0	0	0	37	0
Rubber, petroleum, plastic, coal	8194	195	0	5336	17	4099	1583	2726	0	2639	1142	7991	329
Chemicals, etc.	61200	3137	2398	53299	528	10	260	5311	0	1397	2119	11033	718
Non-metallic products	2	0	0	15	2	2	0	0	0	0	0	599	668
Iron & steel	1	0	0	5	55	11	13	0	0	0	1	585	97
Non ferrous metals	1	0	0	2	21	4	5	0	0	0	1	222	37
Metal products except mach.													
And tpt. Equipment	13	0	0	22	88	1260	394	2194	0	1637	175	1184	575
Tractors, agri. Implements, industrial machinery, other machinery	1152	46	10	844	30	145	0	9449	0	230	759	724	465
Electrical, electronic machinery													
and applications	9	1	0	10	3	174	0	12	0	1	2	472	34
Transport Equipments	193	8	3	163	8	753	1548	1474	0	33	37	38	0
Miscellaneous manufacturing industries	14	1	0	10	4	1007	0	2611	0	31	6	151	31

Annex

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
Construction	4403	240	81	1654	106	9367	0	722	0	213	923	1468	65
Electricity	6087	149	1	2759	18	251	63	9902	0	1927	1735	3899	317
Gas and water supply	3	0	0	3	1	29	2	91	0	5	12	204	10
Railway transport services	1993	82	51	1520	26	1371	51	1156	0	489	305	1503	139
Other transport services	13915	693	330	16254	2263	5970	689	7353	0	1111	864	20857	1178
Storage and warehousing	0	0	0	0	0	0	0	0	0	0	0	0	0
Communication	179	7	0	120	2	468	0	260	0	176	95	465	59
Trade	20847	837	559	14694	8705	1282	1046	3217	0	794	556	40136	2097
Hotels and restaurants	27	1	0	18	0	1022	0	168	0	45	64	0	0
Banking	7901	510	292	6262	621	430	215	2091	0	414	662	19331	1252
Insurance	101	0	0	49	3	0	125	57	0	59	77	1550	95
Ownership of dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0
Education and research	0	0	0	0	0	0	0	0	0	0	0	0	0
Medical and health	0	0	0	0	0	2640	0	0	0	0	0	0	0
Other services	20	0	0	72	16	1862	701	3285	0	690	1398	4890	2471
Public administration	0	0	0	0	0	0	0	0	0	0	0	0	0
Inputs	211449	8909	4955	172232	77631	35024	10668	57305	0	11975	11161	384136	20479
Indirect tax	-25131	-1004	-740	-19113	-571	1084	1689	6155	0	2068	888	1758	1919
Gross value added	422533	34872	23438	868834	177571	124883	114124	188966	0	52261	62889	123864	12561
Gross value of output	608851	42777	27652	1021953	254632	160991	126481	252426	0	66304	74938	509758	34959

Contd..

Sectors	14	15	16	17	18	19	20	21	22	23	24	25	26
Food Crops	1	1	45	0	0	86	2	0	0	0	0	2	0
Cash Crops	2775	0	6	0	2	244	0	0	0	0	0	0	0
Plantation Crop	57	1	4	1	2101	212	0	0	0	0	0	0	0
Other crops	39	62	1536	0	122	10769	180	0	0	1	0	0	0
Animal Husbandry	165	113	35	31	29	520	34	1	1	5	0	2	0
Forestry and logging	35	9798	1636	1	24	868	387	147	5	23	2	8	4
Fishing	0	0	2	0	3	12	17	1	1	4	0	2	0
Coal and lignite	80	55	2453	0	1835	2651	10548	28809	4398	959	46	25	22
Crude petroleum, natural gas	33	1	21	0	66232	11132	0	873	568	195	65	275	0
Iron ore	0	0	0	0	0	0	0	9892	227	249	1	0	0
Other Minerals	2	43	44	0	39	2236	18573	5615	20324	786	6	59	0
Food Products	32	3	113	0	2	642	11	23	19	0	0	4	0
Beverages, tobacco, etc.	0	0	0	0	0	72	0	0	0	0	0	0	0
cotton+wool+art silk+textile products	4902	230	898	6	1556	2374	3541	1242	1319	336	131	310	36
Wood, furniture, etc.	37	3395	1255	2	163	643	619	762	389	124	197	571	97
Paper & printing, etc.	124	345	22094	2	360	4242	247	1270	953	175	83	497	59
Leather and leather products	20	17	1	99	118	5	6	7	22	13	9	22	4
Rubber, petroleum, plastic, coal	287	1441	669	10	3059	5166	7914	37460	9035	1718	684	3002	779
Chemicals, etc.	2016	882	6222	29	11930	68537	4982	4968	8501	1164	463	2602	567
Non-metallic products	11	104	246	0	44	652	4223	622	136	168	51	341	37
Iron & steel	48	303	552	1	360	917	857	169545	17029	13743	3866	10243	1928
Non ferrous metals	18	115	210	0	137	349	326	8639	45291	5228	1471	3897	733
Metal products except mach. And													
tpt. Equipment	81	331	322	3	640	1689	857	23140	4219	2696	674	892	610
Tractors, agri. Implements, industrial													
machinery, other machinery	158	196	253	1	144	762	654	1761	948	380	2872	362	230
Electrical, electronic machinery and													
applications	32	109	162	2	87	292	280	796	228	269	256	7644	202
Transport Equipments	0	8	4	0	16	14	5	470	12	147	16	41	1261

Sectors	14	15	16	17	18	19	20	21	22	23	24	25	26
Miscellaneous manufacturing industries	39	243	340	1	64	1251	1253	821	988	220	86	1043	176
Construction	63	217	186	1	168	566	482	844	483	116	75	147	36
Electricity	1487	1762	3144	6	2821	9079	6785	19853	15824	1997	772	1787	726
Gas and water supply	23	4	145	0	87	458	62	424	126	31	10	38	43
Railway transport services	51	108	954	1	764	1675	5205	20075	3062	936	144	279	96
Other transport services	1781	1569	3723	16	3387	8933	8579	15653	6527	1549	575	1531	367
Storage and warehousing	0	0	0	0	0	0	0	0	0	0	0	0	0
Communication	38	68	294	1	125	2145	319	767	1114	183	113	596	27
Trade	2298	2586	4987	58	5631	15325	10146	53419	13520	4215	1342	3934	911
Hotels and restaurants	0	0	0	0	0	0	0	1	0	0	0	0	3
Banking	1015	2057	3187	17	3871	8761	5661	23004	9465	2658	972	2647	645
Insurance	88	58	344	1	430	1681	617	1899	1394	389	306	1123	226
Ownership of dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0
Education and research	0	0	0	0	0	0	0	0	0	0	0	0	0
Medical and health	0	0	0	0	0	0	0	0	0	0	0	0	0
Other services	758	701	766	17	1271	1482	1448	13155	887	2762	1213	1605	1319
Public administration	0	0	0	0	0	0	0	0	0	0	0	0	0
Inputs	18596	26929	56856	309	107623	166440	94820	445959	167017	43444	16504	45531	11144
Indirect tax	1060	1267	3581	20	7461	7576	4365	30367	11731	3054	1520	3794	1265
Gross value added	18641	30906	25748	524	22801	12227	42472	186110	198608	14979	5441	5123	3917
Gross value of output	38297	59102	86185	853	137885	186243	141657	662436	377356	61477	23465	54448	16326

Contd..

Sectors	27	28	29	30	31	32	33	34	35	36	37	38	39
Food Crops	0	7	0	0	0	1009	0	0	241	31305	0	0	0
Cash Crops	6	75	0	0	0	0	0	0	897	0	0	0	0
Plantation Crop	15	13	0	0	0	0	0	0	125	0	0	0	0
Other crops	15	15680	4	2	0	3589	0	0	733	82953	0	0	0
Animal Husbandry	448	432	0	1069	0	0	0	0	339	17082	0	0	0
Forestry and logging	163	2633	0	0	1	0	0	0	355	2373	0	0	0
Fishing	370	1	0	0	0	0	0	0	27	1198	0	0	0
Coal and lignite	36	146	70588	0	204	0	0	0	386	1018	0	0	0
Crude petroleum, natural gas	698	121	4	2	0	0	0	0	559	0	0	0	0
Iron ore	0	37	0	0	0	0	0	0	67	0	0	0	0
Other Minerals	529	29408	0	8	0	0	0	0	365	0	0	0	0
Food Products	2	10	0	0	0	26	1	0	197	44939	0	0	0
Beverages, tobacco, etc.	0	1	0	0	0	2	0	0	54	8224	0	35	0
cotton+wool+art silk+textile products	577	1290	64	1	16	904	112	16	1710	712	26	78	0
Wood, furniture, etc.	729	17363	191	3	97	198	132	34	1849	597	100	55	0
Paper & printing, etc.	626	569	2717	55	228	2340	163	642	1585	202	1230	1209	0
Leather and leather products	50	16	5	0	0	56	0	0	318	0	0	0	0
Rubber, petroleum, plastic, coal	1773	26232	15551	55	4306	114766	177	643	10713	3032	438	962	0
Chemicals, etc.	4434	15670	1526	141	7	1475	63	0	5025	286	0	0	0
Non-metallic products	121	62488	1	29	8	475	7	0	124	247	0	0	0
Iron & steel	20229	30914	0	26	4	7	12	0	2754	0	0	0	0
Non ferrous metals	7696	11760	0	10	2	3	5	0	1048	0	0	0	0
Metal products except mach. And tpt. Equipment	405	10709	170	22	15	3005	18	69	6315	11	263	63	0
Tractors, agri. Implements, industrial machinery, other machinery	135	661	8706	51	203	5283	186	100	908	604	102	151	0
Electrical, electronic machinery and applications	330	6327	19361	21	378	3944	2	4653	331	510	111	173	0
Transport Equipments	119	212	582	12	15721	8218	4	152	314	6	428	269	0
Miscellaneous manufacturing industries	726	1308	3840	34	72	3787	83	63	5488	736	991	475	0

Annex

Sectors	27	28	29	30	31	32	33	34	35	36	37	38	39
Construction	149	4100	4111	4787	9114	7011	197	3687	1774	3842	4133	322	23835
Electricity	1851	9967	146693	971	23087	29371	1512	2516	7509	6949	3150	1425	0
Gas and water supply	37	1036	5973	797	6	672	9	8	47	2474	40	14	0
Railway transport services	282	7864	25186	70	340	2813	57	499	1595	685	357	211	0
Other transport services	1510	36574	23796	305	795	20190	264	864	30643	13711	1836	1108	0
Storage and warehousing	0	0	0	0	0	6	22	0	4742	0	0	0	0
Communication	521	3177	2990	192	410	7672	124	685	3743	770	5309	3084	0
Trade	3995	41134	32223	167	1198	20313	131	1073	5956	28372	567	507	0
Hotels and restaurants	0	72	1273	46	277	11915	41	359	414	65	3056	1070	0
Banking	1766	20003	21862	85	10871	8710	198	425	30027	144	15649	3396	0
Insurance	239	7871	3452	15	2038	6882	292	61	2758	347	2462	191	0
Ownership of dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0
Education and research	0	0	0	0	325	0	0	0	0	0	0	0	0
Medical and health	0	0	0	0	1615	0	0	60	0	0	0	0	0
Other services	992	15007	15192	1360	6149	55783	1060	4810	34821	8823	22972	3371	0
Public administration	0	0	0	0	0	0	0	0	0	0	0	0	0
Inputs	51575	380887	406061	10333	77488	320424	4872	21420	166854	262220	63220	18169	23835
Indirect tax	5629	27751	11559	195	2900	49885	211	1178	11419	6543	2356	1222	65
Gross value added	24484	231262	212452	24247	91798	246723	7388	74406	677009	132130	241468	44889	317152
Gross value of output	81688	639900	630072	34775	172185	617032	12471	97005	855282	400892	307044	64281	341052

Contd..

Sectors	40	41	42	43
Food Crops	459	262	3704	0
Cash Crops	0	0	6406	0
Plantation Crop	0	0	1767	0
Other crops	1424	147	6958	0
Animal Husbandry	801	596	4046	0
Forestry and logging	0	0	2260	0
Fishing	0	0	231	0
Coal and lignite	0	0	2749	0
Crude petroleum, natural gas	0	0	14417	0
Iron ore	0	0	199	0
Other Minerals	0	0	2422	0
Food Products	0	0	2352	0
Beverages, tobacco, etc.	0	0	740	0
cotton+wool+art silk+textile products	281	160	15989	0
Wood, furniture, etc.	1200	415	4489	0
Paper & printing, etc.	3050	669	6071	0
Leather and leather products	0	0	1341	0
Rubber, petroleum, plastic, coal	1039	323	9025	0
Chemicals, etc.	2626	42942	28292	0
Non-metallic products	0	0	1243	0
Iron & steel	0	0	19970	0
Non ferrous metals	0	0	7597	0
Metal products except mach. And tpt. Equipment	150	86	6043	0
Tractors, agri. Implements, industrial machinery, other machinery	111	63	5646	0
Electrical, electronic machinery and applications	36	20	9115	0
Transport Equipments	133	76	2110	0

Sectors	40	41	42	43
Miscellaneous manufacturing industries	1520	394	54732	0
Construction	5578	878	8387	0
Electricity	351	458	14587	0
Gas and water supply	13	7	249	0
Railway transport services	1352	362	3398	0
Other transport services	11928	4658	17341	0
Storage and warehousing	0	0	0	0
Communication	982	374	8301	0
Trade	1632	10460	32236	0
Hotels and restaurants	7253	1095	1052	0
Banking	11614	1390	27601	0
Insurance	0	0	2233	0
Ownership of dwellings	0	0	0	0
Education and research	2340	10	0	0
Medical and health	0	0	0	0
Other services	16770	76241	28160	0
Public administration	0	0	0	0
Inputs	72642	142086	363458	0
Indirect tax	2367	7315	27413	0
Gross value added	514218	63620	367128	296421
Gross value of output	589227	213021	758000	296421

ANNEX

V

Opportunity Cost Incurred in Granting SEZ Status to POSCO – India and Tax Revenue Inflows to Government from POSCO – India Located in SEZ Area

Report of Das & Associates
Advocates & Consultants
B – 28, Sector – 14, NOIDA – 201301,
National Capital Region,
Telefax: (95120) 2516660, 2516661
E-mail: adityadas@hotmail.com

Law Offices also at:

16, Lawyers' Chambers, New Block,
Opp. Supreme Court of India,
New Delhi – 110001
Telefax: (011) 23070347, 55858459

Opp. Orissa High Court, Cuttack – 753002, Orissa
Telefax: (0671) 2609835, 2609200

1348 – B, Sector – 6, Abhinav Bidanasi,
Market Nagar, CDA, Cuttack – 753014, Orissa
Telefax: (0671) 2609835, 2609200

66 – A, Forestpark, Bhubaneswar – 751009, Orissa
Telefax: (0674) 2530450, 2530381

Tax Revenue to Indian Government at the discounted value

POSCO-India, which would enjoy the status of a Special Economic Zone (SEZ) firm, would contribute Rs 18,403 crore in tax revenue at the discounted value of 12 per cent to the Indian Government for 35 years up to 2040. The different components are: Rs 12,329 crore in indirect taxes on domestic sales and capital goods; Rs 5,742 crore in corporate tax and Rs 728 crore in personal income tax, etc.

For the Government of Orissa (GoO), POSCO-India is expected to bring in Rs. 8,591, which comprises VAT on domestic sales and capital goods as well as Orissa's 30.5 per cent share of federal tax revenues (sourced by Twelfth Finance Commission). This in turn would be made up of Rs 4,556 crore as VAT levied by GoO and Rs 4,035 crore in tax transfers from the Central Government. On the revenue of the Central Government, POSCO-India would contribute Rs 9,812 crore.

In case of the DTA status, POSCO-India would pay Rs 22,092 crore of present value discounted at 12 per cent, which comprises Rs 10,052 crore to the Orissa Government and Rs 12,040 crore to the Central Government.

The difference in tax revenue accruing to the Government owing to the separate slabs for SEZ and DTA totals Rs.3,689 crore which is made up of Rs 2,228 crore to the Central Government and Rs. 1,461 to the Orissa Government at the discounted value.

Taking 2017 as a typical year of full production, POSCO-India would pay Rs 5,442 crore for the SEZ alternative, which is split into Rs 2,803 crore and Rs. 2,619 crore as revenue flow to the Central and State Governments respectively and Rs. 5,764 crore (Rs. 3,001 crore to the Centre and Rs. 2,763 crore to the State respectively) for the DTA alternative. POSCO-India's tax contribution to GoO under the SEZ status would constitute about 11 per cent of the State's total tax revenue of 2016-17.

The State's total tax revenue, which comprises its own tax Rs. 4,010 crore and shared tax Rs 4,160 from the Central Government, was estimated at Rs 8,170 crore in 2005-06. It is projected to rise to 22, 940 crore at current prices based on 9.84 per cent CAGR.

Comparison of Tax Revenue between SEZ and DTA

(Unit: Rs. Crore)

Category	Nominal Value			Discounted Value at 12 per cent		
	SEZ	DTA	Difference	SEZ	DTA	Difference
Tax on Sales	98,735	83,380	15,355	11,573	9,773	1,800
Tax on Inputs	-	16,989	- 16,989	-	2,093	- 2,093
Tax on Capital Goods	756	5,926	- 5,170	359	2,892	- 2,533
Corporate Tax	69,647	68,418	1,229	5,742	6,073	- 331
Personal Income tax	5,833	5,833	-	728	728	-
Electricity duty	-	4,512	- 4,512	-	445	- 445
Municipality tax	-	632	- 632	-	88	- 88
Total Revenue to Govt.	174,971	185,690	- 10,719	18,403	22,092	- 3,689
Revenue to Orissa	77,872	83,877	- 6,005	8,591	10,052	-1,461

Assumption of Tax Computation on the POSCO-India Project

Direct Taxes on Corporate Income

Domestic corporations are subject to tax at a basic rate of 30 per cent and a 10 per cent surcharge. Foreign corporations have a basic tax rate of 40 per cent and a 2.5 per cent surcharge. In addition, an education cess at the rate of 2 per cent on the tax payable is also charged. Based on the above system and SEZ Act and Rules, POSCO-India would pay a minimum 33.66 per cent corporate tax on its profits from domestic sales. In case of Domestic Tariff Area (DTA) Status, POSCO-India would pay 33.66 per cent of corporate tax on its all profits including those earned from exports. This is exclusive of dividend distribution tax and fringe benefit tax.

According to a FICCI study, corporate India today pays 30 per cent corporate tax on its profits. Other components of its tax burden are: 3 to 4 per cent as dividend distribution tax, 3 to 4 per cent as Fringe Benefit Tax (FBT), 3 per cent surcharge and education cess, etc. Thus, corporate India's direct tax burden today stands at over 40 per cent.

Personal Income tax of employees

Irrespective of SEZ or DTA status, personal income tax is levied by Central Government and is administered by Central Board of Direct taxes under Ministry of Finance in accordance with the provisions of the Income Tax Act. The rates for personal income tax are as follows:

Income range (Rupee) Tax Rate (per cent)
0-100,000 Nil / 1,00,000-1,50,000 ,10 per cent / 1,50,000-2,50,000, 20 per cent / 2,50,000 and above, 30 per cent

Surcharges of 10 per cent on total tax is levied if income exceeds Rs 8,50,000.

Effect Rates of Indirect Taxes

Based on the Indian tax structure, the cascading effect of indirect taxes which is made up of excise duty, customs duty, central sales tax/VAT and local levies etc., is felt on the eventual price to the customer, who may see it either as a capital good, or an inputs for production or retail.

As with all firms enjoying SEZ status, POSCO-India would pay 38.9 per cent on domestic sales which consists of 5 per cent basic customs duty, 16 per cent countervailing duty, 2 per cent education cess, 12.5 per cent VAT and 2 per cent in local taxes. Over and above, there would be the demand for Rs 250 per 100,000 gallons as water cess for local levy by the Orissa Government.

On the other hand, the effective tax rates of POSCO-India in case of DTA are as follows;

For domestic sales, POSCO-India would pay 32.9 per cent on domestic sales without 5 per cent basic customs duty. Indirect taxes are not levied on export sales.

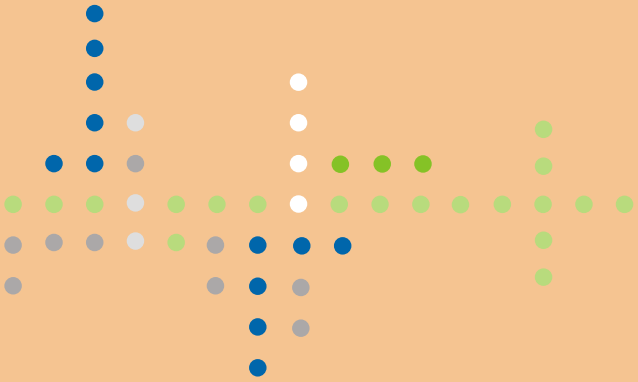
For capital goods, the DTA wing of POSCO-India would pay 7.9 per cent on imported equipments and 11.6 per cent on domestic equipments less CENVET credits. In addition, 12.546 per cent has to be paid for construction services.

On inputs for production POSCO-India would pay 5 per cent to 5.9 per cent on the procured input which are less CENVET Credits, basic customs duty drawback, and input tax credit, as well as 12.546% on other manufacturing expenses. POSCO-India assumes that imported procurement is 65 per cent of total input materials and export sales is 53 - 67 per cent of total sales.

As local levies, POSCO-India would also pay water cess (Rs. 250 per 100,000 gallons), 20 paisa per kWh in electricity cess, 2 per cent as municipality taxes on iron ore.

Sharing of Union tax revenues

Taxes and Duties levied by the Orissa Government are VAT, water cess, electricity duty, and municipal tax on iron ore. Other direct and indirect taxes are distributed to the State as its share of federal revenues. According to the Twelfth Finance Commission, the share of the States in shareable Central taxes is 30.5 per cent.



NCAER GOLDEN 1956 2006 JUBILEE

NATIONAL COUNCIL OF APPLIED ECONOMIC RESEARCH

Parisila Bhawan 11 Indraprastha Estate New Delhi 110 002 India
T +91 11 2337 8263 / 2337 9861-63 F +91 11 2337 0164
W www.ncaer.org E infor@ncaer.org