Applied Macroeconomics and Economic Development

Editors
Adeola Adenikinju
Olanrewaju Olaniyan

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Edited by

Adeola Adenikinju
and
Olanrewaju Olaniyan

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E-mail: liz_real73@yahoo.co.uk

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A SOCIAL COST-BENEFIT ANALYSIS OF THE NIGERIAN LIQUEFIED NATURAL GAS (NLNG) PROJECT

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Olugboyega A. Oyeranti and Olanrewaju Olaniyan

Introduction

Efficient appraisal of investment projects often requires the valuation of all identified costs and benefits. This becomes even more critical in situations where social costs and benefits exist such that pure private profitability criterion becomes inadequate as a measure of social profitability. As observed by Bell and Hazell (1980), investment projects may generate substantial (indirect as well as direct) effects. These effects put together arise principally from production linkages. First, a project would ordinarily generate demands for investment and intermediate goods. Second, a rise in output attributable to a particular project may cheapen supplies to other sectors, thereby increasing the profitability of new investments in other sectors of the economy.

Apart from production linkages, consumption linkages[1] as identified by Hirschman (1958) do come into play as well, if the extra income flowing from a project is capable of boosting the level of final demand in some other sectors of the economy. One way to capture these production and consumption induced direct and indirect effects is to employ cost-benefit analysis to appraise an investment project of interest (Saerbeck, 1990; Kohli, 1993; Brent, 1996; Dinwiddy and Teal, 1996; European Commission, 1997; and Belli *et al*, 2001). Given the fact that the project of interest in this study, the ***NLNG project*** is capable of exhibiting these externalities and linkages, it is considered appropriate to further subject an evaluation of its prospects to analysis within the framework of social cost-benefit analysis.

[1] Consumption linkages refer to the income spending by factor owners, which they have earned as a result of the development and operation of a project.

The essence of social cost-benefit analysis approach to project appraisal is that it considers actual receipts as inadequate measure of social benefits, and actual expenditures as inadequate measure of social costs. This approach therefore makes allowance for actual receipts and expenditures to be suitably adjusted in order to narrow the difference between private and social profitability arising from an investment project. The end result following such adjustments is that social profitability becomes closely analogous to private or ordinary profitability, while fully reflecting net social gains. In order to achieve this objective, it becomes necessary sometimes to resort to a special social discount rate that may diverge from ordinary discount rate for converting future flow of social net returns to present value.

Since social and private profitability are not necessarily mutually exclusive, it is common in evaluating the viability of a project to first subject it to financial analysis to adjudge the project as financially viable, before embarking on holistic economic appraisal. The private profitability of a project is calculated from the cash flow table, and the main theoretical criteria are the net present value *(NPV)* and the internal rate of return *(IRR)*. A complete cash flow statement upon which financial analysis is based consists of a number of inflows and outflows, which include the following: sales revenues; liquidation proceeds; purchase of fixed assets; expenses for goods used in operation; and as a correction factor- changes in net working capital. All of these represent the real sphere of a project. Also, associated with the financial sphere are inflows of financial means, and debt service among others.

The Nigerian government has made substantial investment in the NLNG project and has also made provision for a number of subsidies and tax concessions to the firm. It is therefore necessary to investigate whether the contributions of the NLNG project to the Nigerian economy justify these investments. In other words, do the returns match the opportunity costs?

Cost-Benefit Analysis: Theoretical Issues

Theoretically, a social cost-benefit analysis takes exactly the same form as a profitability analysis. Indeed, a profitability analysis is equivalent to a private cost-benefit analysis (Sell, 1991; 1994). The following differences however exist between private and social cost-benefit analyses (Little and Mirrlees, 1974):

- For the firm operating the project, receipts are identical to benefits and expenditures are identical to costs. But expenditures and receipts to the firm may differ from costs and benefits to society. One way by which this divergence can be dealt with is by valuing the inputs and outputs at different prices from those actually paid by or received by the firm.
- There may be some benefits and costs resulting from the project's operation, which do not appear as inputs or outputs of the firm, and do not vary with these inputs or outputs, and so cannot be allowed for by revaluing such inputs or outputs. In such a case, any resultant costs or benefits must be separately added or subtracted for every operation in which they occur.
- The rate at which costs and benefits need to be discounted may be different in social cost-benefit analysis. It may also be necessary to separate certain kinds of costs and benefits, because it is considered desirable to discount them at different rates.
- Direct taxation has to be subtracted from the figures for expenditures less receipts of the firm *[R-C-K]*[2] to arrive at the final figure for the benefits derivable from a project. This may not necessarily be a cost to the society, but rather a transfer of benefits to the government, and so must be added back to give the social benefit.

In the light of the above likelihood of divergences between private and social costs and benefits, necessary adjustments have to be made to the benefits and costs as well as the rate at which they are discounted. Once the adjustments are introduced, *the present value* of a project becomes its *present social value*, and the *internal rate of return* or yield becomes the *social rate of return* or yield.

In the financial analysis of projects of enterprises, there is currently no generally accepted analytical model for showing all of a firm's financial objectives in one numeraire. Thus, financial analysis as currently practised represents a form of quantitative analysis in terms of selected strategic business objectives, which often include *profitability*,

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[2] R is defined as current sales (net of indirect taxes), C is defined as payment for current inputs (including wages and salaries), and K is defined as less net capital expenditures.

liquidity, and *efficiency*. Nevertheless, this approach does not represent "optimization" in terms of all of the diverse objectives that are being analysed by the financial analyst. The reason is that there are usually no "conversion weights" available for converting units of other objectives like profitability to liquidity and vice-versa. Even, if a model was available for optimizing all of an enterprise's financial objectives, it would still not include non-financial objectives that motivate so many business owners.

Some Methodological Issues

The discounted cash flow method provides us with a tool for comparing different inflows and outflows, by expressing them through the known rate of discount, in terms of a single figure (Ward *et al*, 1991). This single figure takes account of the total amount of income and expenditure, the pattern in which they are spread out over time, and the life span of the project.

Consequently, if:

> I is the supposed initial investment made in year 0;
> $R_1, R_2 \ldots R_p \ldots R_n$ are the incomes derived from the project during the years $1, 2 \ldots p, \ldots n$ over which it is to be exploited,
> If $D_1, D_2, \ldots D_p, \ldots D_n$, are the operating costs for the project during years $1, 2 \ldots p, \ldots n$, only taking account of actual expenditure and leaving out all depreciation (and also leaving out any interest charges on loans contracted to put the project into effect, if the rate of discount is equal to the actual rate of borrowing capital), then the present discounted value of the project, that is, its discounted return, will be:

$$B = -I + \frac{R_1 - D_1}{1+i} + \frac{R_2 - D_2}{(1+i)^2} + \ldots + \frac{R_p - D_p}{(1+i)^p} + \ldots + \frac{R_n - D_n}{(1+i)^n} \qquad (1)$$

This formula can be extended for cases where the investment is not made all at once in year 0 (as is the case in the *NLNG Project*). Here, I, is to be regarded as the sum of the present values of expenditure both on investment itself and also, where appropriate, on renewing some of the

equipment for the project in the course of its lifetime. If $I_1, I_2, \ldots I_p, \ldots In$ are the investments made in years $0, 1, 2, \ldots p, \ldots n$, then:

$$I = I_0 + \frac{I_1}{1+i} + \frac{I_2}{(1+i)^2} + \ldots + \frac{I_p}{(1+i)^p} + \ldots + \frac{I_n}{(1+i)^n} \quad (2)$$

bearing in mind that some values can be zero, especially at the end of the project's life.

The formula for the present discounted return is often written as follows:

$$B = \sum_{p=0}^{P=n} \frac{R_p - D_p}{(1+i)^p} - I \quad (3)$$

The symbol $\sum_{P=0}^{P=n}$ indicating that all terms of the form $\frac{R_p - D_p}{(1+i)^p}$ are being added for all values of p from 0 to n, over the life of the project. This will be termed sum from p=0 to p=n of $\frac{R_p - D_p}{(1+i)^p}$.

The use of the discounting method is premised upon a number of conditions. They include the following:

- There is at all times a standard rate i determined by the supply and demand for capital. This rate i is the same for both lender and borrower on the assumption that the loans are not being transacted through any third party;
- It is possible to borrow any amount or invest any funds available at the rate i prevailing in the market; and
- The future is perfectly known, suggesting that inflows and outflows can be calculated for the project in advance;

The following data are assumed to be available for the calculation of present value: investment and operating income and expenditure; the period over which calculations are to be made; and the rate of discount.

Benefits and Costs

Direct Benefits and Costs

We shall start first by considering the private profitability of the *NLNG Project* in the long run. This is made possible by the data collected from

NLNG sources, which include the *Profit and Loss Account from 1999 to 2030*. The reported profit is considered as the private rate of return of the firm.

Indirect Benefits and Costs

The product of the NLNG is manufactured basically for export. The indirect benefits of the firm to Nigeria can be classified broadly into two groups, viz. governmental and non-governmental. This classification is for convenience as the ultimate beneficiaries of both governmental and non-governmental benefits are the Nigerian citizens.

Benefits

Non-governmental

Foreign Exchange Earnings Benefits

These include benefits by way of foreign exchange converted into naira to meet some local expenditure. They include the amount expended on community development; amount paid to the local contractors employed on the project; and the wages paid by the firm in local currency.

Community Development

This covers the use of funds by the firm to assist in the development of the local communities. Some of the identified ones are the production of basic amenities such as: schools; health centres; granting of scholarships; and micro-credit schemes.

In calculating this sum, we relied on the information from the *Annual Reports and Statement of Accounts of the NLNG Company*. We found that up till the end of 1999, the firm had expended a total sum of eight *million US dollars* on these items while in the year 2000 alone, the company spent about *60 million naira* on local communities. We then calculated the proportion that these expenditures represent in the firm's operating revenue. Since the proportion is 2.2 per cent, we assumed that *2.2 per cent of the firm's operating profit* would be spent on the average on development schemes for the local communities each year. This represents not only benefits in terms of development of the local communities, but also injection of Foreign Direct Investment (*FDI*).

Amount Paid to Local Contractors

This is calculated as the amount paid to the local contractors that are engaged in NLNG related activities. We assumed that this proportion would be *0.55 per cent of the firm's operating revenue.*

Employment Benefits (Wages paid to Nigerian Workers)

The employment profile of the firm has been rising despite the well-known capital-intensive nature of its operations. The number of Nigerian

workers in the company rose from 437 in 1998 to 514 in 2000 (Table 10.1). However, since we do not have the actual figure of salaries and wages paid to Nigerians, we assumed this as amounting to about ***30 per cent*** of total salaries and wages of the firm.

Table 10.1: Staff Structure of NLNG 1998 to 2000

	1998			1999			2000		
	Nigeria	Non-Nigeria	Total	Nigeria	Non-Nigeria	Total	Nigeria	Non-Nigeria	Total
Direct Employees	332	0	332	374	0	374	419	0	419
Secondee	36	113	149	38	139	177	41	126	167
Contract/ Agency	39	1	40	37	2	39	27	1	28
NYSC	30	0	30	28	0	28	15	0	15
Trainee	0	0	0	12	0	0	12	0	12
	437	114	551	489	141	630	514	127	641

Source: NLNG Annual Report and Statement of Account (various years).

Economically, the social benefits of generating additional jobs by the NLNG far outweigh its cost. This is because the wage received by average NLNG worker exceeds the opportunity cost in alternative employment or underemployment. The net gains in employment are thus calculated as the wage bill of an employed person in the firm minus the estimated social opportunity cost of employing the worker. (We use public sector employment as an approximation of the opportunity cost.) In deriving the estimates for this item, we first identified the proportion of wages paid by the firm to Nigerian workers, under the assumption that Nigerian workers would earn 30 per cent of the firm's total wage bill. This amount is then used to derive the wage rate of the average Nigerian worker working with the firm. Using 1998 data, the average wage is equal to N76, 389.00 monthly or N916, 667.00 annually in the NLNG. This compares with the median public sector wage of N10, 564.00 monthly or N126, 768.00 annually (Table 10.2). (This is based on the assumption that the public sector wage rate provides a good indication of opportunity cost of labour and the shadow wage in the market wage outside the NLNG Company) The premium, which is the difference between the wages earned in NLNG and the public sector is therefore approximately *N65, 825 monthly*. Thus, the average worker in the public sector earns 13.83 per cent of the wage of the average NLNG worker. This information then serves as the basis for computing the extra benefits earned by working in the NLNG and included as part of the

social benefit. Hence, the net gain from NLNG employment is estimated as the wage bill in NLNG minus the estimated social cost of employing the workers in alternative employment.

Table 10.2: Average Wage Earned by Workers in LNG and Nigerian Public Sector

	LNG	Public Sector (Median Salary)	Premium
Annual average salary	916667	126768	789899
Monthly average salary	76389	10564	65825

Technology Transfer

There is ample justification to believe that the country would benefit from the technological know-how needed for the operation of the NLNG. We assumed that this benefit can be proxied and quantified by using 80 per cent of the amount spent by the firm on training. However, we had no access to information on amount spent on staff training and hence, this was excluded from our computations.

Reduction in Pollution through Gas Flaring

It is assumed that increased NLNG operations especially from the *Third Train*, which is to use associated gas, would lead to a major reduction in pollution. The expected benefits of increased NLNG operation would include reduction in the effects of acid rains on the zinc roofs, metal wares, cars and houses. It would equally include reduction in health hazards that can arise from gas flaring and pollution. Since we do not have quantifiable information on these, we have not included them in our analysis although we note that they represent major potential externalities by way of additional potential benefits of the project.

Governmental

Dividend from Joint Venture

We obtained the figures on total dividend from NLNG sources. Since the contribution of the Nigerian government to the project is 49 per cent, we assumed that dividend accruals to the Nigeria economy through government accruals would be 49 per cent of total dividend.

Tax Revenue

Tax revenue represents a source of benefit to the domestic economy. Although the NLNG enjoys a tax holiday for the first ten years of its operations, the amount actually due enters into the benefit function of the society. The tax figure was obtained from the profit and loss account of the NLNG.

Social Costs

Reduction in Earnings on Gas Flaring

Currently Nigeria earns income from penalty imposed on oil producing firms that are flaring gas. The operations of NLNG that rely on associated gas would reduce the amount of gas flared and consequently revenue accruing to the government from this source. Current projections and target dates notwithstanding, we assumed quite conservatively that as a result of the operations of the NLNG, gas flaring would be cut by 50 per cent by the year 2011. The income loss from the LNG activity is thus calculated as reducing the long-term earnings of government from gas flaring by 50 per cent in the year 2011. Given that current income from gas flaring is *1.6 million dollars* annually, we assumed that if the current rate of production continues and the current penalty on gas flaring prevails, then the income loss from gas flaring would amount to *0.8 million dollars* annually by the end of 2011. This adjustment is allowed for in the analysis.

Opportunity Cost of Money Invested in NLNG

Public fund expenditure invested in the NLNG represents an economic cost to the society. This is calculated as the opportunity cost of investing the funds in alternative ventures. We assumed that if the government had placed the funds, in, for example, banks in the USA at 3.17 per cent, which is the certificate of deposit rate in the United State of America, the interest accrual on the amount invested would approximate part of the indirect cost of the project as the opportunity cost of investing in NLNG. We now present the results of our analysis.

Result of Cost-Benefit Analysis of the NLNG Project

Net Present Value (US Dollars)

Table 10.3 summarizes the results of the social cost-benefit calculations. The net present values of the benefits from the NLNG project are calculated for *real discount rates ranging from 7.5 to 12.5 per cent*. The Table shows that under the assumptions we have made, the NLNG project generates a high positive net present value. Figures 1 and 2 show the social effects and components of indirect social effects of the NLNG project, respectively.

Table 10.3: Result of Cost-Benefit Analysis of the NLNG Project

Discount rate	NPV *(US$m)*
7.5%	17405.41
10.0%	10423.15
12.5%	6401.33

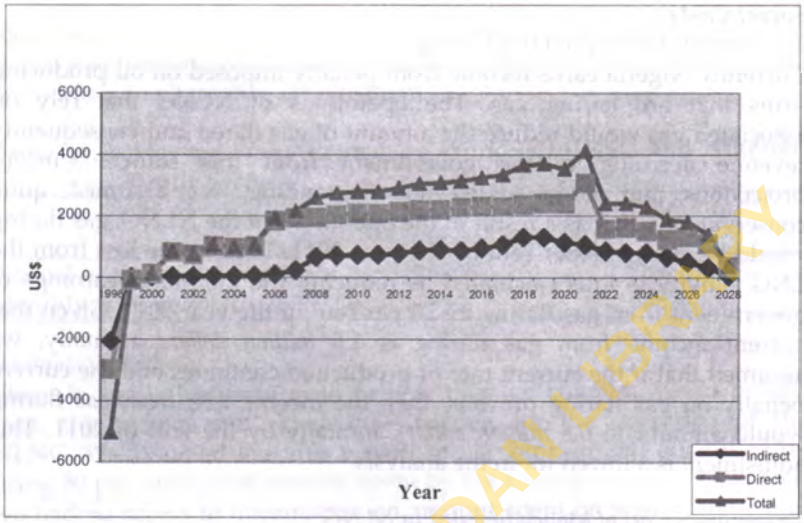

Figure 10.1: Social Effects of NLNG Project in Nigeria

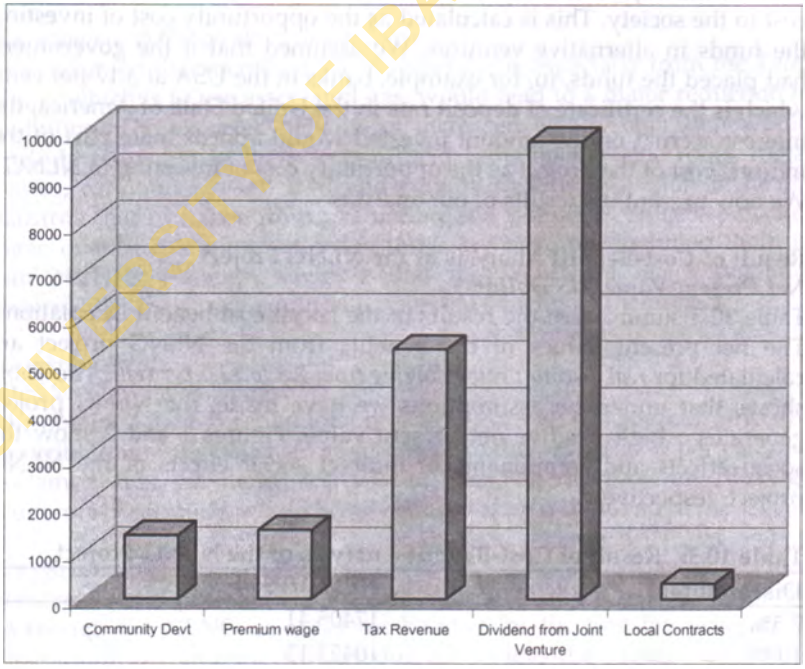

Figure 10.2: Components of Indirect Social Benefit of NLNG Project

Conclusion

The social cost-benefit analysis of the NLNG project strongly indicates that it would on the whole be beneficial to the Nigerian economy. The high rate of return shows that the activity is profitable both in the commercial sense, from the viewpoint of the private investors, and in the social sense, from the national economic viewpoint.

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