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# ON BEING WISE AFTER THE EVENT: SOME EMPIRICAL EVIDENCE FROM GHANA ON THE ECONOMIC IMPLICATIONS OF RISK AND UNCERTAINTY IN PROJECT EVALUATION

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# On Being Wise After the Event: Some Empirical Evidence from Ghana on the Economic Implications of Risk and Uncertainty in Project Evaluation

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## 1 Preamble

This paper will start with a summary of some of the objectives of project appraisal and of feasibility studies. This will include a brief review of some of the methods and approaches that have been suggested in treating risk and uncertainty in such studies. Following on from this will be a discussion of the performance of the Komenda Sugar Factory and Estate, established in the Central Region of Ghana in the second-half of the 1960s. It is possible to obtain an insight into the types of factors which are likely to be most important in affecting levels of risk associated with projections of the technical and economic performance of such agro-industrial projects. Some of the factors will be subject to control by policy measures, or by changes in institutional structures, while others may be largely related to climatic and other environmental features. However, even rainfall patterns, for example, can be modified in terms of the impact they have on agricultural output through irrigation schemes, and soil characteristics can be modified through careful cultivation methods and intelligent use of chemical inputs.

The concluding section attempts to draw together not only the elements of the Komenda project which have accounted for its failure, and which might or might not have been foreseen, but also the possible implications of this type of extreme performance on the methodology and procedures for evaluation of risk and uncertainty in project evaluation in LDCs. The principal conclusions of the paper emphasise the considerable significance of the level and variations of technical performance in influencing the economic performance of projects, particularly in the agro-industrial sector.

## 2 Introduction

Many feasibility studies and other project reports have tended implicitly to view project technical and economic performance as being predictable with some considerable certainty. While it is recognised that the world is an uncertain place, it has proved to be difficult to adapt project appraisal methods to take explicit account of risks without inordinately complicated data and calculation demands.[1] Many risks are quantifiable in principle, and have a 'direct effect' on the cash flows generated by the project (both costs and revenues) whichever method of appraisal is being employed. There is a risk of turning down a prospective good project just as much as one of accepting a prospective bad project. Equally, using a single set of implicitly-assumed risk free cash flows, with the subsequent identification of an economically optimal technology, involves the possibility that this technology is associated with high levels of risk, and that there is an alternative less risky technology with acceptable economic performance which although not optimal in the conventional sense, would rationally be selected.[2] Thus, in some senses the concept of 'second-best' may be invoked, if not literally applied, to override conventional approaches. This approach, if used consistently, could have considerable relevance to countries such as Ghana, where risks and uncertainties abound, and to LDCs more generally, particularly in the areas of project and technology appraisal and selection.

In principle feasibility studies are undertaken in order to allow an objective assessment of the technical and economic viability of development projects, together with, ideally, an assessment of the social and environmental impact of the particular project in view. Such studies are sometimes incomplete either in omitting reference to social and environmental external effects, which could make a project considerably more attractive, or in including only comparatively rudimentary economic analysis. Criticism is often levelled at either inadequate or non-existent appraisal using social accounting (shadow) prices, this criticism emanating principally from academic economists. One response to this might be levelled at the problems associated with the confident use of realistic shadow prices,[3] another might emphasise the operational significance of commercial rather than social profitability in terms of achieving a viable long-term project. However another, and less frequently found, level of criticism could emphasise the technical and economic risks and uncertainties surrounding estimates of project performance, and in turn suggest the establishment of a range of estimates of project performance (e.g. profitability or production costs), rather than a single estimate.

## 3 Approaches to the Treatment of Risk and Uncertainty

Let us take a simple numerical example from within the Discounted Cash Flow method to illustrate the significance that risks might have. Suppose that a project has a Present Value of Costs (PVC) of £1.00 million, and a Present Value of Revenue (PVR) of £1.05 million. Based on an initial investment (K) of £100,000 the Net Present Value (NPV) is £50,000, and the NPV/K is 0.5. A 10 per cent variation in the PVC gives a high NPV of £150,000 (NPV/K =1.5) and a low (negative) NPV of £-50,000 (NPV/K =-0.5). A 10 percent variation in the PVR gives a high NPV of £155,000 (NPV/K = 1.55) and a low (negative) NPV of £-55,000 (NPV/K = -0.55). A 10 per cent variation in costs or revenues gives a 200 per cent variation in profitability - giving a good indication of the ‘knife-edge’ on which the economic viability of projects depends. The same stricture applies to comparisons of the economic performance of alternative technologies of course.

In the World Bank study by Louis Pouliquen, one of the projects analysed was the construction of a deepwater harbour at Mogadishu. The study identified 27 uncertain variables of which seven were found to be particularly significant, and one (labour productivity) was felt to be crucial to the success of the project. Reducing labour productivity from 12 tonnes per hour to tonnes per hour reduced the internal rate of return from 14.2 per cent to 7.3 per cent. The best estimate "gang" productivity was 10 tonnes per hour, and it was on this basis that the original 12.2 per cent internal rate of return was reached.[4] This is an example of the economic implications of variations in the technical performance of a project. The analysis, carried out on an ex-ante basis of course, reached two important sets of conclusions: first, numerical estimates of the probability distribution of alternative rates of return were made, allowing a more precise notion of the effects of risks than is usually found in project appraisal; second, it identified one variable which was particularly important, allowing a recommendation to be made on project implementation which was designed to ensure that a comparatively high value be achieved for that variable in practice.

In strict terms, there is no basic similarity between deepwater harbour construction on the one hand, and integrated sugar cane production and processing on the other.

However, there is sufficient data available to permit at least a partial analysis of one Ghanaian sugar project on an ex post basis. This data is stronger on the technical side than on the economic side, largely because of the extreme changes that have taken place in recent years in the pricing environment in Ghana (see fn 3 and page 13). However, since the economic viability of such projects is very strongly related to technical parameters, and since it is possible to enlarge upon some of the reasons for "short-falls" in technical performance, it was felt to be useful to proceed with a modest approach to a discussion on this basis. Agro-industrial projects are particularly prone to risks, depending as they do for economic viability on reliable supplies of an acceptable quantity and quality of materials for as long a season as possible.[5]

If the question of risk and uncertainty is significant, then we might expect that some of the manuals, guides and text books would give some attention to it. Sugden and Williams commit two chapters to uncertainty in their book on *The Principles of Practical Cost Benefit Analysis*. They outline three conventional methods of incorporating risk and uncertainty into discounted cash flow (DCF), or into financial (accounting), analysis of projects. These are (i) the addition of an item for contingencies; (ii) the addition of a ‘risk premium’ over and above the discount rate (or required rate of return) used in DCF analysis; and (iii) the shortening of the time-horizon, reducing the period within which the project would have to cover its costs (using either payback or DCF analysis). All of these are rejected on the grounds that they do not satisfactorily deal with the realities of the forces relevant to the issue of uncertainty - indeed they are described as a "recipe for muddled thinking."[6]

Alternatively it is possible to use sensitivity analysis to give a range of estimates of project economic performance. Apart from testing for sensitivity to changes in discount rates, foreign exchange rates, wage levels, alternative input and output prices etc., this approach can also be used for:

a) arriving at a "best estimate" of economic performance based on the mean expected values of the main parameters affecting the technology or project (e.g. labour productivity, raw material quality, level of down-time etc);

b) arriving at a ‘most optimistic’ view of potential performance;

c) arriving at a ‘most pessimistic’ view of potential performance.

In the study cited earlier Pouliquen and associates used this approach for the Mogadishu port development, but also extended the analysis further to incorporate probabilities into the establishment of cash flows and rates of return.[7] The use of the probabilities approach is also outlined by Bromwich in his *Economics of Capital Budgeting*, and by the then Overseas Development Ministry in their *Guide to Project Appraisal in Developing Countries*.[8] The major problem with the use of probability analysis is the establishment of meaningful values for probability distributions of the main parameters within the analysis. Objective values imply paradoxically that the project is already operating and that detailed observations can be made, while subjective values can only be made based on interpretation of a good data base and the establishment of intelligent estimates.[9] After such values have been established, the complexities of the data manipulation tend to make the full probability analysis a method which should probably be used sparingly, and then principally for investment decisions which are of major economic significance. Alternatively, if subjective probability distributions are used only for a few selected parameters within a system of sensitivity analysis it would be possible to make investment decisions on projects and on technologies on a much more sophisticated basis. Interestingly enough, in a recent book on *Planning Development Projects* published by the Overseas Development Administration, Bridger and Winpenny place significant emphasis on the issue of uncertainty in their introductory chapter on project appraisal but do not explain how the evaluation procedures should incorporate it into the analysis.[10]

## 4 The Komenda Sugar Project[11]

The Komenda Sugar Project, about 180 kilometres to the west of Accra on the Ghanaian coastline, started operation in 1966/67. At the time of writing (October 1984) it is not operational, having already undergone one rehabilitation project funded by the World Bank and managed by HVA International ( a Dutch company) over the period 1973-78. A number of reports have been written since then in an attempt to initiate a further rehabilitation. The factory equipment was supplied by Skoda, through the

Czechoslovakian export agency Techno-export, after standing in store at Ghanaian expense for two years because it was originally destined for Tsito in the Volta Region in eastern Ghana.[12] For a number of years Associated Consulting Engineers of Pakistan acted as agents for the erection of equipment and subsequently for the management of the project. The estate plantation, intended to supply 50 per cent of the sugar cane to the 1,000 tonnes (gross) per day capacity factory, was established by the State Farms Corporation and was intended to have full irrigation. Ownership of the project was originally vested in the State Sugar Products Corporation, was transferred to the Sugar Products Division of the Ghana Industrial Holding Corporation, and later (as a condition of the rehabilitation project) to an autonomous publicly owned body, Ghana Sugar Estates Ltd. Supervision of the project has consistently been jointly by the Ministry of Industries and Ministry of Finance. Because of these institutional changes it has not been possible to refer to any of the original reports relating to the project.

Both Ann Seidman and Tony Killick have some very critical remarks to make on the establishment and supervision of the Komenda sugar project as well as the sister project at Asutsuare in eastern Ghana.[13] Most of these comments refer to the very early, or pre-establishment, years of the projects. The discussion which follows is based on information kindly supplied by the Komenda management team, with the permission of the Ghana Sugar Estates Ltd head office. This information covers the period up to about 1981/82 by which time sugar production had ceased, although at that time molasses production was continuing on a limited basis.

Table 1 sets out actual data for the year of highest sugar production (1975/76) and for that of lowest sugar production (1972/73), and for the average performance over the period 1968/78, being the ten years which sight be taken as representative of the project. In addition, the table sets out potential performance with optimistic and pessimistic assumptions on the technical performance of the project. Based on this data, discussion of project performance can start with some detailed comments on the cane supply and season length before moving on to more economic considerations. It is of extreme significance that, viewing the last two columns, starting from a

**Table 1**
**Actual and Potential Technical Performance**
**Komenda Sugar Factory and Estate – Ghana**

| | | Best Year 1975/76 | Worst Year 1972/73 | Average 1968/78 | Potential | |
|---|---|---|---|---|---|---|
| | | | | | Optimistic | Pessimistic |
| Cane Area Harvested (hectares) | Plantation | 1,310 | 551 | 971 | 1,500 | |
| | Outgrowers | 1,232 | 1,019 | 1,134 | 1,500 | |
| | Total | 2,542 | 1,570 | 2,105 | 3,000 | |
| Cane Yield (tonnes per hectare) | Plantation | 44.40 | 39.66 | 39.18 | 55.00 | 40.00 |
| | Outgrowers | 34.46 | 37.31 | 34.91 | 50.00 | 35.00 |
| | Total | 39.54 | 38.13 | 36.88 | 52.50 | 37.50 |
| Cane Harvested / Crushed (tonnes) | Plantation | 58,168 | 21,853 | 38,040 | 82,500 | 60,000 |
| | Outgrowers | 42,330 | 38,015 | 39,588 | 75,000 | 52,500 |
| | Total | 100,498 | 59,868 | 77,628 | 157,500 | 112,500 |
| Sucrose Content in Cane | | 10.41 | 9.87 | 10.68 | 12.00 | 10.00 |
| Process Losses (percent) | | 36.08 | 41.17 | 40.34[a] | 25.00 | 35.00 |
| Sugar Production (tonnes) | | 6,688 | 3,476 | 4,946 | 14,175 | 7,313 |
| Number of days in season (gross) | | 174 | 124 | 154[b] | 210 | 173 |
| Factory downtime (percent) | | 41.4 | 38.2 | 49.6[c] | 25.00 | 35.00 |
| Capacity Utilisation -cane crushed | | 86.0 | 51.2 | 66.4 | 134.6 | 96.2 |
| -sugar produced | | 68.1 | 35.2 | 50.3 | 144.2 | 74.4 |

Source: Komenda Sugar Factory and Estate management team and derived calculations. See M.A. Tribe: Komenda Sugar Factory and Estate - A Case Study in Technology Selection and Performance - Draft Discussion Paper, Centre for Development Studies, University of Cape Coast, and David Livingstone Institute, University of Strathclyde, 1983/84.

Notes: a) Calculated from average sucrose content and sugar production; b) Based on six year average 1972/78. c) Calculated from nominal capacity of 1,000 tonnes cane per day and cane actually crushed. d) Based on sustainable cane crushing of 117,000 per year, and sustainable sugar production of 9,828 tonnes per year.

reasonable target for the amount of land available, and using optimistic or pessimistic estimates for cane yield per hectare, sucrose content in cane, and for process losses, the highest sugar production level is approximately twice that of the lowest. Also notable is that the pessimistic (lowest) estimate of potential sugar production levels is actually higher than the highest level ever attained at Komenda. This emphasises the strong link between the technical and the economic performance of the project since, of course, the latter depends on the level of regularly sustainable output as well as on elements of the economic environment such as relative prices, discount rate etc. However, to ascribe the problems of the project simply to poor levels of capacity utilisation would be to conceal the reasons for the observed performance.

Cane supply is a principal feature of the project. In the best year it was 86 per cent of the highest reasonable estimate of a sustainable level (117,000 tonnes per annum), while the sucrose content, at 10.41 per cent, was lower than the maximum achieved (11.89 per cent in 1970/71), and lower than the target figure, which was about 12 per cent.[14] The production of cane on the plantation estate depended initially on the purchase or lease, and the preparation, of sufficient land to supply 60,000-80,000 tonnes of cane per annum. The complexities of land tenure arrangements and of land preparation did not guarantee that the required area was available, so that the maximum area harvested prior to the start of the rehabilitation project was 972 hectares in 1970/71 yielding 26,637 tonnes of cane. An additional 60,000-80,000 tonnes of cane was required from outgrower farmers, and the area harvested built up slowly (but steadily) in the early years of the project, averaging about 1,500 hectares each year from 1971/72 onwards. This is predictable, since outgrower farmers joined the project on a voluntary, but contractual, basis. A major problem which arose in more recent years was a significant disparity between controlled cane prices paid by the Komenda factory, (about C200 per tonne) and de-controlled prices paid by private akpeteshie[15] producers in the surrounding area (C800 per tonne), suggesting that in the longer term price incentives to outgrower farmers could be a significant factor affecting continued cane supply if a further rehabilitation were to be attempted.

Equipment supply has been a constant problem by all accounts so that by 1980/81 only about 50 per cent of the equipment required to handle harvested cane on the estate plantation was available. The principle reason given for this was the lack of foreign exchange available for equipment purchase and maintenance. However, even if the equipment had been available complaints were made about the difficulty of recruiting sufficient labour to harvest the cane. This had even been given as a reason for looking into the possibility of purchasing mechanical cane harvesters. However, this does not give the full story. In late 1982/early 1983, when Komenda was able to pay daily labour for cane-cutting C12.30 per day plus a limited bonus, farmers in the private sector in the surrounding area were prepared to pay 030 to 040 per day, and give some food as well. By mid-1984 when the official daily wage had risen to C40, private farmers were prepared to pay C100. This suggests that something was seriously at fault in the wage-fixing system. The suspicion must exist that the cane harvesting problems were principally related to the lack of adequate i) wage levels, ii) fringe benefits (such as food and transport), and iii) supervisory labour, rather than to problems with labour supply as such.

Difficulties with cultivation equipment supply and maintenance had also been a problem apparently, so that the cane cycle which would normally involve the replacement of the cane setts every 4 to 5 years, had been extended to a number of years which reduced cane yields and cane quality. For example, in 1978 the estate plantation at Komenda consisted of the following balance: plant cane 188 hectares; first ratoon 208 hectares; second ratoon 234 hectares; third ratoon 259 hectares, fourth and subsequent ratoons 291 hectares. This does not give an indication that the situation was too serious at that stage. However, the fact that the average area that would have to be replanted over a five-year cane cycle was about 230-250 hectares, suggests that targets were slipping by 1978.

Irrigation, which can raise cane-yields and cane quality above those found in rain-fed conditions, and reduce variations from year to year significantly, was incorporated in the original design of the estate plantation. The pumping of the irrigation water depended on electricity. When the electricity supply from the special generating station was cut-off by the Electricity Corporation of Ghana in 1977 cane yields on the plantation dropped from 44.40 tonnes per hectare (1975/76) to 24.79 tonnes per hectare (1976/77). This is perhaps the clearest evidence that the Ghana Government was not serious about the project as a whole, and particularly about the rehabilitation project.

The length of the crushing season is crucial to the cane supply situation, and to the economic viability of such projects. The significance is clear from the figures in Table

1. In principle, cane can be crushed at Komenda from mid-October/early-November until about the end of April. This gives a gross crushing season of about 180 days. Some of the reasons for limiting the season length can be seen in Table 2, so that later in the season the sucrose content in cane falls and the fibre content increases giving less sucrose per tonne cane, and making extraction more difficult. The Ghanaian Management Development and Productivity Institute produced a rehabilitation feasibility report in 1979 which outlined the length of the target gross and net crushing seasons. Table 3 reproduces this data. From Table 1 it can be seen that the actual average length of the gross crushing season over the 1972/78 period was only 88 per cent of the target. Monthly data shows that in the years 1973/74 to 1976/77 no crushing took place in November, and in 1973/74 no crushing took place in December. The loss of one month's crushing involves a sacrifice of 20,000-25,000 tonnes of cane. If this is crushed later in the season instead of earlier the cane quality will be lower, involving a loss of sucrose. If the cane has to be left in the fields it would interfere with the regular cane cycle.

For the "optimistic" potential situation, 210 days crushing would be required at 1000 tonnes per day with 25 per cent downtime. This length of season is technically unlikely due to the limitations of rainfall and cane quality. However, if the daily cane crushing were to be raised to 1,200 tonnes per day (gross), then 157,500 tonnes of cane could be crushed within a feasible season length. An increase in the crushing capacity would have been possible within the factory design if cane preparation were to be improved, and if the mill tandem were to be run a little faster with some adjustment to the technical specification.

**Table 2**
**Cane Quality (Monthly Basis) - Komenda Sugar Factory and Estate 1973/74 to .1976/77**

| | December | | April | |
|---|---|---|---|---|
| | Sucrose in Cane (%) | Fibre in Cane (%) | Sucrose in Cane (%) | Fibre in Cane (%) |
| 1973/74 | 10.99 (Jan) | 14.44 (Jan) | 10.54 | 18.00 |
| 1974/75 | 10.84 | 14.70 | 10.16 (March) | 18.49 (March) |
| 1975/76 | 11.24 | 14.47 | 8.58 | 22.85 |
| 1976/77 | 11.85 | 15.76 | 7.70 | 22.85 |

Source: Komenda Management Team

**Table 3**
**Gross and Net Crushing Season**
**Komenda Sugar Factory and Estate – Planned**

| | Days | Percent |
|---|---|---|
| Gross Milling Season | 175 | 100.00 |
| Public and other Holidays | 6 | |
| Lack of Cane (wet fields) | 6 | |
| Evaporator Cleaning | 12 | |
| Technical downtime | 9 | |
| Totals | (32) | (18.0) |
| Net Milling Season | 143 | 82.0 |

Source: Management Development and Productivity Institute, Feasibility Report on Ghana Sugar Industry, 1979, Accra.

The reasons given for the late start to the season are largely related to the difficulties and delays involved in securing import licences and foreign exchange control clearance for the import of essential spares and materials. Similar problems, of course, could apply with imported fertilisers and pesticides. If inputs of spares were delayed, then essential parts of factory equipment would not be reassembled in time for a prompt start to crushing. An alternative explanation of the tardy supply of spares might be that they were not ordered early enough by the project management. However, there is additional evidence of delaying tactics by the Ghana Government at times of financial stringency, which suggests that the fault is more likely to have been with the central government than with project management.[16]

In addition to season length the level of downtime affects the actual crushing capacity. It can be seen from Table 3 that the target level of downtime was 18 per cent, while Table 1 shows that the actual average for 1968/78 was 49.6 per cent. A reduction in stops for repairs, faster execution of repairs, and a reduction in the number of mill chokes could substantially reduce the high levels of downtime observed. In establishing the 'optimistic' level of downtime in Table 1 all these considerations have been taken into account. The figure of 25 per cent is high in a world sugar industry context, but low in a Ghana context.

Other aspects of technical performance which involve fairly considerable levels of uncertainty relate to the sucrose losses within the factory. These will be the worse the greater any delays in transporting cane to the factory, since any period in excess of 48 hours between harvesting and crushing involves significant sucrose inversion and drying out of cane, making crystallisation and extraction (respectively) more difficult. Table 1 shows that sucrose in cane levels have been lower than might have been hoped for, and that process losses are considerably higher than are usually expected in the industry. Actual process losses over the period 1968/78 were just over 40 per cent of sucrose in cane, as opposed to a normally attainable figure of 20 to 25 per cent (the higher of which has been taken as 'optimistic' for the calculation of potential performance). The combination of these parameters accounts for the much lower figures for capacity utilisation based on sugar produced shown in Table 1. To produce sugar effectively it is first necessary to crush cane containing acceptable levels of sucrose, and then it is necessary to convert this sucrose into sugar and get it into the bag at the end of the factory processing.

Economic variables have not directly figured in the discussion to this point. However, in LDCs with the type of economic structure existing in Ghana, the question of foreign exchange tends to be paramount. First, where a very high proportion of capital equipment is imported, the exchange rate will directly affect the level of investment costs. Second, the foreign exchange rate will affect the local currency cost of imported spare parts and replacement equipment, as well as materials and fuels. Third, the availability (or lack) of foreign exchange may crucially affect the operating efficiency of projects demanding imported spares, equipment and materials. This third point can be expanded. We have already seen that the late arrival of spares and materials can delay factory operations at the start of the crushing season. In addition, any reduction in foreign exchange allocations below those required to keep equipment operating efficiently can firstly, reduce the level of technical performance and secondly, cause higher levels of downtime due to repairs on old equipment used beyond the scheduled replacement date. Both of these factors reduce economic efficiency, and are very difficult to predict with any accuracy.

The issue of foreign exchange allocation has affected the Komenda project in a way which makes the above points quite pertinent. The World Bank rehabilitation scheme for the Ghanaian sugar industry (comprising the Komenda and Asutsuare projects) consisted of a US$15.6 million programme of expenditure over the five year period 1973-78. The scheme started a year late due to delays with the agreement to go ahead, so that the prices included in the budget were based on 1971, and had a 6 per cent per annum inflation allowance built in. The major part of the foreign allocations were spent in the Netherlands and in the United Kingdom on management services and equipment. However, the mid-1970s was a period of exchange rate adjustments and of rapid inflation in the industrialised countries of Western Europe. George Kwadzo has undertaken a careful study of the rehabilitation scheme and has calculated that the dollar expenditures which would have been required to purchase goods and services valued at U.S. $15.6 million (including 6% inflation factor) based in 1971 prices would have been 40.42 per cent higher when valued at current prices. This means that simply to undertake the expenditure in real terms outlined in the rehabilitation scheme would have required the expenditure of U.S. $21.9 million.[17]

A further question relating to the foreign exchange rate is simply that of the prices to be used in any appraisal of a possible future rehabilitation. In Ghana the official exchange rate moved from C2.75 = US$1.00 in early 1983, through a system of surcharge and bonuses and subsequent devaluations, until in the latter part of 1984 it was C37.5 = US$1.00. It is now possible to be more confident of the meaningfulness of the official exchange rate. However, the official internal price of sugar (C22,000 per tonne at harbour gate) reflected the unofficial exchange rate between cedi and dollar, rather than the official exchange rate. In these circumstances there would be a considerable difference between the profitability of any rehabilitation calculated at market prices (with imported inputs valued at official exchange rate and output valued at unofficial exchange rate-based prices), and profitability calculated at uniform (or at shadow) exchange rates.

After a period of rapid inflation in Ghana, the relative prices facing any rehabilitated sugar industry are open to considerable revision from those in existence two or three years before.[18] Thus, prices for sugar cane and other inputs, wages, and the prices of sugar and molasses would need complete re-consideration in any new appraisal such have been the changes in the economy. Given the points made earlier concerning controlled prices (e.g. for sugar cane) and for wages (for daily labour) it is open to question whether the established price control system could adapt sufficiently quickly to rapid changes in economic circumstances to allow even basically viable state enterprises to maintain operations on a self-financing basis.

## 4 Conclusions

The issue of the treatment of risk and uncertainty in project evaluation is an important one for development economists to tackle, and to find more effective methods of incorporating it into appraisal methods and procedures. The example given in this paper, the Komenda Sugar Project in Ghana, is an extreme one in a country renowned for its extraordinary performance at economy and project level. However, this extreme example, from the agro-industrial sub-sector, demonstrates graphically the complexities of the inter-relationships which go to account for successful/ unsuccessful technical and economic performance of projects. In particular it demonstrates the significance of technical parameters and of the socio-economic environment in determining the economic performance of projects. Perhaps insufficient has been ventured to firmly justify the assertion that those factors are likely to be more important in the ranking preferences of projects and technologies than comparatively marginal adjustments to foreign exchange rates, wage rates or discount rates for example. However, further analysis should be possible to pursue this line of argument.

The following comments may be made on the Komenda project in summary:

i) Technical

a) A range of natural environmental hazards, supplemented by man-made hazards, combine to make predictions of technical performance highly uncertain. At Komenda the highest level of output achieved was less than the pessimistic estimate of potential performance, and the average performance between 1968/69 and 1977/78 was about two-thirds of this pessimistic estimate.

ii) Economic

a) There are elements in the pricing system which make estimates of relative prices which might be used in an appraisal highly uncertain. Additionally the incentive system built into both controlled producer prices and wages has been non-existent and a negative factor operationally. Difficulties with availability of foreign exchange for essential supplies sake the maintenance of efficient operation questionable.

iii) Bureaucratic/Institutional

a) Complexities of governmental control over the economy tend to be a negative factor in the operation of this type of project, such bureaucratic control being implicit rather than explicit in effect.

b) Planning of plantation and outgrower cane production, harvesting and transport, factory management (manning, supplies and technical performance control), and relations with government demand a very high standard of personnel. At the outset Ghana did not possess skilled and qualified staff to manage complex sugar projects so that outside management from Pakistan and latterly from the Netherlands were employed. The significance of a good management team in reducing the effective degree of risk and uncertainty surrounding project performance, and thereby enhancing its economic efficiency, should not be under-estimated - even in the Ghanaian context.

c) The Komenda project is an example which was poorly conceived, poorly designed and appraised, poorly implemented, poorly managed at project, and particularly at government, levels, and poorly rehabilitated. It is to be hoped that analysis such as that in this paper will assist further improvements to be made to project evaluation procedures in the future in Ghana and elsewhere.

d) Project appraisal (and ex-post evaluation) incorporating, at the very least, some form of sensitivity analysis allows a much clearer view of potential project performance at both technical and economic levels. As well as permitting a clearer view of superficially attractive projects (or even of superficially unattractive projects) which might reverse impressions based on single figure estimates of performance, this type of analysis allows the identification of the main problem areas affecting or likely to affect project performance. Once these areas have been identified policy responses may be designed in an attempt to reduce the size of the problem.

e) However, the operational effectiveness of the type of probability analysis advocated by some of the manuals and texts on project evaluation remains to be tested. The supposition, based on the discussion in this paper, must be that the probability approach has a limited applicability, largely due to the difficulty in establishing meaningful values for objective (or for that matter subjective) probability distributions, and the considerably enhanced complexity of the data and data processing demands of the approach.

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**Footnotes and References**

1. See, for example: M. Bromwich; *Economics of Capital Budgeting*, Penguin Books, Harmondsworth, 1976 - Chapter 12, Risk and Uncertainty; P. Dasgupta, A. Sen and S. Marglin; *Guidelines for Project Evaluation*, UNIDO, New York, 1972 - Chapter 10 Project Evaluation under Uncertainty; G. Irvin; *Modern Cost-Benefit Methods*, Macmillan, London, 1978 - Chapter III Probabilities, Projections, and Investment; L. Y. Pouliquen; *Risk Analysis in Project Appraisal*; Johns Hopkins U. P., Baltimore, 1976. R. Sugden and A. Williams; *The Principles of Practical Cost-Benefit Analysis*; Oxford University Press, Oxford, 1978 - Chapter 5, Uncertainty and Chapter 12; Uncertainty and Cost-Benefit Analysis. UK Ministry of Overseas Development; *A Guide to Project Appraisal in Developing Countries*; HMSO, London, 1972, Chapter 7, Risk, Uncertainty and Sensitivity Analysis and Appendix C An Approach to the Assessment of Risk.
2. See for example: K. J. Arrow: *Essays in the Theory of Risk-Bearing*, North-

Holland, Amsterdam, 1971 – "Although our economics text books have remarkably little to say about the matter, nothing is more obvious than the universality of risks in the economic system." (Chapter 5, page 135); M. M. Dryden; Capital Budgeting; Treatment of Uncertainty and Investment Criteria; *Scottish Journal of Political Economy*, Vol 11, 1964, pages 235-259 "Thus, the whole procedure of using numerical estimates of subjective degrees of belief obtained by inference from individual's actions does not appear to be entirely satisfactory. This summary of approaches to the problem of treating uncertainty in investment decisions can be completed by describing the remaining approaches as being neither probabilistic nor game-theoretic. This group, which includes writers such as Keynes and Shackle, need not detain us long since one of their principal characteristics is their failure to provide clear cut operational decision rules." (page 257); K. Borch; Introduction in K. Borch and J. Nossin (eds); *Risk and Uncertainty*; Macmillan (for the International Economic Association), London 1968 – "The classical production function is obviously a fiction. In a realistic theory we must assume that given inputs can determine the output only in a probabilistic sense." (page xiv)

3. R. L. W. Alpine and J. Pickett; More on Appropriate Technology in Sugar Manufacturing, *World Development*, Vol.8, No.2, February 1980 page 171 and fn 8. On Ghanaian shadow prices as at 1983 see: M.A. Tribe; *The National Investment Bank and the Choice of Technology*, Centre for Development Studies, University of Cape Coast and David Livingstone Institute, University of Strathclyde, 1983, mimeo - and also M.M. Huq, Ghana: Economic Decline and a Case for Recovery; *African Affairs*; forthcoming.

4. Pouliquen; op. cit. page 11, Table 2.

5. J. E. Austin; *Agro-Industrial Project Analysis*; Johns Hopkins U. P. for the World Bank, Baltimore, 1981, pages 74/75 and 95. M. Simpson and A J Wynne; Risk Analysis and Project Appraisal; in C-H. Hanf and G. W. Schiefer (eds.); *Consideration and Modelling of Risk in the Agri-business Sector*, Kieler Wissenschaftsverlag Vauk, 1981 - this interesting approach does not really provide a solution to the probabilistic conundrum which is involved.

6. Sugden and Williams; op. cit,; page 64

7. Pouliquen; op. cit.

8. Bromwich; op. cit.; U.K. Ministry of Overseas Development; op. cit.

9. Pouliquen; op. cit.; page 3, fn. 1. This is, of course, akin to the classical ‘chicken and egg’ conundrum.

10. G. A. Bridger and J. L. Winpenny; *Planning Development Projects*; HMSO, London, 1983, Chapter 2.

11. For additional data and a fuller discussion of issues relating to the project see M. A. Tribe; *Komenda Sugar Project* ……. referred to in the Acknowledgements.

12. A. Seidman; *Ghana’s Development Experience*; East African Publishing House, Nairobi, 1978, page 198, fn.120. See also S. D. Kyei; *The Sugar lndustry: Ghana’s Experience*; Background Paper; UNIDO International Forum on Appropriate Technology, New Delhi, 1978 - 1D/WG.282/119 - Limited Circulation Only.

13. A Seidman; op-cit; pages 180-181, and page 198, fns. 119-120. T. Killick; *Development Economics in Action*; Heinemann, London, 1978; pages 219, 221, 224, 228, 230-233, 235, 246, 253, 256, 260 and 321.

14. A 12 per cent target would have to be a sustained average rather than a peak result, so that single year’s observations would have to approach 12.5 to 13.0 per cent for the target to be achieved.

15. "Akpeteshie" is an alcoholic spirit produced locally in small-scale plants.

16. Killick; op. cit; page 246.

17. Personal communication from George Kwadzo, a postgraduate student in the David Livingstone Institution, University of Strathclyde, based on his detailed study of the World Bank rehabilitation programme of the Ghana Sugar Industry.

18. The new series wholesale price index in November 1983 stood at 2,154.2 based on 1977 =100. Inflation January - November 1983 was 265.4 per cent - Republic of Ghana, *Quarterly Digest of Statistics*; Vol 1, No.11, December 1983, Table 45, page 50. For a fuller discussion of inflation in Ghana see M. M. Huq; op. cit.