Tax Uncertainty in Project Evaluation: A Case Study

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Introduction

Much attention has recently been devoted to the improvement of techniques for the appraisal of investments whose returns are uncertain. The use of sophisticated methods of analysis is particularly appropriate in the evaluation of major extractive projects, which typically involve large expenditures during several years followed by highly uncertain revenues accruing over some decades. The system of taxation in force during the construction and exploitation of such a project is among the crucial factors affecting its financial success. Yet little attention appears to have been paid to the evaluation of uncertainties associated with this factor, both in its own right and in combination with other uncertainties. Indeed it seems to be customary when evaluating a project to regard rates of taxation and other features of the tax environment prevailing at the time of evaluation as fixed for the duration of the project, subject to obvious allowances for impending changes and specific contingencies.

The present Paper reports a simple exercise intended to illustrate the extent and sources of variability of the net present value of a project which might arise from changes in tax arrangements during its lifetime. The information used relates to the tax systems of four countries over the period 1948–1969, applied to data prepared from forecasts of cash flows used by the Rio Tinto Zinc Corporation in the evaluation of three major mining projects. The results obtained suggest that the analysis of tax risks does merit further research, and indicates some points which such research should take into account.

Method

The essential steps of the exercise can be summarised as follows. Three examples of mining projects were considered, each with a different general structure of cash flows. Each project was supposed to be evaluated in the same year in each of four countries. For each of the resulting twelve cases, two net present values were calculated and compared: one on the assumption that the gross cash flows were subjected to the tax arrangements obtaining at the start of the project, the other by applying in each year the tax laws currently in force.

The data defining the three examples were derived from information actually used in the evaluation of three large mining projects by the RTZ Corporation, simplified and adapted in various ways to allow comparative calculations. Three variables – the length of construction period, the operating life, and the operating year in which peak profits are first attained – strongly influence sensitivity to tax changes, and each project represented a combination of these variables frequently encountered in mining ventures; the values are given in Table 1. The scale of capital expenditure and the method of finance in each case were also fairly representative of comparable projects undertaken by British mining companies in the 1960s. As a rough indication, the proportions of loan finance to total undiscounted capital expenditure were 0.53, 0.67 and 0.38 respectively, with repayments to be completed in years 17, 7 and 17 from the start of construction.

TABLE 1
Characteristics of projects

Project	*Construction period (years)*	*Operating life (years)*	*Peak profits (operating year)*
A	4	15	3rd
B	2	20	4th
C	6	25	4th

The years in which each project was finally evaluated and construction of mining works began was taken as 1948 (in place of the various later dates for the underlying 'actual' projects). The tax information used relates to the actual arrangements in force during 1948–1969, a period long enough to cover the estimated lives of projects A and B and most of C's life; for the remaining years of project C the tax rates used were those for 1969. In order to compare

the effects of various tax environments, the British, Irish, Australian and Canadian systems were applied in turn to each project. All results presented here are based on a discount rate of 10%, although calculations have also been carried out for other rates. Net present values relate to estimates of total cash flows based on the price level of the initial year, after interest and all corporate taxes, and taking account of all allowances, grants and tax holidays.[1]

Results and Conclusions

The net present values calculated for each mine are set out in Table 2, while Table 3 gives the difference between the net present values based on 'constant' and 'variable' tax regimes as a percentage of the former. These percentages give a crude but striking measure of the error incurred by ignoring the variation of tax arrangements over time.

TABLE 2
Net present values

	UK	Ireland	Australia	Canada
Project A				
Constant Taxes	25·60	41·31	59·49	65·44
Actual Taxes	29·81	67·70	53·59	61·21
Project B				
Constant Taxes	11·76	43·43	65·90	69·19
Actual Taxes	15·14	68·81	56·36	53·82
Project C				
Constant Taxes	3·97	7·81	12·99	13·89
Actual Taxes	2·16	11·56	10·83	11·09

TABLE 3
Percentage deviations of 'Actual tax' from 'constant tax' NPVs

Project	UK	Ireland	Australia	Canada
A	+16	+64	−10	−6
B	+29	+58	−14·5	−22
C	−46	+48	−17·	−20

These Tables suggest that it would be most useful – despite the obvious difficulties – to attempt prediction of fiscal policies, possibly in terms of probabilities, and to use these systematically in project appraisal. In this connection, it is sometimes suggested that an escalation factor for tax rates should be introduced into the calculations. However, tax changes during the period considered in our study have not always reduced project values. In Australia and Canada, corporate tax rates did increase, while the effects of other aspects of the tax system on mining remained largely unaltered. In Ireland, the upward trend in corporate tax rates was overshadowed by the introduction of a nine-year partial exemption scheme for mining profits. In the UK, all tax arrangements were subject to considerable fluctuations throughout the period; these produced significant increases in the values of projects A and B, while the value of C decreased largely because of the suspension of initial allowances for capital expenditure in 1952/1953. These results illustrate the importance of paying attention to all aspects of a country's 'fiscal bundle', not merely to the rates of taxation. They show also that the sensitivity of a project's value to specific fiscal instruments depends critically on its particular pattern of cash flow generation. It is an obvious, though important, conclusion that attempts to incorporate the effects of possible fiscal changes into sensitivity or probability analysis must rest on a careful assessment of the types of possible changes in relation to the special characteristics of the project under consideration.

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[1] In calculating the 'actual tax' net present values, it was assumed that contracts for construction expenditure were finalised in the year in which the expenditure was incurred.