

nesc

National
Economic and
Social Council

An Chomhairle
Náisiúnta Eacnamíoch
agus Sóisialach

Minerals Policy

No. 60

July 1981

NATIONAL ECONOMIC AND SOCIAL COUNCIL
CONSTITUTION AND TERMS OF REFERENCE

NATIONAL ECONOMIC AND SOCIAL COUNCIL

1. The main task of the National Economic and Social Council shall be to provide a forum for discussion of the principles relating to the efficient development of the national economy and the achievement of social justice, and to advise the Government, through the Taoiseach on their application. The Council shall have regard, *inter alia*, to:

- (i) the realisation of the highest possible levels of employment at adequate reward,
- (ii) the attainment of the highest sustainable rate of economic growth,
- (iii) the fair and equitable distribution of the income and wealth of the nation,
- (iv) reasonable price stability and long-term equilibrium in the balance of payments,
- (v) the balanced development of all regions in the country, and
- (vi) the social implications of economic growth, including the need to protect the environment.

2. The Council may consider such matters either on its own initiative or at the request of the Government.

3. Members of the Government shall be entitled to attend the Council's meetings. The Council may at any time present its views to the Government, on matters within its terms of reference. Any reports which the Council may produce shall be submitted to the Government and, together with any comments which the Government may then make thereon, shall be laid before each House of the Oireachtas and published.

4. The membership of the Council shall comprise a Chairman appointed by the Government in consultation with the interests represented on the Council,

Ten persons nominated by agricultural organisations,

Ten persons nominated by the Confederation of Irish Industry and the Irish Employers' Confederation,

Ten persons nominated by the Irish Congress of Trade Unions,

Ten other persons appointed by the Government, and

Six persons representing Government Departments comprising one representative each from the Departments of Finance, Agriculture, Industry, Commerce and Tourism, Labour and Environment and one person representing the Departments of Health and Social Welfare.

Any other Government Department shall have the right of audience at Council meetings if warranted by the Council's agenda, subject to the right of the Chairman to regulate the numbers attending.

5. The term of office of members shall be for three years renewable. Casual vacancies shall be filled by the Government or by the nominating body as appropriate. Members filling casual vacancies may hold office until the expiry of the other members' current term of office and their membership shall then be renewable on the same basis as that of other members.

6. The Council shall have its own Secretariat subject to the approval of the Taoiseach in regard to numbers, remuneration and conditions of service.

7. The Council shall regulate its own procedure.

Minerals Policy

DUBLIN:
PUBLISHED BY THE STATIONERY OFFICE

To be purchased through any Bookseller, directly from the Council, or from
GOVERNMENT PUBLICATIONS SALE OFFICE, G.P.O. ARCADE, DUBLIN 1

Price: £1.80

(Pri. 9619)

NATIONAL ECONOMIC AND SOCIAL COUNCIL MEMBERS

Chairman: Dr. N. Whelan

Nominated by the Government:

Prof. D. Hannan	Mr. G. A. Meagher	Mr. J. O'Mahony
Dr. B. Hensey	Senator N. Mulcahy	Prof. W. J. L. Ryan
Mr. J. Holloway	Dr. C. H. Murray	Mr. J. Simpson
Mr. B. McDonald	Mr. T. O Cearbhaill	Senator T. K. Whitaker
	Mr. T. O Cofaigh	

Nominated by the Confederation of Irish Industry

Mr. F. A. Casey	Mr. J. McCabe	Mr. C. Power
Mr. L. Connellan	Mr. M. McStay	

Nominated by the Irish Congress of Trade Unions

Mr. P. Cardiff	Mr. R. Rice	Mr. H. O'Sullivan
Mr. J. Carroll	Mr. D. Murphy	Mr. G. Quigley
Mr. J. Hall	Mr. P. Murphy	Mr. R. Roberts
	Mr. D. Nevin	

Nominated by the Irish Co-operative Organisation Society

Mr. J. Buttimer	Mr. P. Kelly	Mr. J. McCarrick
-----------------	--------------	------------------

Nominated by the Irish Creamery Milk Suppliers' Association

Mr. P. Hourigan	Mr. C. Dolan	Mr. T. J. O'Callaghan
-----------------	--------------	-----------------------

Nominated by the Irish Employers' Confederation

Mr. J. Walmsley	Dr. E. McCarthy	Mr. J. J. O'Reilly
Mr. J. Jennings	Mr. P. Murphy	

Nominated by the Irish Farmers' Association

Mr. J. Murphy	Mr. P. Dunne	
Mr. D. Cashman	Mr. J. Richards-Orpen	

CONTENTS

PART 1

The Council's Comments on Minerals Policy

PART II

Minerals Policy

by

Frank J. Convery and Robert F. Conrad

	<i>Page</i>
PREFACE	14
SECTION I: BACKGROUND	
Chapter 1 MINING HISTORY The Base Metals Era	18
Chapter 2 THE NAVAN ERA The Multinationals, The Lease Agreement, Bula, Other Mining Developments, Exploration Licences and Ownership	22
Chapter 3 THE MINING FIRM Exploration, Pre-Development Planning, Investment and Development, Extraction, Uncertainty and the Economics of the Mine	33
SECTION II: NON-TAX ISSUES ANALYSED	
Chapter 4 INTERNATIONALLY TRADED MINERALS AND THE ECONOMY Employment, Net Foreign Exchange Earnings, Forward Linkage, Increased Net Revenues to the Government, Development of Economically Deprived Regions, Development of Indigenous Skills	41

	<i>Page</i>
Chapter 5 DOMESTICALLY CONSUMED MINERALS AND THE ECONOMY The Future	60
Chapter 6 THE ISSUES The Future, Issues for Analysis	64
Chapter 7 SOURCES OF UNCERTAINTY Minerals Ownership, Lease Terms, State Equity, State Mining and Exploration Company	72
Chapter 8 INSTITUTIONAL CONSIDERATIONS Re-Organisation of Existing Units, Skills, Conclusions	79
 SECTION III: TAXATION AND ROYALTY CHARGES 	
Chapter 9 LEGISLATIVE BACKGROUND	85
Chapter 10 THE EFFECTS OF MINERAL TAXATION (Including Royalties) Severance Taxes, Profits Taxes, Expensing Provisions, Progressive Income Taxes	89
Chapter 11 MINERAL TAXATION AND ROYALTY CHARGES IN OTHER COUNTRIES Overview, Irish Tax Policy in Comparison with Other Countries	93
Chapter 12 TAXATION AND ROYALTY RECOMMENDATIONS: BACKGROUND Introduction, The Current Tax Regime—The Corporation Profits Tax, Royalty	96
Chapter 13 TAXATION AND ROYALTY RECOMMENDATIONS: THREE OPTIONS <i>Option I:</i> The Corporation Tax, Royalty, Equity Participation <i>Option II:</i> The Corporation Tax with Equity Participation, Royalty <i>Option III:</i> Summary	105

SECTION IV: SUMMARY AND RECOMMENDATIONS

	<i>Page</i>
Chapter 14 SUMMARY History, Minerals and the Economy, Employment, Foreign Exchange Earnings, Linkage Effects, Increased Net Revenue to the Government, Impacts on Deprived Regions, Minerals Taxation	117
Chapter 15 RECOMMENDATIONS A. Pre-Determined Lease Terms, B. Staffing and Institutional Aspects, C. Terms of Taxation and Royalty Payments, Monitoring Tax Policy, Non-Metallic Minerals, D. State Equity and a State Mining and Exploration Company, E. Minerals Ownership, F. Downstream Development, G. Marginal Mines, H. Industrial Minerals, J. Issues Not Considered,	124
General References	139

APPENDICES

A. International survey of tax, royalty and State equity provisions	142
B. Employment and Earnings in production of domestically consumed minerals	153

NOTE

More background material to the consultants' study is presented in further Appendices. These appendices which are available separately from the NESC are as follows:

- Appendix C: The Endowment
- Appendix D: Resource Depletion
- Appendix E: Base Metals Markets
- Appendix F: Non-Metallic Mineral Markets
- Appendix G: List of scheduled minerals (Minerals Development Act, 1940)
- Appendix H: The Effects of Minerals Taxation (including royalties)
- Appendix J: Mine Closure — A Case Study
- Appendix K: Principal Mining Concerns in Commercial Production

BIBLIOGRAPHY

Taxation Related References (9 pages)

LIST OF TABLES

	<i>Page</i>
Table 2.1 European Lead and Zinc Output, 1978, and Tara Mine Output at Full Production	27
Table 4.1 Output of Irish Mining Industry 1965-1975	42
Table 4.2 Employment, Average hours worked per week and Average Earnings per week in the Mining Industry, 1965-1979	43
Table 4.3 Output of Selected Minerals	46
Table 4.4 Internationally Traded Minerals: Exports, Volume and Value, Current prices, 1968-1979	50
Table 4.5 Annual Costs and Revenues, Electrolytic Zinc Smelter, 1979 prices	51
Table 4.6 Main items of Direct Annual Government Revenue and Cost, Mining Sector	56
Table 4.7 Backward Linkage Related Indirect Taxes and Income Taxes Generated by the Mining Sector, 1975-1978, Current £(000s)	57
Table 4.8 Mining Sector: Direct and Backward Linked Revenues	58
Table 6.1 Employment in Metallic Minerals Mines and Exploration, 1965-1978	65
Table 9.1 Summary of Current Irish Mining Tax Policy	88
Table 14.1 Employment in the Minerals Sector, 1970-1978	120

LIST OF FIGURES

	<i>Page</i>
Figure 2.1 Area Covered by State issued prospecting licences, 1956-1979	30
Figure 2.2 Prospecting Licence Turnover 1969-1979	31
Figure 2.3 Exploration Expenditure 1960-1979	32
Figure 4.1(a) Employment in Mining 1965-1979	44
Figure 4.1(b) Average earnings (per week) 1965-1979 (Constant 1968 £'s)	45
Figure 4.2 Output of zinc, lead and copper, 1968-1979	47
Figure 4.3 Total Output of Gypsum and Barytes 1968-1979	48
Figure 4.4 Minerals Exports valued in Constant prices	49
Figure 5.1 Stone, Slate, Sand and Gravel 1966-1978: Earnings	61
Figure 5.2 Coal, Turf Production and Bog Development 1966-1978: Earnings	62
Figure 5.3 Structural Clay Products, Asbestos Goods, Plaster, Gypsum, Cement, etc.: Earnings	63

PART I

THE COUNCIL'S COMMENTS ON MINERALS POLICY¹

MINERALS POLICY

INTRODUCTION

1. The object of this study is to identify and analyse the returns to the national economy from the exploitation of land-based minerals, to examine ways in which these returns might be increased, and to examine whether or not there should be any changes in Government policy towards this sector.
2. The Council, in March 1979, commissioned Professor Frank Convery and Professor Robert Conrad, to undertake a study of these issues. Professor Convery, who was also the study leader, was at that time Associate Professor of Natural Resource Economics at Duke University, North Carolina. His previous work includes a report on Forestry Policy for the Council². Professor Conrad is Assistant Professor of Resources Economics at Duke University and has undertaken extensive research on mining taxation.
3. The consultants in their study, which is published in Part II of this report, raise a number of issues related to minerals policy. The Council, in its comments concentrates on the following:
 - (i) the appropriate objective for Government policy
 - (ii) lease terms
 - (iii) taxation
 - (iv) State equity
 - (v) downstream development
 - (vi) institutional aspects.

¹Following discussions in the Economic Policy Committee, and in the Council, these comments were drafted by Paul Turpin of the Council Secretariat.

²Published in NES, *Irish Forestry Policy*, Report No. 46, 1979.

The main differences between the views of the Council and the consultants relate to the consultants proposals on lease terms, taxation and State equity. The Council does not believe that the absence of fixed lease terms causes a level of uncertainty which leads to significant under-investment in minerals exploration and development. Neither does it accept that the consultants make a convincing case for changes in the present system of taxation. Finally, it is the view of the Council that State equity is an important policy instrument which will be necessary, on occasion, to safeguard the State's interest.

The Objective of Policy

4. The Council believes that the objective of policy relating to minerals development should be to maximise the net social benefits accruing from the exploitation of the country's minerals. The main focus of the present report is on the issues referred to in paragraph 3, above. It does not address other issues, which the Council recognises are important, such as safety and the environmental impact of mining operations.

5. In their study the consultants divide the land-based minerals into three groups:

- (i) the base metals which are internationally traded, (e.g. zinc, lead);
- (ii) the non-metallic minerals which are internationally traded (e.g. barytes, gypsum);
- (iii) the non-metallic minerals which are primarily for domestic consumption. The aggregate minerals (e.g. stone, sand, gravel) make up the main part of this group.

6. The consultants examine a variety of issues which they consider relevant to the evaluation of policy on land-based minerals. The main direction of their analysis is towards the base metals. In 1979 the value of exports of base metals accounted for 87% of the value of all minerals exports.

7. The Council's comments arising from the consultants' study therefore reflect this emphasis on the base metals. It believes that there are a number of characteristics associated with the exploitation of base metals which give rise to particular policy considerations. These include the following:

- the level of demand cannot be significantly influenced by domestic measures;
- the prices obtainable for the metals often yield a large surplus over the economic cost of extraction;
- it is a highly capital-intensive industry;
- there has been little downstream activity resulting from the mining of base metals in Ireland.

The Contribution of the Mining Sector

8. The production of the main internationally-traded minerals provided direct employment for approximately 2,100 persons in 1979³. This was less than one per cent of total employment in transportable goods industries. The consultants estimate that 85% to 90% of employment in the sector was in the exploration for, and the production of, base metals. They also estimate in the light of expected mine closures, that direct employment, unless there are new discoveries, will fall to about 1,400 by the mid-1980s. The consultants estimate that even if discoveries which in total were equal to the Navan orebody were made every seven years, this would only add 2,000 to 3,000 direct jobs by the year 2000. It is unlikely, therefore, that mining *per se* will make a significant contribution to meeting future national employment needs.

9. All base metal production is exported in concentrate form⁴. The total value of minerals exports in 1979 was nearly £80 million. This was equal to 2.25% of the value of all exports or about 1.1% of GNP. The exports of base metal concentrates accounted, in value terms, for approximately 70% of the minerals exports. The remainder was principally composed of gypsum, barytes and magnesia.

10. Most of direct Government revenue from mining comes from the royalty payments, corporation tax and income tax paid by employees. The consultants estimate that these totalled £4.2 million in 1977 with income tax accounting for 56%, royalty payments 11% and corporation tax 33% of the total.

11. There are three main inputs to the mining process: labour, capital and the ore body. In the long-run the return to the first two factors will largely be determined by market forces. The value of the ore will be equal to the difference between the revenue from the mining operation and the payments to capital and labour. In effect, it is the difference between the price and the economic cost of extraction.

12. The benefits from mining can accrue to the economy in a number of ways. Government will be concerned with the amount and allocation of these benefits. The number of jobs arising both directly and indirectly will be one important consideration. The Council does not have data about ownership and disposition of profits in the mining industry, additional to that given in the consultants' report. Table 4.6, of their study, lists the main items of direct

³The consultants estimate from input-output tables that 2,100 jobs in mining would give rise to a maximum of 1,600 jobs in the sectors supplying the industry.

⁴The concentrate represents the input to the smelting stage of metal production. The concentrating stage is the only stage in the conversion of ore into refined metal which is carried out in this country.

Government revenue from the mining sector. The consultants also state that total dividends paid out by the metals mining sector in 1966-78 amounted to almost £35m, equivalent to £68m in 1979. They estimated that the overall non-Government domestic share in mining profits was unlikely to exceed 20 per cent. In response to a request from the Council the consultants said that, while they recognised the importance of further data on this subject, they were unable to come up with further details. Their estimate of 20% was, they said, based on little more than guesses about the ownership of mining stock. The Council believes there is room for further study on this important matter.

13. The Council shares the consultants' view that the objective of seeking the optimal return to the national economy from the mining of metals will correspond closely with a policy of maximising the direct revenue to the State, for the following reasons:

- (i) most mineral rights are owned by the State⁵;
- (ii) the capital intensive nature of the industry means that the amount of income taxes will be a relatively limited source of funds;
- (iii) the metals mining industry can not be looked upon as a major source of new jobs;
- (iv) the return through downstream and other activities would appear under present conditions and in the Irish context to be low;
- (v) the fact that most of the mining companies operating in Ireland are in foreign ownership suggests that a large part of the funds accruing to private sources will flow out of the country.

14. The goal of maximising State revenue must take into account the need to maintain the attractiveness to private investors of the exploration for, and working of, the country's mineral resources. The policy objective, therefore, is to maximise revenue subject to a desired rate of exploration and development. The demand and prices paid for minerals are effectively outside domestic control. The size and form of the State take, however, will be an important consideration in the calculation of expected net returns by the private investor.

Lease terms

15. The main issues arising with respect to the lease terms are royalty rates, financing and development, and the amount (if any), of State equity sought. The consultants express the view that uncertainty over the lease terms which the Government may agree for the development of new discoveries acts as a significant disincentive to exploration. They recommend that, in order to reduce uncertainty, the Government should establish fixed lease terms which would be known to the public and which would comprise the main elements of

⁵The actual share of minerals rights owned by the State is uncertain. It is unlikely to be less than 65 per cent.

all State mining leases. It is their view that the present provisions could be refined to cater for all eventualities likely to arise in the exploitation of new ore bodies.

16. The Council is unable to agree with the consultants regarding the practicality of introducing fixed lease terms which would apply to all future mining operations. Given the number of variables involved, there could be considerable difficulty in devising fixed statutory provisions which would deal adequately with marginal deposits, on the one hand, and with highly profitable deposits on the other. The Council would be concerned that the statutory terms might have to be fixed at a level which would preclude the working of less attractive deposits⁶. If some flexibility is to be provided by the legislation to deal with that problem, it seems inevitable that this would lead to a demand for flexibility to deal also with bonanza situations and the net result would in effect be no different from the present situation.

Tax Neutrality

17. In the opinion of the consultants there should be a clear distinction between the tax relating to capital (corporation tax) and the royalty. The former should be related to the return on the capital invested and not used as a means to collect the surplus arising from the quality of the ore body. In the absence of externalities⁷, they argue, the tax should be administered in a manner consistent with the concept of "tax neutrality". That is, the rate of tax should apply equally to all sections of the economy and should not discriminate between sectors.

18. The introduction of tax neutrality would mark a significant break with the existing system of taxation. At present the corporation tax payable by the mining industry is 45%. With effect from 1 January 1981 the corresponding rate for manufacturing industry is 10%. A rate of 45% will continue to apply to all non-manufacturing corporate activities. There is not, therefore, tax neutrality between mining and other sectors.

19. The Council does not consider that different tax provisions for the mining industry and for manufacturing industry are likely to cause an undesirable diversion of investment from mining into other sectors for two main reasons. First, because of the high risks involved and the large capital investment which is necessary, funds for investment in mining are likely, in large measure, to be attracted from abroad. Foreign investors will compare the Irish mining tax

⁶Senator Mulcahy expressed some reservations about this approach. He felt that, to encourage a more rapid development of mineral finds, the lease should be agreed in principle (e.g. a formula based on agreed percentages) after the find, but, before the heavy cost exploration phase.

⁷An externality is defined as a cost falling on a third party who has not been compensated for it, e.g. if the cost of environmental damage caused by mining was not borne by the organisation operating the mine.

regime with foreign regimes and not with the tax applying to Irish non-mining sectors when making their investment decisions.

20. Second, tax provisions may have different implications for foreign investors than for indigenous investors. At present, the payments of corporate taxes are eligible as credits against home taxes in certain countries. For this reason there may be a disadvantage in the introduction of a lower rate of corporate taxation and a greater reliance on royalties to capture adequate revenue for the State since royalty payments are not eligible as credits against home taxes. The benefits of tax concessions could therefore flow to foreign Governments.

21. In summary the Council considers that the concept of tax neutrality is not appropriate to the mining industry in Ireland. The concept postulates a situation of perfect competition where all policy decisions are open and where the marginal return on funds invested in different sectors of the economy is equalised. In practice, it must be recognised that it is necessary to use the tax system as a positive means of encouraging economic activity in directions which are considered desirable. There are numerous examples of this in the tax system, the most important being export sales relief which for many years has been a most effective industrial tax incentive in attracting foreign investment and creating employment. The 10% corporation tax scheme which has operated in replacement of export sales relief also falls into this category.

Capital Allowances

22. The consultants also recommend a reduction in the value of the present capital allowances. They proposed that there should be limited or no free depreciation⁸: exploration and development expenses which currently get free depreciation with an additional 20% investment allowance in case of exploration and plant and machinery costs, should instead be depreciated during the period of mine production. The new provisions would not apply to existing mines.

23. The Council feels that it would be unwise to introduce more stringent conditions on capital allowances which would apply to new mines only. Such a change would be likely to discourage further exploration — a result clearly not intended by the consultants — since the capacity of an enterprise to repay its borrowings within a reasonable period could be impaired. In addition, it would be difficult to defend the existence of separate depreciation rules for existing and new mines. The Council believes that the present depreciation arrangements for mining are generally consistent with the other elements of State policy for the mining industry. It feels, however, that the necessity for

⁸Free Depreciation i.e. the firm may time its depreciation schedule to minimize its payments. It has the option of writing off 100% of its investments immediately.

continuing the 20% investment allowance might be examined in view of the fact that this allowance lapsed for other sectors at the end of 1980.

The Tax Package

24. An international survey of minerals taxation (including royalties) in other countries is given in Appendix A to the consultants' report. The survey shows that while the rates of income taxation are roughly similar, the tax allowances, such as the immediate write-off of all exploration, development and capital expenditures mean that the Irish tax regime appears generous by international standards⁹.

25. The consultants recommend a review of the present system of mines and minerals taxation. They recommend that any changes to the taxation package would be incorporated into fixed publicly available lease terms. Leases which have already been agreed would not be affected. In Chapter 13 of their report they discuss a number of options to the present system which would accord more closely to their own views on tax neutrality, State equity and the maintenance of a clear distinction between the tax on capital — corporation tax and the royalty charge for the mineral. Each of their options would also involve a reduction in the level of tax allowances.

26. The Council's views on the specific issues of tax neutrality, State equity and fixed lease terms are given elsewhere in these comments. The Council would have serious misgivings about unnecessary experimentation with new systems of State take unless the advantages were manifest. It does not believe that the types of revisions set out by the consultants would protect the position of the State as adequately as the present arrangements. An important consideration is the encouragement of foreign investment in the Irish mining industry. The Council believes that the present system, which relies heavily on corporation tax, is correct as these taxes are creditable in the home countries of foreign firms investing in Ireland. The Council is not convinced that a reduction in the present level of tax allowances would not lead to a serious reduction in the exploration for, and development of new minerals discoveries.

State Equity

27. The consultants hold the view that the collection of State revenue from mining companies, through taxes and royalties, is more effective than through

⁹The actual extent to which the Irish tax regime is lenient, or not, could only be quantified on a case by case basis. There are wide variations between the taxation instruments and the allowances employed in different countries. For example, the Irish package does not include depletion allowances. In the United States the depletion allowance is a significant factor underlying the economics of mining operations. It is possible to envisage a situation where a mine would be more profitable under the American than the Irish tax regime. In general, however, the Irish system appears the more generous as the main allowances can be claimed early in the life of the mine.

the holding of State equity. They advance three reasons for this: first, lease specifications without State equity can be used to ensure a coincidence of the firm's behaviour with the public interest; second, as many mining companies are subsidiaries of multinational enterprises, the State's representation on the board of the Irish companies may not be sufficient to ensure that the nominee will participate in all decisions affecting the company; third, mining companies have an aversion to State participation and other things being equal will invest less where it is a requirement.

28. While recognising that some of the objectives which equity holding is designed to achieve could be attained by other means, the Council is of the view that account must also be taken of the national sensitivities which are now a fact of life in regard to the exploitation of publicly-owned natural resources. It is cognisant, in particular, of the standards which have now been universally established in relation to petroleum, where the need for State involvement and participation in the production process is fully accepted. It is also conscious of the special considerations which arise in regard to uranium, lithium and similar minerals.

29. The importance of the information and control aspects of equity holding has been recognised by the consultants and the Council believes that these and other shareholder rights cannot be too readily discounted. The key issue is the safeguarding of the State's right to an appropriate level of income. The Council believes that this may require State equity in certain circumstances. Finally, the Council notes that Option II put forward by the consultants makes provision for the purchase by the State of an equity holding. The Council believes that there would be very considerable difficulties about the purchase of State equity for budgetary and other reasons.

Downstream Development

30. No processing of base metals beyond the concentrate stage takes place in Ireland. The consultants discuss the costs and benefits of a smelter which would produce 110,000 tons of zinc per annum. They estimate that at the present world price it would not be possible for a new smelter in Ireland to break even. In reviewing the market for zinc the consultants conclude that there is little prospect of a large increase in demand for, or price of, the metal in the short-term.

31. There is, at present, much idle capacity in European zinc smelters. It would be particularly difficult for a new smelter to gain a share of the market and repay the very high capital start-up costs over a reasonable period. The consultants are of the opinion that Ireland would not have a comparative advantage in zinc smelting. In the first place, the close proximity of a zinc mine is not seen to be very significant. It is notable that the Western European

smelters import around 40% of their concentrate from outside Europe. Closeness to the outlets is said to confer a more significant economic advantage. The main markets for zinc are car manufacturing plants and iron and steel works. Thus, there are no major outlets in Ireland. Secondly, the smelting of zinc is highly energy intensive, with electric power typically accounting for 20%-30% of total operating costs. Electricity costs in Ireland are relatively high by European standards and are also heavily dependent on imported oil.

32. There have been a number of proposals to build a zinc smelter in Ireland over the last 20 years. In 1977 New Jersey Zinc commenced a detailed feasibility study. However, in 1978, in the light of continually low prices for zinc metal, the company indicated they did not wish to proceed with the project. A number of companies, such as Tara, Mitsui (Japan), Billiton (Netherlands) and Outokumpu (Finland), have in the past expressed an interest in the project. The Soviet Government expressed an interest in participating in the construction of the plant and in the provision of technology and the training of personnel. They had no interest in the ownership of the smelter or the marketing of its output. No decision could be made on this proposal before the principals for any project had been decided.

33. On 23 December, 1980 the Minister for Energy announced that due to the adverse economic conditions in the zinc industry the proposed zinc smelter at Ballylongford, Co. Kerry would not be proceeded with. He indicated three main reasons for the decision:

- (i) substantial over-capacity in the zinc smelting industry, particularly in Europe;
- (ii) the slowdown in the demand for zinc metal. This situation was expected to continue for the immediate future;
- (iii) at the current price of zinc, the only smelters making any profit were those enjoying cheap sources of electricity.

34. In conclusion, the economic outlook for a zinc smelter is not favourable at present. Any such project would be highly capital intensive. The employment which would result from a fully operating smelter with an output of 110,000 tons of metal is estimated also to be around 450 jobs. It would not be a significant factor in attracting zinc using industries. These downstream activities generally locate near their major markets e.g. steel mills, car manufacturing plants. The Council believes that a zinc smelter should only be built in Ireland if it could be proved to be commercially viable without the aid of abnormal State subsidies. This is unlikely in current circumstances but should be kept under review.

Institutional Aspects

35. The main instruments of Government minerals policy are taxation and lease provisions, and the Minerals Exploration and Development Division of the Department of Energy aided by the Geological Survey Office (GSO) plays the central role in developing and implementing policy. It is the responsibility of the Geological Survey to supply the basic geological data and maps necessary for more detailed exploration. The GSO provides advice to the Department of Energy on issues such as the extent and workability of deposits, the allocation of exploration licences and the performance of the licencees. There are two institutional issues which merit further attention:

- (i) are the present organisational arrangements effective in creating an environment conducive to exploration and development?
- (ii) should the State intervene in a more direct way?

36. There has been a considerable expansion in the number of staff in the GSO since the upsurge in mining activity from the beginning of the 1960s. It would appear that demands on staff more directly involved in minerals development have grown more quickly and there may be insufficient resources to meet a number of the policy issues which arise. The consultants question to what extent it is desirable to rely on an *ad hoc* use of outside expertise to resolve some of the more complex issues. They recommend that the State should increase its encouragement of minerals exploration by a limited expansion of the full-time staff in this area. It is possible that the reduced use of outside experts in favour of full-time staff could have a positive effect on public expenditure and the Council recommends that this should be considered. The Council was informed that the arrangements adopted for petroleum affairs, where expertise available in the public service was brought together in the Department of Energy, have worked fairly well in practice and perhaps there is a headline to be followed here in respect of hard minerals. Finally, the Council is aware that there is, at present, a review, envisaged for the GSO and would like its views to be considered in the course of that review.

37. A more direct form of State involvement in the mining sector would be the establishment of a State Mining and Exploration Company. The case in favour of a State mining company is based on the scale of profits made in the past on mining, the extent to which these profits were retained in the country, the alleged unwillingness of the foreign mining companies to take downstream activities seriously and the possibility of improving cut-off grades¹⁰. The establishment of such a company might be justified on economic grounds if there was evidence of significant under-investment in exploration and development. The consultants did not find compelling evidence to point to the existence of market failure and were of the opinion that there was not a convincing case for a State Mining Company at this time.

¹⁰The grade is the percentage of metal in the material to be mined. The cut-off grade is the lowest grade at which the mining company believes it is worthwhile to extract the mineral.

38. The Council would have considerable reservations on the general proposals of setting up a State Mining Company, unless it could be demonstrated that its operations could be carried out without cost to the Exchequer or without significantly diverting revenues which would otherwise accrue to the Exchequer. The Council would be strongly opposed to the idea that if such a company is established it should be confined to less profitable activities.

PART II

MINERALS POLICY

by Frank J Convery and Robert F Conrad

Preface

In undertaking this study at the request of the National Economic and Social Council, we had two broad objectives: the first was to provide a reference document wherein could be found a summary of the important data and issues pertaining to on-shore minerals discovery and development in Ireland. This first objective involved mainly identifying issues, and pulling together and organising data and reference material from various sources. The second objective was to analyse and evaluate existing policies, and make suggestions. Our terms of reference called on us "To evaluate the general scope and efficacy of the current policies on the exploration (including processing) of land-based minerals; to explore policy options which might contribute to increased returns to the national economy from the development of such resources". In fulfilling this latter prescriptive assignment, we found that lack of time and/or data in some instances precluded a comprehensive analysis. In such cases we have made qualitative judgements and/or provided suggestions for further study. In doing so, we were consoled by the knowledge that it is customary for researchers to raise many more questions than answers; we have not shirked our responsibilities in this regard.

Our mandate embraced all land-based minerals. We found it convenient to divide the minerals into two groups, namely those that enter primarily into international trade (mainly zinc, lead, copper, silver, barytes, gypsum, dolomite) and those that are sold primarily on the domestic market. Discussion in Ireland concerning minerals policy has concentrated on issues relating to the internationally traded minerals, especially the metals. We continue this tradition, but do devote some attention to other mineral types.

This report is divided into 4 sections. To the extent that it was possible to do so, we have made each section self-contained; for example, the readers interested only in the non-taxation issues can, with minimal cross-referencing to other sections, confine their attention to Section II.

In Section I discussion of the background to Irish mining is provided, embracing a review of past development, and an outline of the decision-making process of a mining firm. In Section II a variety of non-taxation related policy issues are analysed. These are set in the context of the role which mining plays in the economy. In Section III issues relating to taxation alone are discussed, while in Section IV results are summarised and conclusions are presented.

While doing this study we benefited enormously from the generously given advice and guidance of several individuals. From the mining industry, Brendan Hynes of Tara Mines Ltd., Michael Wymes and James Stanley of Bula Ltd., Patrick Boland of Irish Base Metals Ltd., and Sean Finlay of the Irish Mining and Exploration Group were especially helpful. Useful assistance was also given to us by Jerome Casey of Cement-Roadstone Holdings Ltd. In the Geological Survey Office, C. E. F. Williams, Ralph Horne, Aubrey Flegg and Peadar McArdle provided valuable background information, while in the Department of Energy, Patrick Duggan and Michael Colgan were among those who gave us useful counsel.

Throughout the study we were ably assisted by Niall O'Neill and Colm Joyce, students from the NIHE in Limerick on internships with the National Economic and Social Council. In addition to providing general data gathering and logistical support, Mr. O'Neill conducted a survey of the workers who were made redundant by the closure of the Gortdrum mine, and provided a draft report of the results of this survey. He benefited from the advice of John O'Connell and Frank Treacy, both from AnCO, and Frank Cunningham of the National Manpower Service.

We are very grateful to John Teeling of the Department of Business Administration, University College, Dublin for sharing with us his insights and encyclopaedic knowledge of the Irish mining industry.

John Blackwell and Paul Turpin of the NESC staff were most helpful in providing useful background information and coordinating the study; in the latter role they countered the vagaries of trans-Atlantic communication with great ingenuity and élan. We appreciate also the valuable comments received from members of NESC's Economic Policy Committee. We are grateful to the Economic and Social Research Institute (ESRI) for putting its facilities so generously at our disposal, and to the secretariat staffs of both ESRI and NESC for their excellent typing services. Maureen Doran-O'Reilly of the ESRI Library was of invaluable assistance in locating reference materials.

Finally, a special word of thanks is due to Ben Dhonau of the Geological Survey Office and Michael O'Connell of the Department of Energy. They were very generous with their time and attention, and were patient with our importuning far beyond the call of duty. Ireland is fortunate indeed to have such capable and dedicated public servants.

While we gratefully acknowledge the assistance of all of the above, responsibility for the report's contents rests entirely with us. Frank Convery was the project leader for this study, and, with the exception of Chapter 3, wrote all of Sections I (*Background*), II (*Non-Tax Issues Analysed*) and IV

(*Summary and Recommendations*) together with Appendices B, C, D, E, F, G and K. Robert Conrad contributed Chapter 3 (*The Mining Firm*) in Section I and all of Section III (*Taxation and Royalty Charges*) together with Appendices A and H while Frank Convery and Niall O'Neill co-authored Appendix J. All but two of the Appendices are not published in this volume; they are available on request (mimeo) from the National Economic and Social Council.

SECTION I

Background

Mining evokes powerful images; of fortunes made and lost, of boom times and ghost towns, of truculent miners and disastrous accidents. Ireland's mining history in recent times has provided its share of drama. In the first chapter of this section, the story of Irish mining up to 1970 is outlined. Since most of the interesting policy issues have emerged since 1970, we devote the second chapter to a consideration of developments during the past decade. In analysing policy it is useful to have a feeling for the major phases of a mining cycle as viewed by a mining firm; this is presented in Chapter 3.

CHAPTER I

MINING HISTORY

It was the onset of the Second World War, and the consequent difficulty of importing raw materials, which concentrated the collective Government mind on the issue of development of indigenous resources. The Minerals Development Act of 1940 was the legislative manifestation of this concern. Although, as we shall see, this law proved to have limitations, it is very comprehensive, and still comprises the primary legislative foundation for Irish on-shore hard minerals policy.* It applies to all minerals listed in Appendix G and provided for the following:

- For the State to undertake prospecting, or award prospecting licences, "granted upon such terms and conditions as the Minister thinks proper and specified in such licence". In effect this allowed the issuance of exclusive exploration licences.

Compulsory acquisition by the State of unworked minerals and of mining facilities, subject to certain provisions. One of these provisions, namely that the acquisition order "shall specify the nature, situation, and extent of the minerals to which it relates" was to cause problems subsequently for the Government. In default of agreement, compensation for State acquired minerals is to be determined by the Mining Board. The Board consists of a chairman (who must be a practising barrister or solicitor of at least 10 years standing) and two other members, one of whom is a member of the panel of official arbitrators appointed pursuant to the passage of the Land Acts of 1919 and 1925, and the other is an officer of the Minister. Appointments to the Board are made by the Minister, and the decision of the Board shall be "final, conclusive and unappealable". These provisions relating to the Board have been significantly modified in the Minerals Developments Act, 1979.

- The issuance by the State of State mining leases, which permit the working of State owned minerals, subject to specified conditions.
- Payment to the State by the lessee of State owned minerals of "such moneys, whether by way of fine or preliminary payments or by way of rent (including a royalty rent) or by any or all of such ways as the Minister,

*Excluding on-shore oil, which is covered under provision of the Petroleum and other Minerals Act (1960).

with the concurrence of the Minister for Finance, shall think proper and shall agree upon with the lessee".

- The working of State owned minerals by the Government.
- Provisions for the development of privately owned minerals.

This Act was followed by the Slieve Ardagh Coal Development Act, which was followed in turn in 1941 by The Minerals Exploration and Development Act. This provided for the setting up of a wholly owned State Mining Company (Mianrai Teoranta) with authority to prospect for, mine, process and market minerals. The war-time shortage of sulphur led this company to explore for this mineral at Avoca. Between 1942 and 1947 about 16,000 tons of pyrites was produced for the sulphuric acid industry. This, in turn, led to a very extensive exploration effort by Mianrai Teoranta, resulting in the proving of millions of tons of low grade copper ore in Avoca. This tonnage was internationally published in 1955, and Mogul Mining Corporation of Canada took out an option to develop the ore-body. Production lasted from 1958 to 1962, when the property was placed in receivership by the Government. Dilution of the ore by waste rock and low copper prices combined to make the mine uneconomic to operate. Since the Government had guaranteed this project financially, £2 million of public funds were expended after closure in fulfillment of this commitment.

During the war years Bord na Mona, a State organisation, expanded turf output rapidly to help meet the energy needs of the nation from indigenous resources. The Turf Development Act of 1946 facilitated a further major expansion by the State in this area. Thus, after the war, the wartime era initiative by the Government in underground minerals exploration and development was quickly ended and transferred to the private sector, while turf development was retained as a State responsibility. Between 1948-1954 licence packages were put together by South African promoters and sold to companies; the main focus was on Abbeytown, Silvermines and Glendalough. It proved difficult to attract the requisite investment.

In 1956 the Finance (Profits of Certain Mines) (Temporary Relief from Taxation) Act was enacted. This provided a significant incentive to the private mining sector. Profits made in the first 4 years of profitable activity from the mining of non-bedded minerals were to be exempt from tax, and during the following 4 years they were to be taxed at 50% of the normal rate.¹ These provisions applied only to mines which commenced production prior to April

¹However, a royalty would still be payable by mining companies extracting State owned minerals. The Minerals Act (1940) allows the Minister to set the royalty on a case-by-case basis; it has typically ranged on an ascending scale from 4 to 10% of net profits.

1961. This latter provision was subsequently extended first to April 1966, and then to April 1976. Thus, by 1956 a coherent policy package was in place. Exclusive prospecting licences could be granted, 60-65% of the mineral rights were State owned and this, together with the right of compulsory purchase, was presumed (erroneously, as subsequent events proved) to ensure that the discoverers would get the benefit of their discovery even if the minerals found were privately owned. The tax provisions supplied the requisite financial incentive.

The Base Metals Era

After 1956 several Canadian companies started exploring for minerals. Consolidated Denison did a considerable amount of development and drilling at Allihies in County Cork, and exploration efforts generally concentrated on the old mine sites. However, in 1959 Northgate Exploration, through its wholly owned subsidiary Irish Base Metals Ltd., initiated an exploration programme in Ireland which concentrated on the Carboniferous sediments of Counties Clare and Galway. Extensive use was made of geochemistry and geophysics in the search for new ore bodies. Late in 1960 a geologically very significant discovery of copper was made in County Clare, which proved uneconomic to work. In 1961 the big breakthrough came with the discovery of the rich lead-zinc-silver ore body at Tynagh, Co. Galway.

This provided the essential stimulus for further exploration. At the time of the Tynagh discovery, prospecting licenses had been issued for an area totalling 300 square miles; by 1964 the area so covered had increased to nearly 1,900 square miles (Schultz, 1973). In 1963-64, about 12 million tons of ore with a high zinc and lead content had been demonstrated by drilling at Silvermines, County Tipperary by Mogul of Ireland. Nearby, at Ballynoe, a large barytes deposit was proved about the same time. In 1964, copper in mineable quantity was discovered at Gortdrum, Co. Tipperary. In 1965, Rio Tinto Zinc found a lead-zinc deposit at Keel, Co. Longford, and invested £1.2 million over 3 years in its development; it proved to be uneconomic. This spate of discoveries created a bonanza atmosphere in the mid-sixties. As one writer put it: "Shebeens in the West became clearing houses for the transfer of geological gossip".

One might have expected some questions to be raised concerning the necessity and advisability of continuing the generous provisions of the 1956 Finance Act. However, such was not the case. Indeed, in the 1967 Finance Act, the period of complete exemption from profits tax was extended from 4 to 20 years. Since most mines have a profitable life of less than 20 years, this meant in effect that most mining operations would pay no tax. Mr. Charles J. Haughey, then Minister for Finance in presenting the bill to An Dáil suggested that the additional tax incentives "can generate a large volume of outside

investment" and that "instead of bringing in rather complicated new provisions, I have come down in favour of the simple decision to substitute for the existing reliefs a 20 year period of complete exemption" (Parliamentary Debates, Vol. 227, 1967). No substantive questions or objections were raised by members of An Dáil concerning the extension. Since virtually all of the output of non-bedded minerals is exported, this provision put mining in the same category as incorporated firms in manufacturing industry, which were exempted from tax on export profits.

In late 1970, Tara Exploration and Development Company, which shares common shareholders with the Northgate Exploration group — discovered what has proved to be the largest zinc-lead deposit in Europe, near Navan, Co. Meath. The very size and significance of this deposit threw a number of issues into stark relief, and triggered a re-casting of government policy.

CHAPTER 2

THE NAVAN ERA

The ore discovered initially by Tara Exploration and Development Company was owned by a farmer, Mr. Patrick Wright. Negotiations between the company and the owner reached an impasse. On March 15th 1971 the Government issued an order for the compulsory acquisition of all the minerals at issue. However, shortly before the issuance of the order, Bula Ltd., a newly formed company, acquired the property (surface and mineral rights) from Mr. Wright; this was announced publicly on March 21st. The shares in Bula were owned by Thomas Roche, being then Managing Director of Cement-Roadstone Ltd., his son-in-law Michael Wymes and Richard Wood of Wood Construction Company — a Cement-Roadstone subsidiary and Patrick Wright. Cement-Roadstone Holdings is Ireland's leading supplier of raw materials to the building and construction industry, owning an estimated 2 billion tons of sand, gravel and aggregate reserves, operating from 86 locations; it is the nation's sole producer of cement. Bula Ltd. challenged the legality of the acquisitions order in the High Court. Fortunately for Tara, the bulk of the Navan deposit extended south of the river Blackwater, and this portion was almost entirely Government owned. Tara quickly acquired the surface rights to this portion.

In the meantime, the size and likely profitability of the Navan deposit raised serious misgivings concerning the wisdom of the 20 year tax holiday allowed in the 1967 Finance Act. It seemed likely that most of the ore would be extracted before the deposit would yield any significant tax return to the public. It was a Fianna Fáil Government which had sponsored the 1967 tax provisions. A new Fianna Fáil Government (elected in 1969) was in power in 1970, and it began to reflect the popular concern. Early in 1971 the Minister for Industry and Commerce indicated that he was anxious to have the situation of minerals reviewed, with particular reference to the question of whether the State would seek to obtain a greater financial return from mining operations.

The Resources Study Group, based mainly in Trinity College, Dublin, launched a vigorous campaign for nationalisation of the mines, arguing that the wealth of the nation should not be allowed to be taken away by foreigners; their second pamphlet had the attention-catching title *Navan and Irish Mining: Documentation of a £850,000,000 robbery*. While this group was probably very much to the left of the Irish political main stream of this time,

nevertheless, some of their concerns regarding minerals exploration tapped sympathies deeply embedded in the national psyche at least since the times of Arthur Griffith and Sinn Féin. At this time also, the desirability of locating a smelter in Ireland to refine the ore was frequently expressed. The Irish Congress of Trade Unions passed a motion supporting nationalisation of mineral and natural resources, and the setting up of a State smelter. The Resources Protection Campaign was launched at this time as a very active lobby in support of these twin goals as described by Neligan (1974).

In February 1973 a Fine Gael/Labour Coalition Government was elected, and gave high priority to changing the tax law applying to the mining of non-bedded minerals. In September 1973 the new provisions, which would take effect from April 1974, were announced. The 20 year exemption was withdrawn; mining firms were to pay the prevailing corporate profits tax rate (now 45%). However, provisions for deducting prospecting, exploration and mine development expenses and plant and machinery depreciation were made more generous. In addition, mines that were judged to be marginal could apply for relief of taxation. The mining industry association presented counter proposals suggesting retention of exemption from taxation for existing mines and a return to the 1956 status — the first 4 years of profitable operation tax-free, the following 4 at 50% of the corporate rate — for subsequent mining operations. However, the Finance (Taxation of Profits of Certain Mines) Act, 1974, when enacted, contained all of the salient features proposed initially by the Coalition Government, as listed above. Thus, all mining firms are taxed at the regular corporate rate, regardless of minerals ownership. In the situation where the State owns the minerals, as is the case with the Navan orebody south of the River Blackwater, a royalty is also payable. In such instances, under the terms of the Minerals Development Act, 1940, the amount and manner of royalty payment is to be decided by the Minister.

Meanwhile, the High Court supported the contention by Bula Ltd. that the Government's acquisition order for the ore on Patrick Wright's property was invalid. It found that the legislative requirement that the order "specify the nature, situation and extent of the minerals to which it relates" was inadequately complied with. The Supreme Court in 1974 upheld the lower court's ruling. While a technicality provided the basis for the court's judgement, it was felt in some quarters that in fact the provisions of the Minerals Development Act vis-a-vis compulsory acquisition inadequately guaranteed the Constitutional rights of private property, as laid down in Article 43 of the Constitution:

"The State guarantees to pass no law attempting to abolish the right of private ownership, or the general right to transfer, bequeath and inherit property".

but adds:

"The State, accordingly, may as occasion requires delimit by law the exercise of the said rights with a view to reconciling their exercise with the exigencies of the common good".

By zoning, implementing the Land Acts, compulsorily acquiring land under the Forestry Acts, 1946 and 1956, and the Turf Development Act, 1946, etc., the State has frequently drawn on the latter provision. Therefore, the constitutionality issue is not whether the State can compulsorily acquire, but rather, whether there is sufficient rationale for so doing vis-a-vis the common good, and whether the procedures followed ensure that the owners get fair market value for their property. One doesn't need to be a constitutional lawyer to have misgivings about the provisions of the 1940 Act in this latter regard; for example, the only tribunal of appeal available to the private owner was the Mining Board, whose members are appointed or dismissed at the Minister's discretion, and one of the three members is an "officer of the Minister". In the recently enacted Minerals Development Act, 1979, an attempt has been made to counter these and other limitations.

Thus, by late 1974, the mining firms had suffered two reversals; their tax exempt status was removed, and the right of mineral discoveries to benefit from their find was in question as a result of the outcome of the Bula - Tara case. Of the estimated 83 million tons of ore in the Navan orebody, about 22 million are now legally owned by Bula Ltd., with the balance being State owned, but extracted and concentrated by Tara Mines Ltd.* Inevitably, because of the background to the case, the prospects for an amicable and co-operative working relationship between Bula and Tara were dim. How to ensure that the Navan ore body is exploited to the nation's optimum advantage by two adjacent antagonistic firms is a major policy issue. However, lack of data precluded us from contributing usefully to the analysis of this issue.

Before Tara could commence development of its portion of the Navan orebody, two hurdles had to be overcome. Planning permission had to be secured from Meath County Council, and a mining lease had to be issued by the Government. Because Tara Mines Ltd. proposed mining entirely underground, and because the firm prepared an environmentally acceptable plan, with minor modifications its development proposals were endorsed by An Taisce and approved by the County Council. Getting the mining lease was another matter.

The most basic issue to be addressed in the lease negotiations was how much and in what form the State should charge Tara Mines Ltd. for extracting and selling this publicly owned ore. Subsidiary issues involved how much control

*These ore quantities are based on company estimates.

the Government should exert over the mining and disposal of the minerals. During 1971 and 1972 there were no serious negotiations concerning a lease. Presumably this was because of the Tara/Bula litigation and because an inter-departmental committee was conducting a major tax policy analysis. However, in April and again in August, 1971, the Minister for Industry and Commerce had given Tara assurances that the firm would be awarded the lease. Thus encouraged, Tara pressed ahead with costly "development" of the mine. Since development could not legally proceed in the absence of a licence, this work was technically in the nature of further exploring and proving the deposit. However, the only way to finance this scale of work was through the issuance of new shares in the company.

The Multinationals

Mr. Hughes, a native of Keady, County Armagh, has been the driving force and leading personality in Irish metals mining for the past two decades. He and his associates emigrated to Canada in the late 1940s and became involved in mining there. They returned to Ireland to participate in the mining renaissance in this country. To facilitate this effort, in 1958 they purchased a public company in Canada and called it Northgate, to be used as a means of financing exploration and development.

The Tara Exploration and Development Company, which actually made the discovery, was formed by Hughes and his associates in 1953. Thus, at the time of the Navan find, the company, though Canadian, was in fact controlled by Irishmen, all by this time resident in Ireland. However, the issuance of new shares provided an opportunity for the major corporations to ultimately achieve control. Charter Consolidated (the British base for Anglo-American, which is a major South African based mining corporation) and Cominco (leading Canadian producer of lead and zinc) entered the market, and with the help of a large block of shares acquired from Fitzwilliam Resources, launched a full take over bid in February, 1974. Noranda (a major Canadian mining/smeltering firm) countered with encouragement from the Hughes group, but the end result has been a loss of control by the original directors. The equity in Tara Exploration and Development Co., which owns 75% of Tara Mines Ltd., is now held as follows: Noranda (42.2%), Cominco (17.7%), Charter Consolidated (10.6%), Northgate (9.8%), Other Shareholders (20.3%).

The Lease Agreement

In early 1974, the Government developed a lease package for Tara which was unacceptable to the company. Further litigation was in prospect, but the issues were finally resolved without court decision, and agreement on the terms of a State mining lease was reached in February 1975.

Some terms of the agreement and 25 year lease which has provisions for renewal, are as follows:

- A free 25% of non-dilutable equity participation by the Government in Tara Mines Ltd., together with royalty payments, calculated on pre-tax income, of 4.5%. Profits will of course also be taxed at the corporate rate.
- Maximum production of 2.5 million short tons annually, based on estimated reserves of 65 million short tons.
- Distribute by way of dividends not less than 50% of the profits at the end of each financial year, subject to conditions.
- Requires concentrates to be provided to an Irish zinc refinery at normal commercial terms.
- Provides for the appointment of the Minister's nominees to the Board of Tara Mines Ltd.
- A variety of restricted company transactions.
- An undertaking to co-operate so as to ensure that any privately owned minerals in Nevinstown will be exploited in the most efficient and economic manner.

After the Supreme Court decided that the Government's acquisition order was invalid, the then Minister for Industry and Commerce started negotiations with the owners of Bula concerning State participation in the company. Agreement was reached whereby the State was given a 25% non-dilutable share in Bula Ltd. for no financial consideration, with a further 24% to be purchased from the shareholders at a price to be determined by a Board of three independent experts appointed by the President of the Institute of Arbitrators in London. One half of the sum was to be paid on completion of the determination by the Board, with one quarter paid one year later and the final quarter paid after two years. The consultants estimated that the Government's 24 per cent share was worth £9.54 million; this amount has since been paid in full to the original shareholders in Bula Ltd.¹

Other aspects of the agreement include:

- An undertaking by the Minister "to use his best endeavours to ensure that the Government of Ireland agrees to guarantee an amount not exceeding £10 million in respect of the major financing required by the Company to develop the mine".
- An agreement prohibiting the Minister from forcing Bula to "depart from its plan to operate as an independent mining and milling concentrate production unit".
- Provisions which appear to allow the non-State shareholders to sell to persons who are "of good financial standing and repute and are not

¹£4.77 million on 13th June 1977, £2.385 million on 13th June 1978 and £2.385 million on 13th June 1979.

persons to whom the Minister could reasonably object as a fellow shareholder in the Company".

- Provisions requiring Bula to supply a native smelter on normal commercial terms.
- Provisions restricting the actions of the shareholders in various ways; for example they are precluded from selling the ore body.
- A commitment to comply with reasonable directions from the Minister to co-operate with persons having rights to work adjoining minerals.

In June 1977, the first concentrates were produced from Tara mill. To construct the mine and install the milling and concentrating plant cost the company £85 million, making it the largest single industrial investment in Ireland up to that time.

Tara's total ore reserves at the start of production amounted to about 61 million metric tons of an undiluted average grade of 11.0% zinc and 2.4% lead.* The concentrator is capable of treating 7,000 metric tons of ore daily for an average annual production of 2.3 million tons of ore, which will provide 400,000 tons of zinc concentrate and 70,000 tons of lead concentrate, yielding about 220,000 metric tons of zinc and 42,000 metric tons of lead. Tara's output at full capacity can be compared with European lead and zinc production and consumption in 1978.

TABLE 2.1
European Lead and Zinc Output, 1978, and Tara Mine Output at Full Production

	<i>Mine Production</i>		<i>Metal Production</i>	
	Thousands of Metric Tons			
	Lead	Zinc	Lead	Zinc
Europe	464	1,005	1,353	1,640
Tara at Full Capacity	42	220	36	200
Tara as % of Europe	9.05	21.89	2.66	12.20

Note: The metal outputs listed for Tara are estimates of the metal produced by the European smelters from concentrate supplied by this company.

Source: *Statistics of World Production and Consumption*, International Lead and Zinc Study Group, London, 1979.

It is clear that Tara, providing at full production 22% of Europe's current zinc mine production and 12% of its zinc metal production will be a major factor in the continent's zinc market. The revenues received per ton of zinc metal in concentrates are directly related to the European producer price for zinc metal. This price fell from \$795 per tonne in May 1977 to \$550 per tonne in February 1978. Cutbacks in production and improving demand led to increasing prices,

*Company estimate.

with the zinc producer price reaching \$720 per tonne at the end of 1978, and \$845 per tonne in June 1979; in September 1979 it had fallen to \$780. The London Metal Exchange price per tonne for lead also increased growing from an average of £345 (sterling) in 1977 to £433 in December 1978 and reaching £645 in June 1979 (World Bureau of Metal Statistics, 1979). The depressed prices in 1977 and throughout most of 1978, combined with labour problems and depressed output to produce losses over this period such that a re-financing of Tara Mines' debt re-payment with the Bank Loan Consortium and the Canadian Export Development Corporation was required. These institutions have provided loans totalling \$130 million. The Government withheld approval of the re-scheduling until the Blackwater River safety issue was cleared up. The agreements providing for re-financing were signed on May 31st 1979. In the last quarter of 1978 and the first quarter of 1979 a reduction in costs per unit output combined with high metal prices and higher grade of ore milled to produce profits; net income in 1979 amounted to about \$10 million, but the further decline in zinc metal prices in the first half of 1980 resulted in the Tara Exploration and Development Company Ltd. registering a net loss of \$3.581 million for the second quarter of 1980.

Bula

Getting planning permission from Meath County Council is the first hurdle to be overcome by Bula before mine development can commence. The plans as presented by Bula call for extraction on an open-cast basis for the first 5 years of operation, taking out 40% of the ore, the balance to be extracted over a 15 year period by underground means. The 21.6 million tons of ore have an average combined grade of 8%; an average ton of ore has 1.2% lead and 6.8% zinc, i.e. a lead zinc ratio of 1:5:5. This compares with 61 million tons of ore at Tara with an average grade of 2.4% lead and 11.0% zinc. Optimum extraction of the Bula orebody will require diversion of the River Blackwater.

The County Council raised 33 questions concerning Bula's planning application, the key ones having to do with the diversion of the river, and the noise levels associated with the use of explosives above the ground on a site only 1.5 miles from Navan. Responses to the issues raised by Meath County Council were submitted by Bula Ltd. in December 1979; the Council refused the application, and Bula appealed to An Bord Pleanála. An oral hearing was completed in August 1980.

Other Mining Developments

Although the Navan orebody has dominated the Irish mining scene throughout the seventies, other significant developments also occurred. After Avoca closed in 1962, further exploration and analysis took place. With Canadian financing, Avoca Mines Ltd. started production in 1971, but the combination of low grade ore — about 0.6% copper — and low copper prices

which dogged the earlier operation are once more militating against profitable production. As a result of losses incurred up to the middle of 1975, in that year the government guaranteed part of the company's borrowing; at the beginning of 1979 the total amount guaranteed stood at £2.3 million. Since then the government has decided to lift the interest burden, pay off borrowing (capital and interest) and advance a further £1 million, with the hope that repayment will be possible in the coming years. In 1980, the company continued operation only because of Government subvention. Gortdrum mine in Tipperary, which started producing copper, silver and mercury in 1967, closed in 1975.

On a more positive note, production of peat, gypsum, barytes and limestone expanded rapidly throughout the period, while exploration for uranium has recently been initiated on a large scale, stimulated by EEC funding. With the opening of a new coal mine in Ballingary, Tipperary, coal output may expand in the future, after 3 decades of decline.

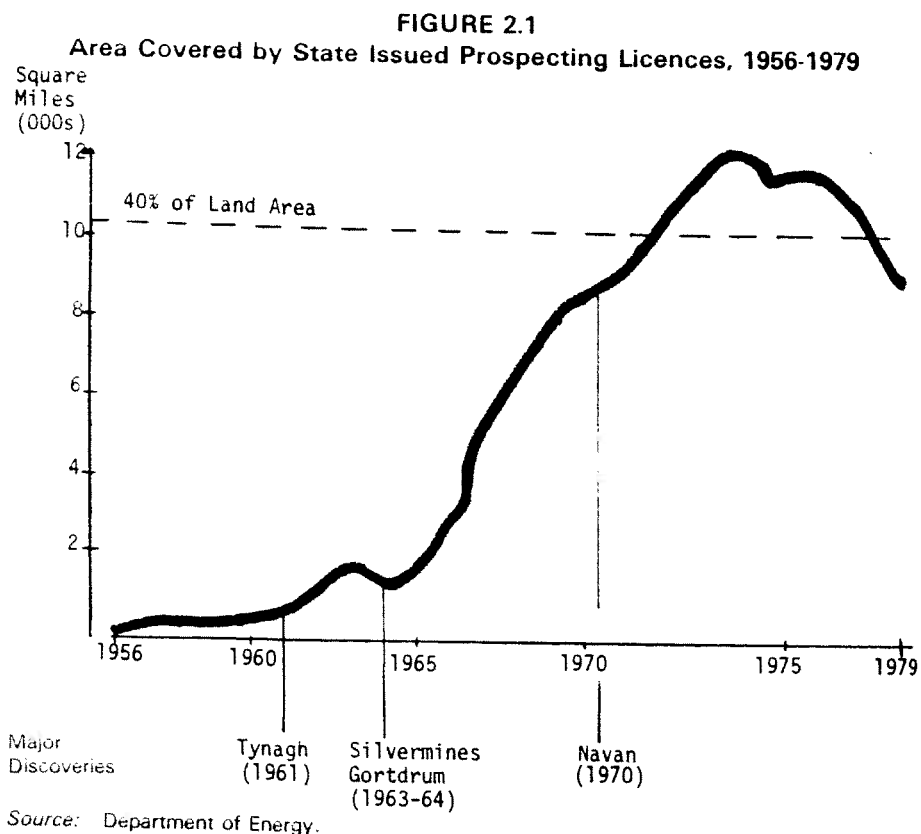
Exploration Licences and Ownership

In March, 1976, the Minister for Industry and Commerce issued new rules with regard to prospecting licences. Licences are now issued initially for 2 years, to be renewed for up to a total of 6 years, if a satisfactory level of work is carried out. A minimum expenditure of £1,000 per annum in current money values is required in the first 2 years for each metalliferous licensed area. The prospecting fee will be £10 per square mile for the first two years and each renewal up to the beginning of the sixth year, when it increases to £20 per square mile. If the Minister feels that there are minerals in an already licensed area which are not being adequately explored by the licensee, prospecting licenses may be issued to other parties in respect of such minerals. Technical capability and general validity will also be used in evaluating licence renewal applications (Finlay, 1979). These rules appear to have had the effect of releasing licenced areas not being actively explored for exploration by others (Figure 2.1). Thus, Dresser, Inco, Aquitaine, Amax and Billiton started exploring in Ireland, with much of their effort concentrated on licence areas surrendered by other prospectors. Increased prospecting costs have resulted in the formation of several joint venture exploration operations (McGrath, 1978).

The concerns regarding minerals ownership which arose as a result of the court findings that the Government's acquisition order vis-a-vis the Navan orebody was invalid did not appear to significantly reduce exploration activity, although there was some decline in real expenditure on exploration (Figure 2.3). Nevertheless, if another order relating to an economically significant ore body were to be declared invalid, it would probably result in a sharp drop in exploration investment. To help avoid this, the Minerals Development Act

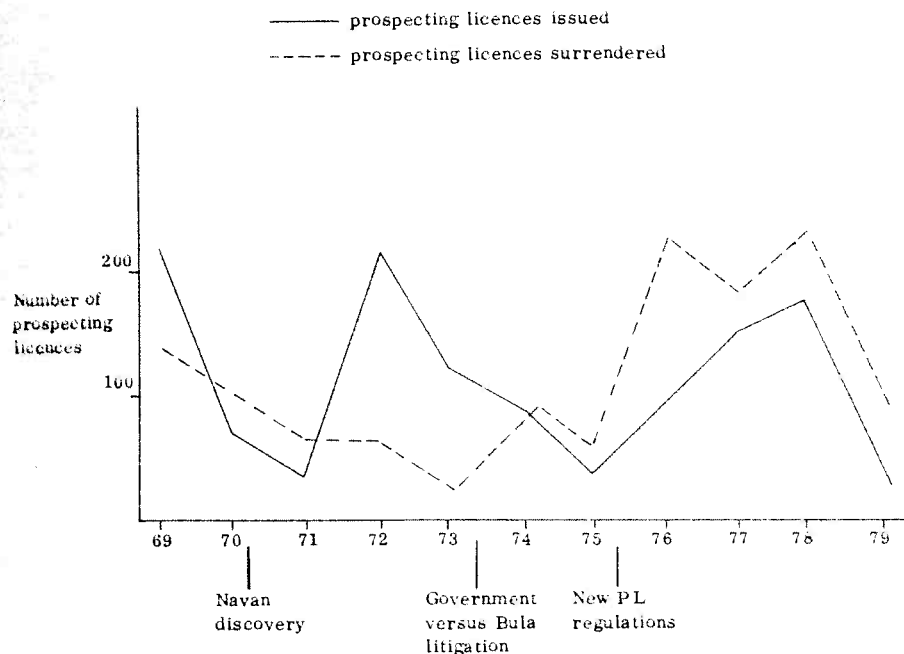
(1979) has been enacted. This bill vests the exclusive right of working minerals with the Minister, who may work them himself or grant a lease or licence for their working. Disputes between the State and private owners regarding compensation will go to the Mining Board, as provided for in the Minerals Act (1940). However, the Board's composition is changed, replacing the "officer of the Minister" by a property arbitrator, while appeal of the Board's decision to the High Court is provided for. A more cogent deterrent to future exploration activity is the absence of any significant commercially exploitable find since 1970.

The data in Figures 2.1, 2.2 and 2.3 support the view that the licensing provisions introduced in 1976 have concentrated on increasing the level of exploration expenditure on fewer areas. However, as more sophisticated exploration methods are required, the cost per "unit of exploration" tends to rise. However, the increasing accumulation of knowledge, experience and expertise in Irish minerals exploration helps to compensate for this cost increase. The 6 months long postal strike in 1979 may help explain the relatively low level of exploration licence issuance in that year.



The interested reader is referred to an excellent publication titled *Mineral Exploration in Ireland* compiled by the Irish Association for Economic Geology (1979) for a detailed discussion of exploration, together with a technical review of some major base-metal discoveries.

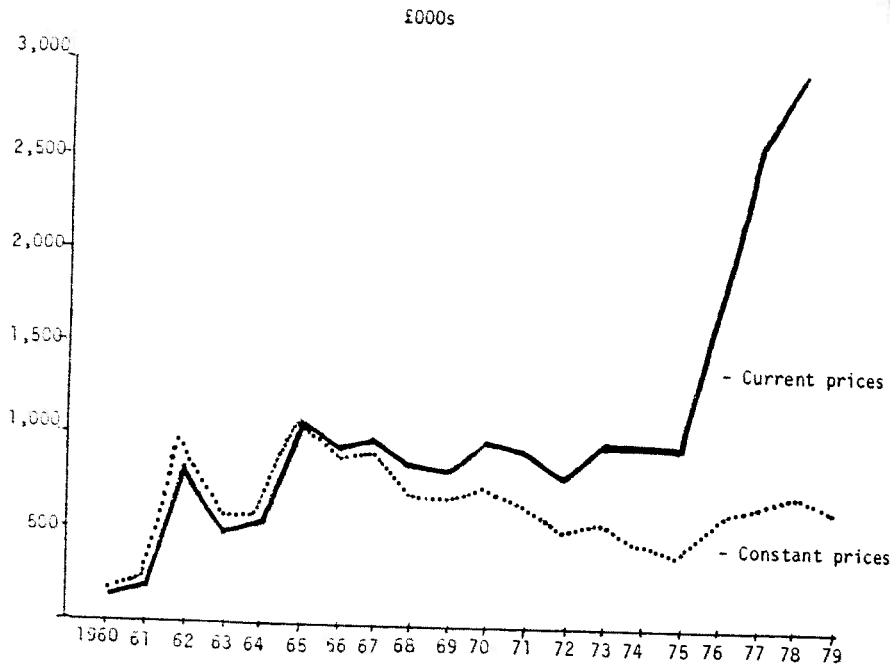
FIGURE 2.2
Prospecting Licence Turnover 1969-1979



Note: Figures for area under licence in 1979 and issues in 1979 are distorted downwards owing to the hold-up in the issue of new licences in that year because of the Post-Office Dispute.

Source: Department of Energy

FIGURE 2.3
Exploration Expenditure 1960-1979



Notes:

(a) Consumer Price Index used as basis for inflation adjustment (1965 prices).

Source:

Taken from Finlay (1979), and Department of Energy data.

Sources of Data:

1960-1972: Irish Mining Industries Association. (now with IMEG).

1973-1975: Personal estimates by Finlay averaged over 3 years.

1976-1979: IMEG.

CHAPTER 3

THE MINING FIRM

Introduction¹

The objective of the mining firm is to profitably extract and process ore. However, minerals are not readily accessible, and they are becoming increasingly difficult to find. Thus, the mining firm achieves its objectives (if at all) only after a long and costly process. The major phases of the mining cycle are described in detail below.

Exploration

Exploration is usually divided into three segments. The first stage involves a search for areas of possible mineralisation or "anomalies" over large regions. Where substantial mining activity has been present, the geologist refers to old mappings, surveys and other historical documents as a first step. Modern exploration is aided by airborne exploration (and even satellite photography) which uses various methods depending on the type of mineralisation sought.²

The second stage is on-site exploration of promising areas. Depending on the presence of outcrops of mineralisation, testing proceeds by direct observation and a variety of geophysical and geochemical techniques. The goal at this stage is a preliminary determination of the size of the mineralised area and the most promising sections for drilling.³

The purpose of the drilling phase is to determine the quantity and quality of reserves. A variety of methods are used depending on the depth and other geological characteristics of the deposit. Based on those samples the ore is divided into three categories:

- (1) Proven reserves: ores that have been both delineated and measured; tonnage, grade and quality ore known within a 5% error.
- (2) Probable reserves: characteristics computed from measurements from widely spaced samples and from geological projections; errors are usually less than 20%.

¹This section is only an introduction to the complexities of the mining process. It is based on Conrad (1978), and Conrad and Hool (1979 a, b). For a mining engineering perspective see: McKinstry (1948), Truscott (1962), Pileider (1968), Just (1967) and Thomas (1973).

²See Thomas (1973) for details.

³The Irish Geological Survey and two mining engineers with different companies have noted to us that such techniques are difficult in central Ireland due to the nature of the bogs.

(3) Possible ore: no samples available; estimates based on inferences from "geological structure and geographic anomalies".

Possible ore, being only a guess, is usually not included in reserve estimates used in making economic decisions.⁴ This does not imply that possible ore does not matter. In many cases possible ore contains the largest tonnage and may be a major determinant of the mine's ultimate value. However, the ore in those areas will not be extracted until far into the future, and the uncertainties regarding the true tonnage, combined with the uncertain nature of prices and costs, make any estimate of their value purely speculative.

The samples obtained from drilling are used to determine other geological characteristics. The information gained from these samples includes:

- (1) length, width and depth of mineralised area;
- (2) major fault structure;
- (3) discontinuities;
- (4) specific gravities;
- (5) moisture levels;
- (6) grade of ore;
- (7) characteristics of overburden.

These characteristics are used to determine the appropriate technology to employ and to estimate the recoverable ore (or mineable ore) which might be obtained. Finally, the samples are assayed to determine the quality and chemical composition of the ore. These studies determine what process will be necessary to separate the valuable contents of the ore from the rock and other impurities.⁵

Pre-Development Planning

If exploration has been successful a determination of the mine's profitability must be made. This determination is usually accomplished in two steps. Stage one is a "quick assessment" of the chances for profitable extraction based on current price projections, the average grade of ore and other rules of thumb. The purpose of these rough calculations is to determine if the expense invested in more detailed planning would be warranted.⁶

Stage two is a detailed feasibility study of the project. This study involves a determination of the best technology to employ and the scale of operations.⁷

⁴For a complete description see: Thomas (1973), Byrne and Sparvero (1969), Maximov, Miloserdina and Eremin (1973), Preston (1960) and Patterson (1959).

⁵See references cited in footnote 4 above.

⁶See Stahl and Lazzirowicz (1974), Raymond (1976), Miller (1971), and Halls, Bellum and Lewis (1969). The industry has traditionally employed the "Hoskold formula," Hoskold (1877), or a variant of it at this level.

⁷See MacKenzie (1969, 1970, 1971), Lindly (1976), Roff and Franklin (1964) Frohling and McGeorge (1975), and Thomas (1973) for examples and critiques on mineral feasibility studies.

Also major areas of the mine are sequenced for development; methods of extraction and processing are determined. Transportation and storage facilities are studied and planned. The engineering detail is quite specific in order to determine capital and labour requirements and costs, as well as the best sequence of production.

These studies also yield estimates of recovery using different techniques. Each mining and processing method will have a different impact on recoverable reserves. For instance, some ore may be lost in underground mines because of required roof and floor supports, while an open pit operation may be able to recover such ore. These factors are classified into three major groups: (1) extraction, (2) dilution and (3) recovery.⁸ Extraction losses are incurred because of the mining process itself, i.e., roof and floor supports, etc.

Dilution occurs when waste rock gets mixed with ore, in the extraction process. It affects both the tonnage and quality since more material must be handled and is of lower quality. The ratio of waste to ore — the stripping ratio — is important in determining the relative economic feasibility of underground and surface extraction methods. A final adjustment is made for loss of metal at the concentrating stage. It is not feasible to separate all "metal" from all "rock" at this stage. Some metal will be lost in this process and some impurities will remain in the marketed product (i.e., concentrate is much less than 100% pure).

It is clear that these three factors are determined in large measure by the geological structure of the deposit and the level of technological knowledge. Furthermore, the three factors are interrelated. A plan to minimise extraction losses may increase the dilution factor because more waste may have to be recovered to get more ore. This lowers the quality of mill feed which may increase plant recovery costs and lower the quality of final output. Economic factors are equally important considerations however. Each mining and processing method may involve different costs as well as affecting the various loss factors. In addition, each method may affect the value of the final output (or at least change the cost of maintaining output of a specified value). It is rarely feasible to find a method that lowers both losses and costs. Therefore, trade-offs must be made to determine the most "profitable" methods.

Marketing studies are also made during this period to estimate the likely price and access to markets.⁹ Preliminary negotiations with potential buyers are initiated to determine quality and quantity characteristics which may be the basis for long-term contracts. This information is combined with the engineering studies to make a determination of the mine's profitability. The

⁸Thomas (1973) defines these terms.

⁹The following is based on Conrad (1978) and the references therein.

procedure commonly used is to determine the annual extraction and development profile for a given scale of plant and specific technology. Next, the size of plant is changed (in increments of about 50%) to generate new present value estimates. This procedure is used because of the scale factors known to exist in mining operations. Increases in scale decrease costs per ton up to a point. Thus, within the relevant range, in addition to bringing future extraction closer to the present by increasing annual extraction, increases in plant size decrease average costs, thus increasing the present value. In addition, lower average cost per ton of ore extracted may increase the reserve base by allowing extraction of lower grades of ore. Finally, parameters such as prices and costs are changed, either by Monte Carlo methods or by subjective projection, to determine how robust the estimates of profitability are under different regimes.

The decision of which type and scale of operation to construct will be based on a number of criteria. First, the net present value is calculated with various discount factors to adjust for risk. The internal rate of return is calculated both for total invested capital and for equity to determine the return relative to other investments. Maximum rates of return to mining investment vary across firms but usually are in a range of 15% - 25% in real terms. Finally, the payback period is determined. Given the uncertain nature of mining investments, firms seek to recapture their investment at the earliest possible date in order to repay debt and to ensure a minimum return.

If it is estimated that the investment will be sufficiently profitable, the firm then proceeds with contract negotiations and financial arrangements. Loans are an important part of the investment process. Since the major funds must be arranged at least three to five years before any cash/flow is generated, the firm wants to leverage the investment and the risk as much as possible. Banks are cautious, however, with these loans and usually must be assured of contract agreements and other parts of the financial package to insure its funds as well as the financial viability of the project.

Investment and Development

Once all the financial and other arrangements are made, the firm can proceed to construct the plant. Before any ore is extracted, the mine, the processing plant, storage and transportation facilities must be constructed. The surface facilities are usually completed before the mine begins operation. However, not all the mine is constructed at once. Rather major developments of different parts of the mine are sequenced in a manner consistent with the overall development plan. This is true for both technical and economic reasons. For instance, the Tynagh Mine developed an open pit operation and later moved underground as the deposit became less accessible.¹⁰ Also the

¹⁰Site visit to Tynagh 6/10/79.

underground techniques have changed from open stoping to room and pillar methods as dictated by geological and cost considerations. From an economic perspective this is a rational procedure. If the mine developed too many areas relative to its capacity, additional costs would be incurred earlier, including increased overhead, to keep the areas in safe and productive condition. It is better to sequence development so that new areas are developed as others are exhausted in order to lower overhead and defer incremental expansion costs until conditions warrant. Because of financial considerations and uncertainty, the firm selects for initial development areas that have the best ores and the least cost in order to pay back the capital.

Extraction

After all the time and expense required to explore, plan and construct the mine have been committed, the firm is able to extract and process the first ton of ore. At this stage the firm is constrained by all its previous decisions. Capacity and technology are in place, limiting the amount of ore that can be extracted and determining both overhead and variable costs. In addition, extraction is limited to areas that have been developed. The only physical variables the firm can control are the rate of extraction and the quality of the ore extracted and processed. Nevertheless, decision-making regarding these variables is a dynamic process. Production schedules are established for 6 to 12 month intervals and are re-evaluated in light of new information and changing market conditions.¹¹

The sales which result from extraction and processing generate the firm's cash flow. The firm uses the cash flow either to repay debt or as returns to equity, to begin operations in other mines, or to reinvest the funds in the current operation. Reinvestment may be in the form of new exploration expenditures to prove-up more reserves; to finance expansion if reserves and market conditions warrant; to develop new areas of the mine for the next phases of exploitation; or for working capital to finance the current level of activity. How these funds are allocated will depend on the past performance, the current state of operations and future prospects for the mine.

Uncertainty and the Economics of the Mine¹²

Uncertainty in mining operations arises from three sources. First, a firm does not know the exact magnitude or quality of the deposit. Until shafts are developed or overburden removed the geologists and engineers do not know the exact delineation of particular areas and in some cases do not know the

¹¹This horizon seems to be the industry range and has been used by Tynagh.

¹²This section is condensed from Conrad (1978) and Conrad and Hool (1979). In these works mathematical models are used to explore the optimal policies for investment and extraction.

quality until after the ore is extracted and processed. Steps are taken to minimise these risks but they can never be fully eliminated.

Second, the future path of prices and costs is unknown and cannot be accurately predicted. Attempts are made to reduce these risks by entering long term contracts to ensure a market. However, the price received is a function of the metal price and contracts are periodically renegotiated. Finally, there are social and political risks. Governments may change tax, environmental and other policies affecting the mine's profitability.¹³

These uncertainties are compounded by the time lag between the first expenditure on exploration and the generation of positive cash flow. In addition, the firm is constrained by its ability to gain and process information. If the firm attempted to account for every possible state of the world the firm would either run out of funds or the project would never be operative. Therefore, trade-offs are made between accuracy of prediction and the risks the firm is willing to assume.

Since the mining process follows a logical sequence most mining firms segment the decision problem according to the major phases in the sequence. This segmentation allows the firm to make one decision at a time, e.g., (1) should more exploration be done?; (2) how much development is warranted?; (3) how much ore should be extracted this month? Such a procedure does not eliminate the uncertainties and the decision structure must allow for incorporation of new information and periodic re-evaluations.

Because all decisions are not made and re-evaluated simultaneously, simplifications or "rules of thumb" have to be used at various levels. These simplifications vary from one decision level to another. They relate to: (1) length of the planning horizon; (2) areas of the mine under consideration; (3) averages of such variables as days worked and tonnages of ore processed. For instance, the initial investment decision plans for the extraction of proven reserves, and therefore an estimate of the mine's entire life is obtained. At the current extraction level, the firm is concerned only with developed areas, and the planning period may be less than a year.

The segmentation of the problem results in a hierarchical decision structure which allows for revisions as time proceeds. For example, exploration imposes data (ore estimates) on initial investment. The resulting investment imposes data (capacity and technology) on current extraction. However, this structure also provides informational linkages from lower to higher levels in the re-evaluation process. The information gained from current extraction, i.e.,

profits, revised reserve estimates, etc., are used in evaluating changes in capacity (if any) and in the development profile.

One implication of this decision structure is that as the firm moves to lower levels uncertainty is reduced. At the extraction decision level, the firm cares only about short-run prices and costs because prices ten years from now have no impact. The areas are developed so that the characteristics of these areas are known. Finally, the firm knows the capacity and other constraints so that the short-run costs are known. However, at the initial investment level the firm has none of this information. Prices and costs must be projected far into the future so that the firm must use annual averages to make any predictions at all. The structure of the entire ore body is not known, nor is the exact nature of costs and technological variables.

Another implication of this structure is that changes in the long-run mining profile take time and incur adjustment costs. For instance, if current prices are higher than expected and this trend is expected to continue, the firm may desire a larger capacity or more development to capture this trend. An "immediate" response is not possible, and if it is made at all the prices could have peaked before the expansion of capacity is complete.

In this environment, public policy, particularly taxation policy, will have differing effects on the mine's operation depending on the level at which the firm is operating. In addition, the policy will affect all future decisions as this information is passed through the decision structure. Thus a change in tax policy will have both immediate and delayed response from the firm.

The above has been a simplified description of how an economist views the mining problem, with emphasis on the nature of uncertainty and the decision structure. It should be emphasised that this structure is not unique to mining. All economic agents have planning periods of various lengths (people plan for retirement and plan next month's budget) that result from uncertainty. Examples also exist which compare with exploration and the long lead times necessary to obtain a positive return. The drug industry spends large sums on research (exploration) for new drugs much of which is spent on abandoned projects.¹⁴ This research is conducted with the knowledge that a competitor may find a substitute first and control the market (if a cure has not already been found by another method). Finally, the time from initial discovery to sales may be quite long and costly. Therefore, while risks exist at all levels of the mining problem, they must be taken in context and evaluated on their relative strengths in affecting the firm's behaviour and any public response to it.

¹³Thomas (1973) details these risks.

¹⁴I am grateful to Henry Grabowski for this example.

SECTION II

NON-TAX ISSUES ANALYSED

It is useful to estimate the current and prospective contributions of minerals to the economy as a means of helping identify the key policy issues. In the first two chapters of this section, we respectively examine the contributions of the internationally traded and the domestically consumed minerals in this regard. Although the latter make a much larger total contribution in terms of employment provided etc., activity in this sector is largely (but not entirely) dictated by the level of production in construction-related sectors-building, road and rail construction and maintenance etc.; the opportunity for autonomously led expansion by domestically consumed minerals is limited. Conversely, while internationally traded minerals make a relatively modest total contribution, autonomous expansions and contractions are feasible. Our consideration of the role internationally traded minerals play in the economy is therefore more detailed than that accorded to domestically-consumed minerals. Economic contribution is estimated in terms of employment, net foreign exchange earnings, linkage effects with the rest of the economy, increased Government revenue and development of economically deprived regions.

In our analysis of minerals and the economy it became clear that a primary contribution for the economy lies in capturing for the public benefit the scarcity rent resulting from minerals development. In Chapters 6 and 7 we discuss matters impinging on this issue; these include minerals ownership, lease terms and the proposed state mining company. The institutional mechanisms for developing and implementing minerals policy are examined in Chapter 8.

CHAPTER 4

INTERNATIONALLY TRADED MINERALS AND THE ECONOMY

In evaluating minerals policy, the following current or potential contributions of the sector are usually thought to be important:

- Employment and its quality
- Net foreign exchange earnings
- Forward and background linkage effects, generating resource based industrialisation
- Increased revenues to the Government
- Development of economically deprived regions
- Development of indigenous technical, entrepreneurial and managerial skills
- Increased domestic labour and capital income

The above, of course, comprise criteria which a Government interested in fostering economic expansion might use to evaluate any development proposals. In applying them to the Irish mining sector, it is useful to distinguish between the total contribution and those at the margin. The former are of general interest, but it is the latter which are of primary relevance from a policy perspective; we are interested in the implications for society of expansions or contractions. In analysing the role of the minerals sector in the economy, we have drawn freely on the approach used by Gillis *et al* (1978) in their examination of minerals' tax policy in Bolivia, and on the recent study by Grimes (1978) of the impacts on the Irish economy of base metals production.

Following Grimes (1978), in Table 4.1 are presented some production statistics for 1965-75. Unfortunately, the Census of Industrial Production data for 1976-78 were not yet fully completed at the time of writing.

Employment

Employment, average hours worked per week and average earnings per week from Census of Industrial Production are listed in Table 4.2. It can be seen that, with the exception of a small dip in 1975 and 1976, employment has steadily increased, growing almost eightfold between 1965 and 1978. However, even at this historically high level, employment is just 1.01 per cent of total transportable goods employment. From Henry (1980) we find that the

TABLE 4.1

Output of Irish Mining Industry 1965-75

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975 ^c
Gross Output (Million £)											
Metal Ores and Concentrates	0.2	3.4	5.5	10.0	14.0	14.9	12.3	N.A.	24.3	23.3	19.5
Other	0.6	0.8	0.7	0.7	1.3	2.6	3.0	N.A.	2.8	2.0	1.6
Total	0.8	4.2	0.2	10.7	15.3	17.5	15.3	18.5	27.1	25.2	21.1
Cost of Materials	0.2	0.7	1.2	2.1	2.8	3.1	3.2	3.9	4.8	5.5	5.1
Net output	0.7	3.4	5.0	8.5	12.5	14.4	12.0	14.6	22.4	19.8	16.0
Wages and Salaries	0.2	0.5	0.8	1.3	1.7	2.5	3.2	3.5	4.6	5.5	6.0
Wages as percentage of Gross Output	25	12	13	12	11	14	21	19	17	22	28
Persons Employed (E)	319	497	739	949	1250	1430	1660	1665	1725	1675	1222
Transportable Goods Employment (000s)	183.675	185.275	186.7	191.255	202.45	208.075	206.6	206.75	214.0	215.9	201.15
E as percentage of Transportable Goods Employment	0.17	0.27	0.40	0.50	0.62	0.69	0.80	0.81	0.81	0.77	0.61
Net Output as percentage of total net output in transportable goods industries	0.3	1.4	1.7	2.6	3.2	3.3	2.4	2.5	3.0	N.A.	N.A.

^aUp to 1974, output etc. of barytes, gypsum and dolomite (magnesia) were included under "other", but since then they have been included in a separate classification. Thus, output, employment etc. in 1974 and 1975 are exclusive of those associated with these minerals.

Source: Ginnin (1978) p. 109 and issues of Irish Statistical Bulletin

employment multiplier for the Stone, Ore and Gravels sector in Ireland in 1976 was 1.76. Thus, on average, the 2,100 jobs in mining in 1979 generated about 1,600 jobs elsewhere in the economy, for a total of internationally traded minerals' based employment of 3,700. The limitations of input-output analysis as a method of estimating multiplier effects are discussed later on in this chapter.

TABLE 4.2

Employment, Average Hours Worked per Week and Average Earnings per Week in the Mining Industry, 1965-79

	CPI (1968 = 100)	Employment ^a	Average Hours Worked per Week	Average Earnings per Week ^b			
				Mining		Total Transportable Goods	
				Current	Constant 1968 £	Current £	Constant 1968 £
1965	89.0	275	46.6	15.63	17.56	11.04	12.40
1966	92.4	450	50.2	17.10	18.51	10.91	11.81
1967	94.8	675	48.7	20.06	21.16	12.26	12.93
1968	100.0	900	47.9	21.61	21.61	13.02	13.02
1969	105.7	1150	45.6	27.07	25.61	14.68	13.89
1970	114.4	1375	43.9	28.06	24.53	16.21	14.17
1971	124.6	1500	46.3	32.19	25.83	19.37	15.55
1972	135.4	1650	44.6	32.26	23.83	22.45	16.58
1973	150.8	1700	45.0	44.16	29.28	26.03	17.26
1974	176.4	1775	46.1	53.64	30.41	30.69	17.40
1975	213.2	1500	45.7	76.84	36.04	39.17	18.37
1976	251.6	1500	41.4	86.85	34.52	48.85	19.42
1977	285.9	2050	42.4	96.14	33.63	58.36	20.41
1978	307.7	2000	41.4	91.59	29.77	66.50	21.61
1979	348.4	2100	43.4	110.58	31.74	76.64	22.00

^aAverages of the quarterly data

^bof industrial workers on March of each year

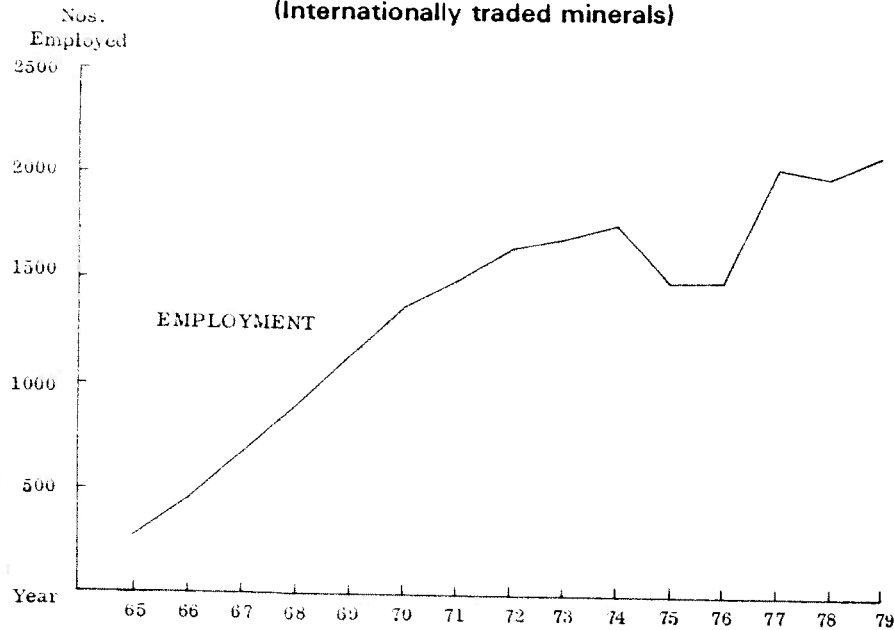
^cFirst quarter only

Source: Successive issues of the Irish Statistical Bulletin

The highly capital intensive nature of Irish mining can be inferred from the fact that this sector in 1973 contributed 3% of total net output in transportable goods industries but only comprised 0.81% of the total labour force. The capital intensity can be observed directly by examining capital outlays per employee, illustrated here by the capital invested in the Tara and Tynagh mines:

FIGURE 4.1(a)

Employment in Mining 1965-79
(Internationally traded minerals)



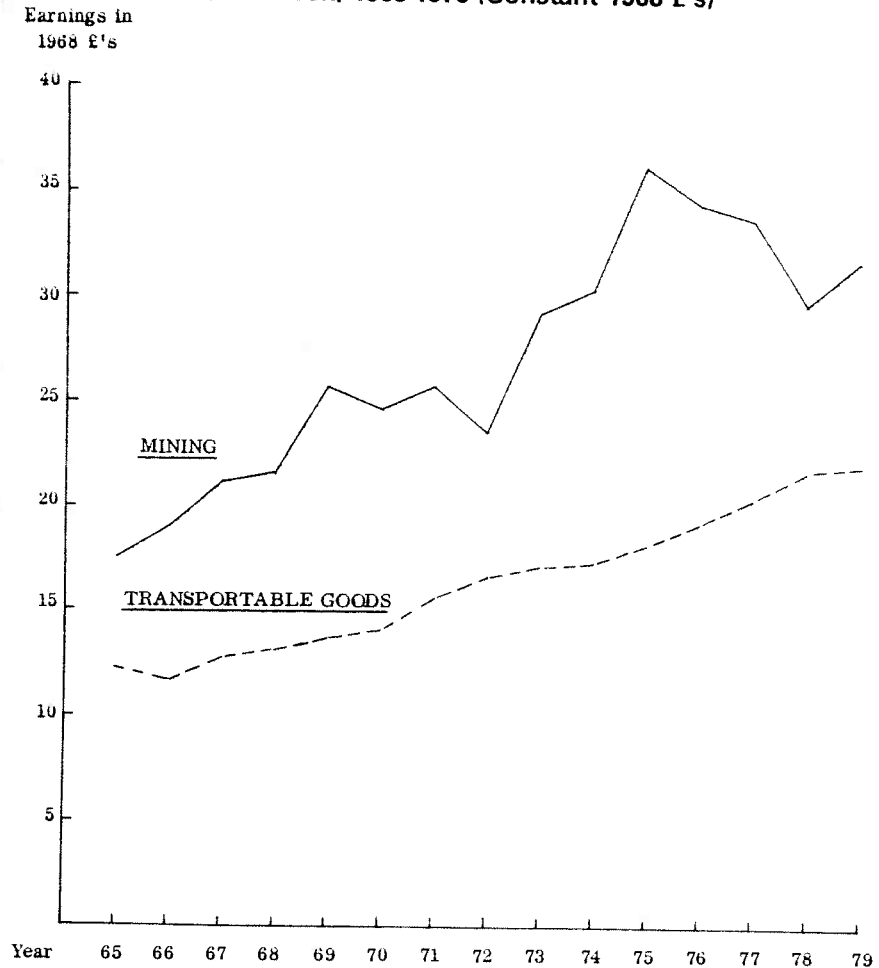
Source: Irish Statistical Bulletin, various issues.

Year	Capital Expenditures (000s £)	
	Tara	Tynagh
1971	2646	N.A.
1972	1790	N.A.
1973	3325	670
1974	8444	580
1975	12803	312
1976	39854	510
1977	20178	458

Thus, over the 1971-77 period Tara invested £89.040 million, exclusive of interest charges, to bring on-stream a mine employing 808, a capital cost of £110,198 per employee. Most of the capital costs associated with Tynagh were incurred at mine development, in the mid sixties. Nevertheless the 1973-77 incremental capital outlays amount to £2.530 million, or £6300 per employee for a total project life of only 7-8 years. These numbers compare with an average total capital cost per job in overseas grant-aided firms of £15,530 in Ireland in 1977.

FIGURE 4.1(b)

Average Earnings
(Per Week) 1965-1979 (Constant 1968 £'s)



Source: Ibid

Net Foreign Exchange Earnings

Virtually all of the metallic minerals, barytes and magnesia mined are exported, while most of the gypsum is manufactured into import substituting plasterboard. The production of metal, barytes, magnesia and gypsum is listed in Table 4.3*. Exports are presented in Table 4.4 and Figure 4.4. It is clear that the internationally traded minerals have become quite significant contributors to total value of exports with the share reaching a peak in 1969 at 5.17% of the

*and illustrated in Figures 4.2 and 4.3

TABLE 4.3

Output of Selected Minerals

	Copper	Lead	Zinc	Silver	Gypsum	Barytes	Pyrites
	000's Tons of Metals			000 oz.	000's Tons		
1965	--	2.3	1.3	51	221	100	--
1966	1.1	38.1	23.1	1218	213	121	--
1967	3.5	59.7	36.1	2113	244	74	--
1968	6.9	60.7	50.5	1911	254	131	--
1969	5.9	60.0	105.2	1842	280	157	--
1970	7.7	62.5	98.7	2243	285	214	--
1971	11.8	48.7	89.0	1491	325	190	28
1972	13.0	55.0	83.0	N.A.	374	229	66
1973	13.0	55.4	66.0	2014	429	266	67
1974	12.6	37.6	65.9	1984	378	318	57
1975	10.0	36.0	65.0	1180	331	295	70
1976	4.0	32.1	61.2	925	355	323	58
1977	4.8	40.4	114.5	936	343	373	49
1978	4.8	47.8	176.0	631	386	344	41
1979	4.8	71.1	212.1	1075	411	319	N.A.

Source: Census of Industrial Production, *Irish Statistical Bulletin* various issues, and the Geological Survey

total; in 1979 minerals exports peaked in absolute terms. To estimate the direct net effect of these sales, it is necessary to deduct the leakages abroad from these revenues received.

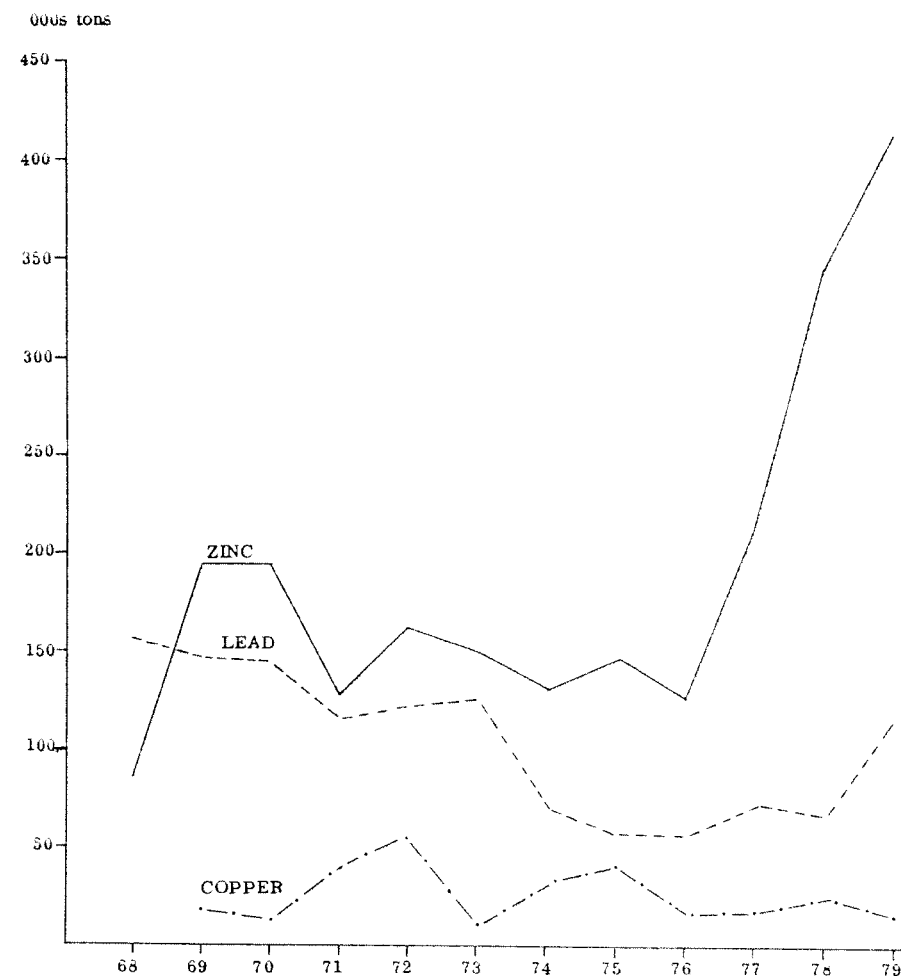
Forward Linkage

As noted earlier, the dolomite mined at Bennetsbridge is processed to produce magnesia, and most of the gypsum extracted at Kingscourt is made into plasterboard, but there is no downstream processing of the metals beyond the concentrate stage. The apparent opportunity to generate income and employment by metal smelting has received intense and sometimes acrimonious attention in Ireland in recent years.

In 1961 Mr. Patrick Hughes of Northgate Exploration announced that he proposed to build a smelter whenever it was feasible to do so. Smelter Corporation of Ireland, a Northgate subsidiary, obtained planning permission for a 72,000 ton electrolytic zinc smelter on Little Island, Co. Cork; it was shelved in 1970 because of low metal prices. Since that time several further feasibility studies have been undertaken, including one initiated in 1977 by New Jersey Zinc. The company decided not to proceed; since then Japanese, Dutch and Finnish interests and the Russian Government, among others, have examined the possibility, but no decision to proceed has yet been made. The reason is that, on the cost side, Ireland is at some competitive disadvantage vis-a-vis other producers, while metal prices and existing capacity are such

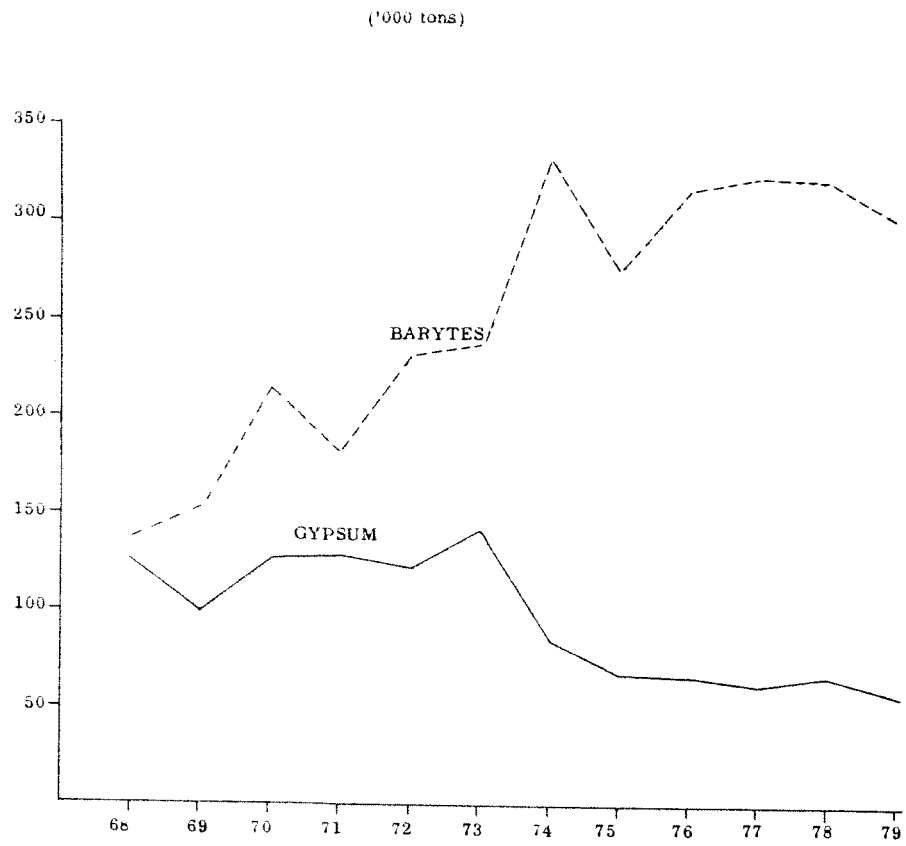
FIGURE 4.2

Output of Zinc, Lead and Copper, 1968-79



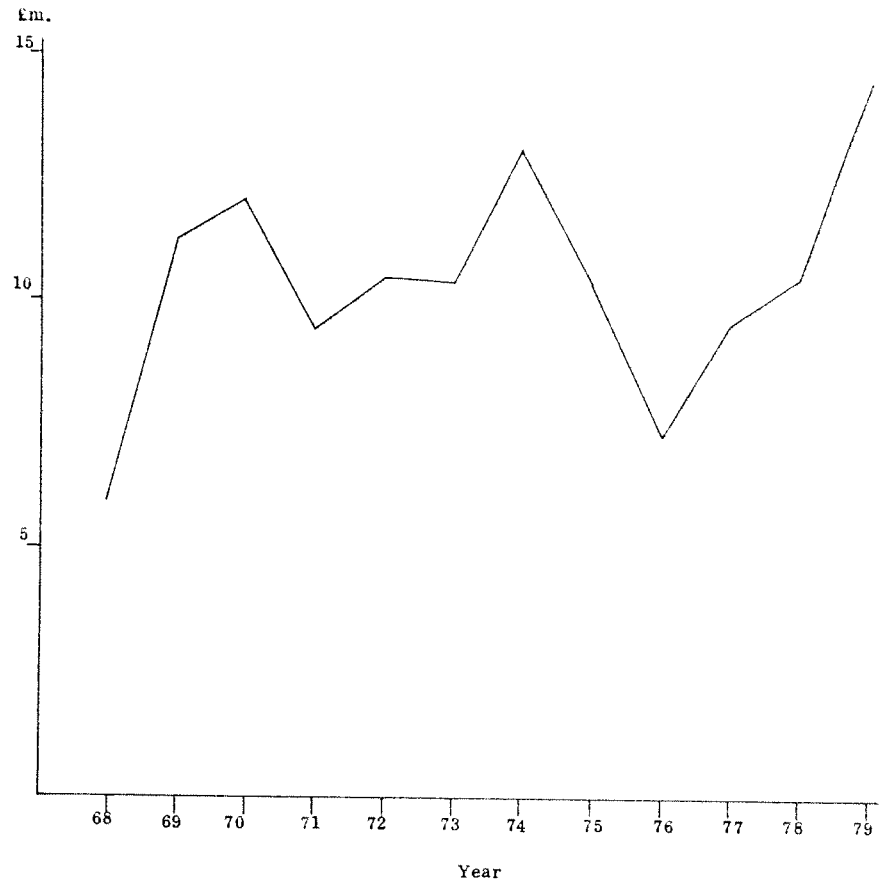
Source: Table 4.4

FIGURE 4.3
Total Output of Gypsum and Barytes, 1968-79



Source: Table 4.4

FIGURE 4.4
Minerals Exports Valued in Constant Prices (1953 £'s)



Source: Table 4.4

TABLE 4.4

Internationally Traded Minerals: Exports, Volume and Value,
Current Prices, 1968-1979

	Zinc	Lead	Copper	Gypsum	Barytes	Mag- nesia	Total	Mineral Exports as % of Total Exports
1968	86	156	—	126	138	N.A.	506	
Value 000s Tons	2891	4988	—	352	683	N.A.	8914	2.76
Value 000 £							6110	
Value 000 £ (1953£)								
1969	194	148	18	100	151	N.A.	611	
Volume Current	8509	5898	2922	277	930	N.A.	18536	5.17
Value Constant							11852	
1970	194	146	14	126	215	N.A.	695	
Volume Current	9165	7184	2130	373	1122	N.A.	19974	4.80
Value Constant							12128	
1971	129	117	40	129	186	N.A.	601	
Volume Current	6182	4164	4085	357	1107	N.A.	15895	3.01
Value Constant							9156	
1972	164	124	56	123	233	N.A.	700	
Volume Current	8745	4602	5449	419	1223	N.A.	20438	3.87
Value Constant							10661	
1973	150	126	11	143	238	35	703	
Volume Current	11172	6953	1978	499	1481	862	22945	2.64
Value Constant							10157	
1974	134	74	32	85	334	35	694	
Volume Current	15467	8337	5633	528	2292	1494	33751	3.00
Value Constant							13189	
1975	147	59	41	68	279	43	637	
Volume Current	17448	4904	4690	602	2281	3239	33164	2.29
Value Constant							10409	
1976	128	57	19	66	316	34	620	
Volume Current	13273	5541	1580	759	4018	3520	28691	1.54
Value Constant							7540	
1977	211	72	19	63	324	37	726	
Volume Current	20266	9154	2010	975	4843	4175	41123	1.63
Value Constant							9272	
1978	344	69	25	66	323	51	878	
Volume Current	26672	7770	2569	1147	5322	5383	48863	1.65
Value Constant							10050	
1979	414	115	18	57	302	36	942	
Volume Current	39294	26249	4092	1079	4856	4038	79599	2.28
Value Constant							14593	

Notes: Volumes of Metal are in tons (000s) of concentrate. Volumes and values for barytes and magnesia pre-1977 are assumed to be synonymous with "Minerals Crude NES" and "Clay and Other Refractory Minerals" respectively in the various December issues of *Trade Statistics of Ireland*. Value of copper include other minerals, 1969-71. Gypsum volumes and values include gypsum as plasters. Value is expressed in constant £ using the Wholesale Price Index (1953 = 100).

TABLE 4.5

Annual Costs and Revenues, Electrolytic Zinc Smelter, 1979 prices

Costs

Running Costs	£ million	
Power 462 million kwh	8.0	(1)
Labour 450 employed	2.5	(2)
Other	4.0	(3)
	14.5	(4)
Capital Cost (Total £100 million) over 10 years @ 4%	12.3	(5)
Concentrate Costs Metal Price of £400/ton 104,200 Tons of Concentrate at £207/ton ¹	21.6	(6)
Total Costs (4) + (5) + (6)	48.4	(7)

Revenues

100,000 tons of Zinc @ £400/ton	40.0	(8)
Sulphuric Acid and Cadmium	5.0	(9)
Total Revenues	45.0	(10)
Profit (Loss)	(3.4)	

Alternate-Higher Metal Prices

(Zinc £500/ton)		
Concentrate Costs (104,200 x £260)	27.1	(11)
Total Costs (4) + (5) + (11)	53.9	(12)
Total Revenues (100,000 x 500) + (9)	55.0	(13)
Profit (Loss)	1.1	

¹Purchase Price per ton of metal intake = $400 \times 0.85 \times 0.61 = 207$. No. of tons of metal required to produce 100,000 tons of metal, when conversion efficiency is 96% is equal to $100,000 \times 1/0.96 = 104,200$.

that investment in additional European smelting capacity is in any event hard to justify financially.

With regard to capital costs, it is apparently much more expensive to build a new facility than it is to increase capacity at an existing site; the "greenfield" costs of providing infrastructure etc. are greater than the cost savings associated with an entirely new plant. Electric power costs typically comprise 20-25% of total smelter operating costs, and electricity is expensive in Ireland compared to costs of our European competitors in this regard. Scandinavian smelters use cheap hydro-power, German and East European firms have access to cheap lignite power, while in the Netherlands and Belgium, power costs are subsidised.

The electrolytic process is the one almost universally favoured for zinc smelting in recent years. It involves roasting the zinc concentrates to remove sulphur, removing other impurities in a liquid solution, and then using an electric charge to deposit the zinc on aluminium cathodes. Sulphuric acid and cadmium are also produced. It is highly energy intensive, using about 4200 kWh per ton of zinc produced. Total annual electricity consumption for a 110,000 tons/annum smelter would total 462 million units, amounting to 5.8% of total ESB electricity sales in 1978/79.

The costs in Table 4.5 appear to be of the order of magnitude involved in building and operating a 110,000 ton/annum zinc smelter, using the electrolytic process. This is about the smelter capacity generally discussed in relation to Ireland. It can be seen that at the current price of about £400 per ton of metal, annual losses of £3.4 million would be sustained; at a zinc metal price of £500/ton, a small profit would be recorded. Note that since all values, including the interest charge on capital, are expressed in real (net of inflation) terms, the £500 per ton price is in 1979 £. If inflation continues for 2 years at an annual rate of 14%, this means that the money price in 1981 would need to be £650/ton in order to remain constant in real terms (£500 in 1979 £). While the data in Table 7 are only suggestive and vastly simplified, it does appear that a metal price of about £500/ton is required for profitable operation. Note however that a firm with power costs half of Ireland's could make a small profit with metal prices at £400/ton, other things being equal. Similarly, a company that had entirely paid off its capital costs would be profitable at the lower price, although there would of course continue to be some charge under this heading for capital repair and replacement.

The Imperial Smelting Furnace (I.S.F.) technology has also been discussed. This allows the smelting of both lead and zinc. In this process the concentrates are first roasted to remove sulphur and then mixed with coke in a blast furnace. The lead is recovered from the bottom of the furnace, while the zinc is vapourised and emitted from the top. Both the zinc and lead must be refined

after smelting. This process is designed to take bulk (i.e. lead and zinc mixed) concentrate. It is generally felt that technically, environmentally and economically, the electrolytic process is the better of the two. Some attention has also been given to the Soviet KIVCET method, which is much less energy intensive than the electrolytic process, but it remains unproven.

A smelter requiring an intake of 104,200 tons of metal will need 190,000 tons of zinc concentrate (55%). This is less than half of Tara's projected output at full production. The smelter size was apparently selected in the knowledge that European smelters are operating at only 77% capacity, with a rated annual 1979 production capacity over consumption of more than 500,000 tons.

Based on the above data, even if a smelter does come on-stream, the economic impact is likely to be relatively modest. It will employ up to 450 persons, yielding a payroll of £2.5 million annually. Much of the payment for power will go to pay for imported fuel and electric generating equipment. The extent to which profits (if any) and interest and capital payments stay in Ireland will depend on the extent to which the equity in the company and the financing institutions are owned by individuals who spend their receipts in Ireland.

Much has been made of the propulsive impact a smelter would have in terms of generating further activity downstream, in the minerals processing and metals fabricating industries. We have not been able to find analyses which look carefully at the extent to which a smelter would provide Ireland with an overall comparative advantage in generating this type of activity.

The current main outlets for zinc are galvanising, die-casting and brass. For galvanising and die-casting it would appear most logical from an economic point of view to locate a smelter adjacent to iron and steel works, and car manufacturing plants respectively to service the above markets. Brass is over 60% copper, and may be more economically "footloose" than galvanising or die-casting. From the point of view of generating further linkage, lead smelting seems to be a more promising activity, since the presence of refined lead could make the establishment of a lead-acid battery manufacturing unit commercially feasible. This option has not been much debated, possibly because of the adverse implications for the environment of lead smelting.

It is necessary to be concerned with estimating the likely extent of induced activity if the taxpayer is being asked to forego income or pay more taxes in order to generate it. For example, it might be suggested that the mining sector should accept a lower price for concentrate than that obtaining on the world market, in effect subsidising production at the smelter.* If the income of the

*However this option is explicitly foreclosed in both Tara's lease terms and the agreement with Bula.

mining sector were untaxed, and the surplus profits were being invested outside the country, this would be one (albeit inefficient) way of capturing a portion of the rent associated with the ore body. However, the tax regime now in place and the options we outline later promise to return a significant amount of the rent to the Government; the benefits of reducing this tax yield must be compared with the returns foregone before a sensible decision can be reached. Similarly, if energy for a smelter were to be subsidised, either the cost of this will be borne by other energy users in the form of higher prices, or there will be a direct subvention from the tax-payers to the smelter. As before, in either case the costs of subsidisation should be compared as carefully as possible with the expected benefits of so doing.

It seems to us that, given the current uses of zinc metal, a zinc smelter is unlikely to generate substantial ancillary metal related activity. Compared with iron-ore and copper for example, zinc's capacity to act as a propulsive force in the economy appears to be limited. A study of the multiplier effects of the zinc and aluminium smelters in the Netherlands showed that compared to other industrial sectors the effects are very modest, with the employment multiplier falling in the range of 1 to 2 jobs per job provided in smelting. This is the level of multiplier we can expect in Ireland from normal industrial activity, so that on this basis smelting does not deserve any special indulgence (Ministry of Economic Affairs, The Hague, 1981). However, other uses of the metal may develop in time which would have more impact in this regard, (Electric car batteries using zinc have recently been demonstrated by General Motors); in addition, limited as it appears to be, a zinc smelter seems to be the only potentially viable means available of establishing a significant beach-head in Ireland in metal fabricating activities.

Increased Net Revenues to the Government

The revenue potential of minerals derives from the fact that a *scarcity rent* can accrue to them; these rents exist "whenever a payment to any factor* owner in a particular occupation exceeds the minimum payment required to retain a factor in that use" (Gillis 1979, p. 98). When minerals are publicly owned, it is usual for the Government to use tax policy to appropriate some or all of the rent in addition to the "normal" taxes imposed on the capital and labour which are used to exploit them.

Since minerals tax policy is considered in detail elsewhere in this volume, this very important issue will not be dealt with further in this chapter. As noted above, the rent may also be appropriated in part by forcing the mining companies to absorb reductions in net revenue as a means of achieving other

goals. At the margin, there will probably be deposits being exploited which yield very little, if any, rent, i.e. they only return sufficient to provide a "normal" return on invested capital. Indeed, if the Government or a company provides subsidies, we can find mines operating which are making losses or less than normal profits.

For the major mines listed, we can see that some have or are likely to generate a significant scarcity rent, while others are not.

<i>Mine</i>	<i>Scarcity Rent</i>
Tynagh (Zinc/lead/silver)	yes
Silvermines (Zinc/lead)	yes
Tara (Zinc/lead/silver)	yes
Bennetsbridge (Dolomite)	yes
Kingscourt (Gypsum)	yes
Magcobar (Barytes)	yes (Private owned minerals)
Milchem (Barytes)	?
Sligo Bay (Barytes)	No
Gortdrum (Copper/Mercury/Silver)	No
Avoca (Copper/Pyrites)	No

The bulk of the direct Government revenue from mining typically comes from the royalty and income tax payments made. In addition, taxes paid on dividends and by mine employees comprise revenue to the State. The tax yield from dividend payments is likely to be very small; the overall non-Government domestic share in mining profits is unlikely to exceed 20%. There is further tax income generated as the full multiplier effects of the sector work through the economy. As in the discussion of output and employment, these are the gross effects; in the absence of mining, some of the production factors would have been employed elsewhere in the Irish economy, thereby generating tax revenues.

Counter-balancing the revenue generating aspect, the mining sector also costs the state money. The Minerals Exploration and Development Division in the Department of Energy, the Minerals Division of the Geological Survey, and the mine safety officers of the Department of Labour must all be financed. Revenue from the sale of exploration licences, now amounts to more than £100,000 annually.

The main items of direct revenue and cost are listed over time in Table 4.6. Since most of the output of the mining sector is exported, very little VAT is paid, and likewise, the tax on domestic shareholders' dividends is thought to

*A factor of production — labour, capital, other inputs.

be very small. Thus, Royalties, Corporate Tax and Income Tax paid by employees are the main items of direct revenue. However, the linked sectors whose output is related to the output of the mining sector do pay VAT, while additional wage income is also generated on which income tax is paid. From Henry's input-output table we find that the direct multiplier for indirect tax per unit of final demand for Stone, Ores and Gravel is 0.0094 (attributable to the Stone and Gravel components) while the combined direct and indirect coefficient per unit of final demand is 0.0962 (Henry, 1980). The difference ($0.0962 - 0.0094 = 0.0868$) is the coefficient to apply in estimating the indirect taxes generated by the mining sector.

Applying this coefficient to total exports by value, for 1975-78 yields an estimate of indirect tax payments generated by backward linkage. Similarly, the difference between the direct, and the direct and indirect salary and wage multipliers per unit of final demand ($0.4653 - 0.3061 = 0.1592$) can be applied to total exports to yield an estimate of wages and salaries generated by backward linkage.

Multiplying this in turn by the average percentage of total wages and salaries paid in income tax provides an estimate of backward linked income tax paid (Table 4.7).

TABLE 4.6
Main Items of Direct Annual Government Revenue and Cost,
Mining Sector

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
000s £ Current										
Revenue										
Royalty	393	513	362	145	307	700	90	293	455	220
Tax	42	31	49	39	n.a.	2127	1215	3359	1400	n.a.
Total	435	544	411	184	n.a.	2827	1305	3652	1855	n.a.
Employee Income Tax (PAYE)										
Total	272	400	512	621	828	1045	1260	1540	2357	2300
Cost	707	944	923	805	n.a.	3872	2565	5192	4212	n.a.
Mines and Minerals Div. (Dept. of Industry, Comm. and Energy)		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	132
Exploration and Mining Div. (Geological Survey)		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	100	138
Total										270

Notes: Data for 1967-1972 only include the base metal mining operations. PAYE in 1969-72, 1973, 1974, 1975 and 1976-78 was estimated as 16%, 18%, 19%, 21% and 23% of wages and salaries paid. Wages and salaries for 1976-78 estimated as follows: Numbers Employed × Average Weekly Wage × 52. Costs of Exploration and Mining Divisions taken as 1/6 of total Geological Survey budget, based on personnel engaged.

Total estimated backward linked tax revenue in 1978 amounted to £5.587 million, yielding an average gross return to the exchequer of £114 per £1,000 of output delivered to final demand (exports in this case). In interpreting these data, the reader should be aware that there are two countervailing forces at work. On the one hand, since the household sector has not been incorporated in the endogenous portion of the model, the multiplier effects of household expenditure are not included, and to this extent the backward linked impacts are understated. On the other hand, in the absence of the mining sector, some of the factors engaged in the mining and related sectors would be employed elsewhere in the economy, generating output, employment, foreign exchange etc. To the extent that these impacts would occur in the absence of the mining sector, the direct and backward linked impacts are overstated. It would be comforting indeed if we could say with any assurance that these two forces exactly neutralised each other, but, unfortunately this is not the case. In addition, to this difficulty, input-output analysis has some inherent limitations.

These include: —

- (1) The potentially distorting effect of aggregation, as noted above, needs to be considered in interpreting the data.
- (2) An effect of the tax incentives facing Irish producers has been to discourage linkage. The distorting incentives will be partially removed in 1981, and this could influence (increase) the extent of intersectoral trade, thereby invalidating to some extent the 1976 coefficients.
- (3) The coefficients are average values, and should be applied and interpreted cautiously in evaluating marginal changes.

TABLE 4.7
Backward Linkage Related Indirect Taxes and Income Taxes
Generated by the Mining Sector, 1975-78, Current £ (000s)

	1975	1976	1977	1978	
Exports (000s £)	33,164	28,691	41,123	48,863	(1)
Indirect Taxes (Coefficient = 0.0868)	2,879	2,490	3,569	4,241	(2)
Wages and Salaries (Coefficient = 0.1592)	5,280	4,568	6,547	7,779	(3)
Average % of Wages Paid in Income Tax	17.3	18.9	17.9	17.3	(4)
Income Tax Paid	913	863	1,172	1,346	(5)
Total Backward Linked Tax Revenue Generated (2) + (5)	3,792	3,353	4,721	5,587	(6)
Backward Linked Revenues Generated per £1,000 delivered to Exports	114	117	115	114	(7)

Source: Coefficients estimated from Henry (1980).

- (4) The household sector was not treated as an endogenous sector, so that the inducing effects of payments to householders are not included in the analyses. This means that the multipliers listed understate the full output and employment impacts (but see (5) below).
- (5) The estimated impacts are gross rather than net. In the absence of the mining sector some of the factors engaged there and in the background linked sectors would have been employed elsewhere in the economy.

With these reservations in mind, we can now present the total significant direct and backward linked revenues generated for the exchequer by the mining sector (Table 4.8).

The mining companies also pay rates to the local authorities, but estimates of the amounts involved, or of the value of services rendered in return, were not available to us.

Development of Economically Deprived Regions

Kearns (1978) notes that it is at the local level that the impacts of mining are most profoundly felt. The mines at Tynagh, Co. Galway and Gortdrum and Silvermines, Co. Tipperary are located in rural areas with few non-farming employment opportunities available. The spending of wages and salaries in the area can rejuvenate a local economy. In this regard, Kearns (1975), observes that Loughrea, Co. Galway has been transferred into a relatively prosperous and thriving community, taking on some of the trappings of a boom town. Some infrastructure is also provided locally; in this category are the port facilities at Foynes, Galway, Arklow and Dublin which have been built to ship concentrate.

TABLE 4.8
Mining Sector: Direct and Backward Linked Revenues

	1975	1976	1977	1978
Direct (000s £)	2,565	5,192	4,212	n.a.
Backward Linked	3,792	3,353	4,721	5,587
Total	6,357	8,545	8,933	n.a.
Tax Generated per £1,000 delivered to Final Demand	192	298	217	n.a.
<i>Total Government Receipts</i>				
Corporate	26,530	29,644	69,652	105,843
Tax Receipts Other*	900,128	1,235,979	1,412,020	1,621,976
Total	926,658	1,265,623	1,481,672	1,727,819
Mining Related Receipts as % of Total	0.68%	0.67%	0.60%	n.a.

*Excludes sundry receipts and Post Office receipts.

Mining can also have negative effects. The high wages and salaries paid may inhibit other firms from locating their operations in the area. However, there may be no net loss to the State if potential investors locate elsewhere in Ireland. There will be pressure on roads and other public facilities such as schools, water and sewer systems; it may not be possible to re-coup the full additional costs imposed by the new users. Some local people may not welcome the attendant disruption and price inflation. Finally, mine closure poses especially severe problems for an area which has adjusted to the periodic payroll injection into the local economy. In addition, the people are left with a more or less unsightly mine site in their environs. This painful transition to a no-mine local economy has already been made at Gortdrum, and the problem will shortly be faced at Tynagh.* In Appendix J, we present a case study of mine closure.

Development of Indigenous Skills

The development of Irish mining has involved the training of a cadre of native miners; more than 95% of those now employed are Irish. This provides a pool of expertise to draw on if additional economically exploitable finds are made. However, this advantage is reduced by the fact that Irish mine workers tend to be unwilling to move from their own locality. In addition, the skills of underground miners, especially, are not readily transferrable to other occupations.

At the professional level, the mining boom has had an energising effect, especially on the profession of geology. The Geological Survey has been revitalised and enlarged, in part at least as a result of the expansion of mining activity, while new employment opportunities in exploration and mining have been created. The Universities, the National Board of Science and Technology and the Institute of Industrial Research and Standards have all significantly expanded their efforts in the minerals area. Irish mining has also provided an opportunity for the development of indigenous entrepreneurial skills; the extent to which the opportunities have been availed of is difficult to estimate.

*In July 1980 underground mining ceased at Tynagh.

CHAPTER 5

DOMESTICALLY CONSUMED MINERALS AND THE ECONOMY

This group is composed predominantly of aggregate minerals, including sand, gravel and stone (including limestone), and the fuel minerals consisting of coal and turf. We also include the downstream processing of minerals into cement, ready-mix, pipes, etc. in this category. This activity is included in the Standard Clay Products sector. While there is a small volume of exports, the bulk of this processed mineral output is consumed domestically.

Below can be seen the consumption of aggregate minerals for 1977:

Sector	Consumption (million tons)	% of total
Building (cement, concrete, mortar)	14.27	48.8
Transportation (roads, railway)	7.36	25.2
Farm related (Aglime, drainage)	7.51	25.6
Other (burnt lime, etc.)	0.10	0.3
Total	29.24	99.9

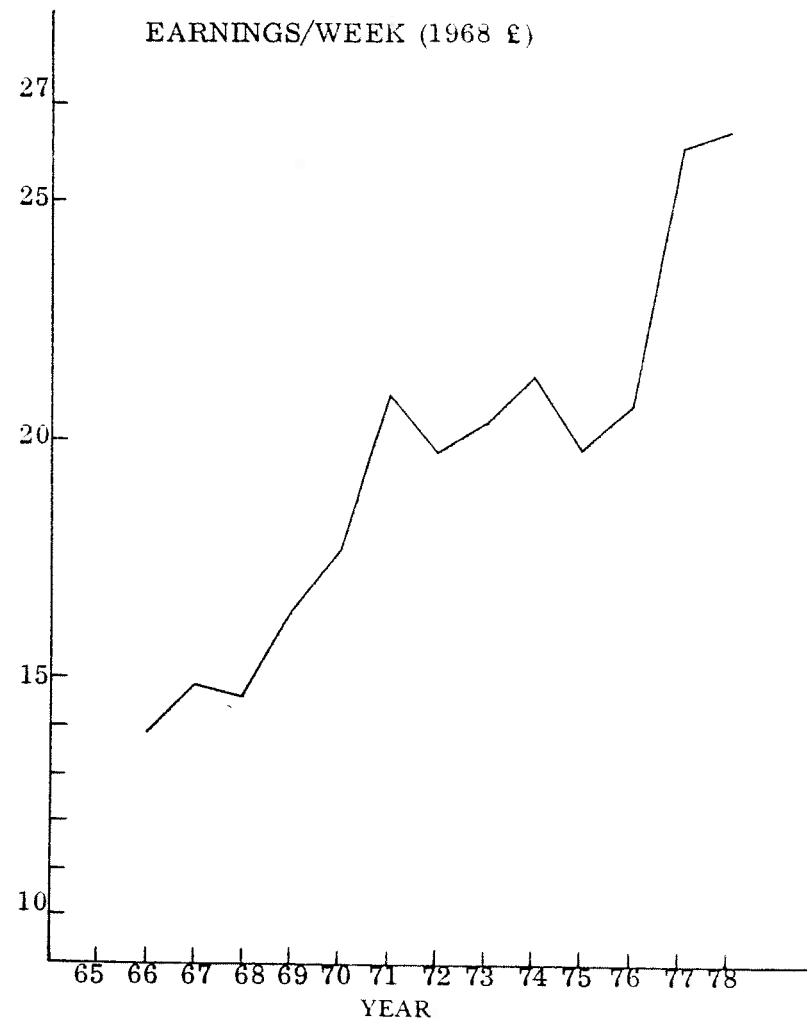
Source: Jerome Casey, Cement Roadstone Holdings Ltd., Personal Communications, August 1979.

It is clear that construction-related activity — building and road and rail construction and maintenance — is the principal determinant of demand for aggregate minerals, accounting for 74% of consumption in 1977; in the short-run, demand is residual. In the longer run, if domestically produced construction materials can increase market share by being more price competitive or technologically advanced than imports (aluminium, lumber, etc.), then output can expand even when construction related activity is constant or falling. Of course, the converse can also happen, if imported structural materials become more price and technologically competitive than domestic products.

Data on employment and earnings per week in stone, slate, sand and gravel, structural clay products (including cement production) and coal, turf, and bog development are presented in Figures 5.1, 5.2 and 5.3. Over the 1966-78 period examined, employment in stone, slate, etc. peaked at about 4,000 in the 1971-74 period, but has declined since then. Earnings per week in real terms have increased modestly over the period. In Structural Clay Products, employment grew sharply — by about 2,000 — from 1970 to 1975, but has

FIGURE 5.1
Stone, Slate, Sand and Gravel 1966-78

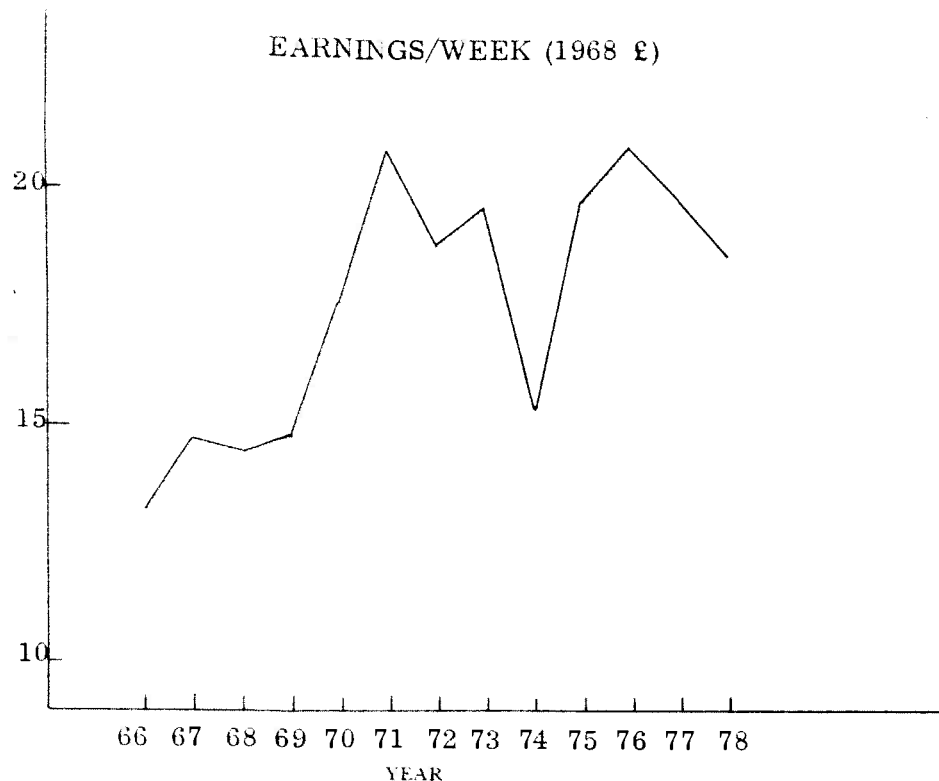
EARNINGS/WEEK (1968 £)



Source: Irish Statistical Bulletin, various issues. The actual figures are given in Appendix B.

since declined slightly. Weekly earnings have increased at a modest but fairly consistent rate over the period. There was a sharp and persistent decline in employment in coal, turf and bog development up to 1973; since then there has been a slight increase, generated by the intensification of investment in peat development initiated at that time. Average real weekly earnings in this sector have shown little variation since 1971.

FIGURE 5.2
Coal, Turf Production and Bog Development 1966-78



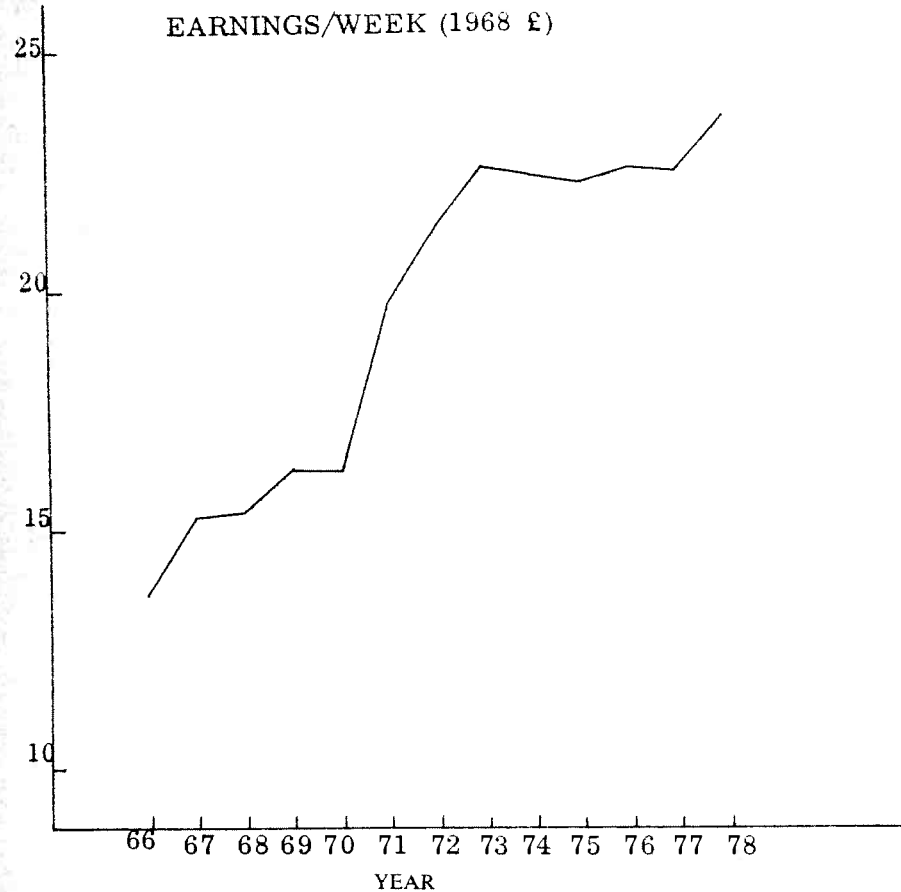
Source: *ibid.*

The Future

Construction expenditures in the aggregate has been static in real terms over the 1974-77 period, ranging from £201 million in 1974 to £207 million in 1977 (constant 1968-69 prices) (Baker, 1978, p. 132). During this period, reductions in outlays on housing and road construction have been counterbalanced by expansions in agricultural and industrial construction. As noted earlier, employment in the aggregate minerals and Structural Clay Products sectors fell over this period.

With regard to prospects for the next 10-20 years, we can anticipate some expansion in construction activity, with much of the growth occurring in infrastructure, agriculture and project (e.g. energy) development. However, significant growth in employment in the construction-related minerals sectors is unlikely; the capital intensive nature of the minerals supply and processing sectors and trends in labour saving technology imply that preventing a decline

FIGURE 5.3
Structural Clay Products, Asbestos Goods, Plaster, Gypsum, Cement, etc.



Source: *ibid.*

below the high levels obtaining in the early seventies will be an achievement. In the turf and coal sector also, the most optimistic prospect for the future is for maintenance or a slight increase in the current level of employment. The best hope for increased future employment is the discovery and commercial development of minerals with downstream employment-inducing potential, such as pottery clays.

We can say that the sectors producing minerals primarily for domestic consumption make a major contribution to the economy, employing about eight times the number engaged in the metallic minerals sector. However, for the reasons noted above, prospects are modest for expanding employment beyond the levels achieved in the early seventies.

CHAPTER 6

THE ISSUES¹

The Future

We have seen that the principal internationally traded minerals produced in Ireland now provide direct employment for 2,100 persons and generate about a further 1,600 jobs elsewhere in the economy, for a job total of 3,700.

It is difficult to estimate the extent of foreign exchange earnings. In 1977 exports were valued at £41.123 million. Applying the direct plus indirect multiplier of 0.162, (Henry, 1980) associated imports are estimated to amount to £6.662 million, leaving a balance of £34.461 million. Of the balance, £1.855 million went to pay taxes and royalties, while wages amounted to £10.248 million. However, some of the wages will go to buy imports, but this will be balanced by expenditure on domestic goods and services, and on profit and interest payments made to Irish residents. Total dividends paid out by the metals mining sector in 1966-78 amounted to almost £35 million, equivalent to almost £68 million in 1979 £. It has not been possible to identify the proportion of this that stayed in, or returned directly, to Ireland. Estimates of the tax/royalty take in the 1969-77 period are presented in Table 4.6. Altogether, it seems likely that the net balance of payments effect fell in the range of £14-18 million in 1977.

The Government revenue generated directly by the mining sector in 1977 was £4.212 million. An estimated further £4.721 million is generated indirectly, for a total take by the Exchequer of £8.933 million, amounting to 0.6 per cent of total tax receipts.

While these contributions are by no means trivial, in the context of the national economy they are not of great significance. Can the contributions of the sector be increased in the future? Looking first at employment, we can see from Table 6.1 that both Tynagh and Silvermines are likely to be closed by 1985.* Avoca continues to have difficulties, and its future is by no means secure. On June 13, 1980, the Minister for Energy announced that additional

¹The information in the following Chapter is based on conversations with several knowledgeable individuals, and journal and newspaper articles. These include Blake (1978), Farmer (1975), Dowling (1977), Tansey (1979), Walsh (1979) and an unsigned article titled "The Smelting Saga" in *Irish Business*, July 1977 pp. 29-31.

*In July, 1980, underground mining ceased at Tynagh.

finance was being provided for Avoca Mines Ltd. He noted that a Supplementary Estimate had been approved by the Oireachtas in April, 1979 to provide State support amounting to £4.35 million for this firm, and observed that the break-even price per ton of copper would be about IR£1,300, compared with the current June 1980 market price of about IR£920.

TABLE 6.1
Employment in Metallic Minerals Mines and Exploration, 1965-78^(a)

	Tynagh	Gortdrum	Avoca	Silvermines	Navan	Explora- tion ^(b)	Total
1965	185	11	—	28	—	87	311
1966	262	30	—	90	—	135	517
1967	295	102	—	274	—	151	822
1968	329	111	—	454	—	161	1,055
1969	357	155	—	534	—	111	1,157
1970	391	248	307	544	—	148	1,651
1971	390	247	328	550	17	131	1,663
1972	372	242	325	571	27	109	1,646
1973	361	249	373	588	43	100	1,714
1974	380	240	351	582	66	110	1,729
1975	375	Closed	186	561	83	110	1,315
1976	393		189	568	438	110	1,693
1977	404		209	560	677	110	1,960
1978	397		223	560	759	110	2,049
1979							
1980	Closure			To close in 1983?			

Notes:

^(a)The data are industry estimates; the numbers do not sum exactly to the official totals presented in Tables 4.1 and 4.2.

^(b)The employment in exploration from 1974-78 is an estimate.

Source: Industry sources.

Bula Mines Ltd. may have started production by 1985, but both planning permission and full project financing have yet to be received. This means that within five years we can plan definitely on only about 800 jobs at Tara, and even these could be threatened by a further zinc metal price collapse. With Avoca continuing production, with Bula operating and with a continuing exploration programme, we could expect a total of about 1,400 jobs to be provided, a drop of 700 from the present total. A further 1,000 positions would be provided in the linked sectors. Thus, even with an optimistic scenario, the 5-10 year outlook is not promising.

The extraction of the non-metallic internationally traded minerals — barytes, gypsum and dolomite — only provides employment for 200-350; separate estimates of employment for these minerals are not available. While some expansion of output may be expected, the additional direct employment generated thereby will be modest, adding probably not more than 100 jobs. If a major discovery is made of say, base metals or uranium, the longer term

outlook would improve. A sense of the magnitude involved can be provided by examining optimistic and pessimistic scenarios for the future. If finds in the aggregate of the magnitude of the Navan orebody are made every 7 years — a most unlikely occurrence — this would add 2-3,000 direct jobs by the year 2,000, with an additional 1,500-2,300 jobs generated in the backward linked sectors. Thus, the most optimistic long-term (10-20 year) scenario would be provision of employment from existing mines of 1,400 (direct) and 1,000 (indirect) for a total of 2,400 jobs provided, with a further 2,000-3,000 (direct) and 1,500-2,300 (indirect) generated by new discoveries. The total (direct and indirect) employment provided under this most optimistic of outlooks would fall in the range of 5,900-7,700 jobs. Since current employment generated by the mining sector is about 3,700, this represents a marginal gain of 2,200-4,000 jobs.

The pessimistic scenario would have no new finds, no start-up by Bula, closure by Avoca, Tynagh and Silvermines, and a withering of the exploration effort. This would leave Tara as the sole employer, generating 800 jobs (direct) and 600 (indirect) for a total of 1,400, a marginal loss from current employment of 2,300. With regard to employment, therefore, in the future the spread of variation from the present is likely to range from a loss of 2,300 jobs to a gain of 7,700 jobs. It is clear from the magnitude of these numbers that the internationally traded minerals sector as such is not going to be able to play a very significant role in ameliorating the nation's unemployment problems, in terms of mining-based employment generated.

What of the smelter? If this were built it would provide jobs for 450 (direct) and 340 in the backward linked sectors, for a total of 790 jobs. The great imponderable is the extent to which a smelter would give minerals processing and metal fabricating activities a sufficient comparative advantage so that operation in Ireland would be profitable. In view of the current predominant uses for zinc metal, we expressed scepticism earlier that a zinc smelter would trigger much in the way of forward linked economic activity. We were not able in the time available to do the careful type of investment analysis of possible smelter-related activities which would provide the necessary information on the financially feasible opportunities in this regard. However, the very modest linkage generated by smelters in the Netherlands does not provide much basis for optimism.

Overall, it seems reasonable to conclude that the marginal gains in employment generated by the mining sector over the next two decades will not be dramatic. The reader may wonder at the apparent unconcern with which we apply the employment intensities and multipliers of today in estimating future employment. We do so partly because of the difficulties inherent in usefully incorporating technical change in our estimations, but mainly because the changes which are likely to take place will tend to re-

inforce the point that the minerals sector cannot be looked to directly as a large-scale provider of jobs. However, it may be able to play a significant role in providing resources in the form of cash payments to the government, which can then be used elsewhere to provide income and employment. The extent to which it will be able to do so will depend on the magnitude of the scarcity rents available, and on the extent to which the surplus is invested in wealth and job-producing activity in Ireland.

For Tara, we can make a rough estimate of the surplus available. Below are presented the values of a ton of lead and zinc concentrate and ore, ex mine, at three alternative metal price levels (1979 \$).

Metal	Metal price per ton	Concentrate Value ex-mine/Ton	Ore Value before concentration* /Ton
Zinc (\$)	1,100	284	52
	800	200	36
	600	169	31
Lead (\$)	1,330	481	16
	1,108	394	13
	665	310	10

*For zinc it is assumed that the average concentrate grade is 55 per cent, that ore grade is 11.0 per cent and that the concentrating efficiency is 91 per cent; for lead it is assumed that the concentrate grade is 63 per cent, that the ore grade is 2.4 per cent and that the concentrating efficiency is 85 per cent. Value per ton of ore = Concentrate Value / (Concentrate Grade / Ore grade × concentrating efficiency). Lead price converted from £ sterling to US \$ using a conversion rate of 2.216.

The formulae used to derive concentrate values were as follows:*

Zinc Concentrate Value = Producer Price × 0.281 - 25

Lead Concentrate Value = LME Price × 0.59 - (69 + 0.2 (LME - 258)) × 2.216

Taking the highest and lowest combinations, we find value per ton of concentrate falling in the range of \$68 - 41, or, converting to Irish £ at a conversion rate of 2.06, falling in the range of £33 - £20. These ranges may be conservative; if for example, we express in 1978 £s the peak zinc metal price of \$789/ton which occurred in 1974, we find that it would be valued at \$1,500, adjusted to 1978 using the wholesale price index. However, while over the 25 - 35 year projected life of Tara we may expect one or two high peaks of this order, the bands identified are thought to represent the more likely year-to-year operating price range, in 1979 £.

At optimum efficiency it is thought that operating costs (including wages and salaries, maintenance, spares, rates and administrative costs) will amount to £11 per ton of ore mined. There will, in addition, be £4-5 million of expenditure required annually for capital equipment replacement; since it is anticipated that 2.3 million tons of ore will be treated annually, we add an additional cost of about

*The reader is referred to Appendix E for the derivation of these formulae (available on request from NESG).

£2/ton for capital equipment replacement. Major development expenditures will also have to be incurred from time to time. It was not possible to derive estimates of what these might be; if we allow an annualised amount of £2/ton (about £4.6 million/annum) for this requirement, that gives us a total cost per ton of ore produced at $11 + 2 + 2 = £15$. Thus, at optimum production, assuming the price ranges provided, the "surplus" available to cover principal and interest charges, taxes and profits, could fall between £18 and £5 per ton. With a total annual production of 2.3 million tons of ore, this would leave a total "surplus" annually in the range of £41.4 - £11.5 million (1979 £).

Clearly, a number of caveats must be entered. Since we have used constant 1979 £, the assumption is implicit that costs per unit of output will remain constant in real terms, while prices are adjusted above or below the 1979 level. We have assumed that optimum output can be achieved and sustained. In deriving ore value, we applied general industry operating and market coefficients to this particular firm. Changes in exchange rates, e.g. a falling Irish pound vis-a-vis £ sterling or the US dollar, will lower costs relative to revenues, and vice-versa. Strikes and other stoppages will increase unit production costs. In 1978 Tara had to pay £7.84 million to service its long term debt. This, together with amortisation costs, high unit production costs and low metal prices combined to produce a loss of £5.19 million for that year.

If the company can meet its heavy debt repayment schedule over the next 5 years, we feel that it is reasonable to assume that, beginning about 1985 net cash flow before tax in the order of £10 - 35 million per annum can be realised. Little or no tax or royalty payments can be expected before then primarily due to tax allowances. Interest charges will range from about £8 million in 1979 to £2 million in 1983/84, dropping as capital is repaid. The annual return to the exchequer thereafter will be of the order of £6 - 21 million (1979 £) annually, including tax, royalty and dividend payments. At the maximum level, this would represent 20% of total tax paid by corporations, and 1.5% of total Government receipts (excluding the Post Office and sundry receipts) in 1978. To what extent the balance of the surplus accruing remains in Ireland will depend on the decision of the other (mainly foreign) shareholders concerning the disposition of their returns.

At full production, Tara will be producing 400,000 tons of zinc concentrate and 70,000 tons of lead concentrate annually. Applying the range estimates of concentrate prices used earlier, we find that annual gross output value should fall in the range of £147.27 million - £89.3 million (1979 £). The Government take will help ensure — especially at the higher prices — that a significant amount of the scarcity rent accruing will stay in the country and make a positive contribution to the balance of payments.

Issues for Analysis

In reviewing the development of Irish minerals policy, we can say, in view of the foregoing, that, from a national welfare point of view, broadly speaking policy has evolved in the right direction. The early policy depended entirely on the employment generated (directly and indirectly) and on a very modest royalty to capture the benefits of the country's minerals' patrimony for the nation as a whole. In any highly capital-intensive endeavour, depending almost exclusively on employment and linkage effects to garner the benefits is likely to prove unsatisfactory for a number of reasons. By definition, compared to the total resources committed, labour's share is small. Putting the entire onus on this factor to recoup most of the benefits for the nation provides too narrow a base for this task.

Depending on linkage to generate benefits is likewise apt to be unsatisfactory for this purpose; there is very little linkage in Ireland, in part because we have designed our incentives such that they discourage its development. So long as manufactured goods exported are exempted from payment of corporation tax and VAT, while sales to firms within the country are liable for both, there is a powerful incentive to bypass internal sales opportunities in favour of direct exports. While there are plans (now acted upon) to help eliminate this asymmetry in the incentives facing producers by having a uniform 10% corporation tax for all manufacturing industry, it will be some time before the distorting effects of the existing provisions are eliminated. In addition, VAT will still be payable on internal sales but not exports, while non-manufacturing firms will be taxed at the "regular" corporation tax rate. This will result in underinvestment at the margin in the service sector relative to manufacturing, so that service-sector linkage will be less than would probably obtain under uniform tax treatment.

Large capital intensive projects also tend to impose substantial administrative, service and environmental costs. It can take a considerable allocation of tax payers' resources to achieve appropriate review of proposals, in compliance with the requirements of the Planning Acts and other legislated requirements. Involvement in site selection and planning will typically be substantial, while grants to the maximum per capita level allowable will often be paid. Service costs, in terms of providing infrastructure e.g. roads, water, power etc., will sometimes be subsidised, while it may not be possible to recover the incremental costs of police protection, health and education services, water and sewer servicing etc. from the workers and their families who receive these publicly provided benefits. Finally, large capital intensive projects often impose significant external environmental costs, which may be simply aesthetic in nature but may also have adverse economic and health — risk implications. All of these costs must be weighed in the balance with the anticipated benefits.

The above is not at all an argument against encouraging capital-intensive projects *per se*. However, we are arguing that in the near absence of profits' taxes and the lack of scarcity value prices for water and other services, where infrastructure is subsidised and linkage is weak, the taxpayers will probably often not in many cases be able to recoup their total investment in capital intensive projects. What is needed is a framework that allows pricing of publicly owned factors at their scarcity value, and a tax regime that allows the public to at least recover their costs, broadly defined. One could envisage undertaking a full-blown benefit — cost analysis wherein factors and outputs were shadow priced at their marginal social value, as suggested by Ruane (1979), or a less ambitious effort to at least inventory the trade-offs.

Mining is exceptional among capital-intensive projects in Ireland in that on the one hand, the State does not in general provide grants or subsidise infrastructure,² while on the other, it does tax away some of the scarcity rent accruing. Thus, the general thrust of minerals policy has been in the right direction, but there are a number of aspects which seem to offer prospects for improvement. Major concerns in this regard relate to the neutrality of taxation vis-a-vis other investment opportunities in Ireland and abroad, and to tax regimes which might be most consistent with the national interest. The objective is to design a system that will continue to attract investment so as to maximise the present value of the rent accruing to the people of Ireland (broadly defined). In Section III — 5 chapters — taxation issues are discussed.

There are other factors which influence both the level of investment in Irish mining and the magnitude of the rent accruing. One of these is the level of uncertainty faced by the potential investor. Other things being equal, the more uncertain the outcome, the less investment there is likely to be undertaken. There are three major institutional sources of uncertainty in Irish mining. The first is the mineral ownership question; can the firm finding an orebody be assured that it will be allowed to reap a fair share of the benefits resulting from its exploitation? As noted earlier, an effort has been made recently to mitigate this uncertainty through legislation. However, there are also non-legislative complementary actions which bear consideration, and these will be discussed.

Another source of institutional uncertainty is the fact that the terms of the mining lease are not negotiated until the stateowned minerals in question have been discovered and proved. This was not a disincentive to investment so long as there was a *de facto* understanding that whatever the precise nature of the terms negotiated, they would consist of only a modest royalty charge in the form of a share of the profits. However, the change in the tax regime in 1974, combined with the protracted lease negotiations involving Tara, permanently disposed of the earlier congenial (to the mining companies) arrangement, without replacing it with a new set of conditions which the mining firms can expect to obtain when it comes time to issue a lease.

The final source of uncertainty is the recent announcement that a State Mining Company may be established. Exploration licences are issued on administrative/discretionary bases (i.e. they are not sold by sealed auction or some other "neutral" mechanism). Unless the State company is clearly discriminated against, by being given the least desirable areas, it will be difficult to demonstrate to the private sector that favouritism is not being shown to the public firm. Every time the State Mining Company is given a licence in preference to a private firm, this will add to the already high level of paranoia in the private mining side, and tend to reduce private sector investment. In the next chapter we discuss these sources of uncertainty. In the chapter following we examine some institutional considerations relating to the development and implementation of minerals policy.

CHAPTER 7

SOURCES OF UNCERTAINTY

The three important sources of uncertainty referred to in chapter 8 which can be mitigated are the uncertainties concerning minerals ownership, lease terms and the proposed State Mining Company.

Minerals Ownership

We are not competent to evaluate the adequacy of the Minerals Development Act (1979) in terms of its constitutionality or its ability to "solve" the ownership problem. However, there are two actions which would complement this legal initiative. It can readily be demonstrated that an inability to capture the full benefits of an investment will result in a level of input into the activity in question which is less than that which is socially optimal. Benefits which cannot be captured by the investor are called external benefits. Investment will not proceed to the point where total marginal benefit is equal to marginal cost, but only to the level where marginal private benefit is equal to marginal cost. The effect of the existence of external benefits is underinvestment and a less than optimal level of output. This has its analogue on the cost side, where the existence of external costs results in a level of production in excess of the socially optimal level. The problem is compounded when uncertainty enters the picture. If the investor does not know whether he is likely to capture the entire value, or lose the whole thing, and cannot assign probabilities to the outcomes, the incentive to under-invest is increased.

The benefits generated by the mining sector were discussed earlier. In looking to the future, an attempt was made to identify these benefits at the margin, although no effort was made to express them in a common metric. We can assume that providing more income, employment, tax revenue, foreign exchange earnings etc. is in the public interest; uncertainty regarding the right to work minerals will reduce investment in exploration and development, thereby reducing the flow of these benefits to society. There is, therefore, an unambiguous public interest in ensuring that difficulties concerning tenure do not inhibit their realisation.

As long as private owners are assured of the opportunity to get fair market value for their property, the case is compelling for providing some type of tenure protection to the exploring companies. We belabour this point because if and when the constitutionality of the new law is tested, it is important that

the stake which society as a whole has in the matter be weighed in the balance against any rights foregone by individual owners.

Guidelines for Owners

Another way of helping to minimise problems in the tenure area is to assist private mineral owners to understand what is a reasonable and mutually advantageous negotiating stance. In particular, the concept of a contract which would give the explorer a legal right to any mineral finds and with negotiating terms specified in the event of a commercial discovery, could usefully be developed and then promoted. Since there is widespread misunderstanding of the minerals industry, together with some mistrust of the motives of mining companies, the initiative and leadership in developing the contract guidelines would be more effective if it came from a third party. The State's mining lease terms would provide a useful starting point. The farming organisations, the legal fraternity, auctioneers and land valuers, agricultural advisers etc. could all play a useful role in developing and/or disseminating guidelines, while the Government itself could also play a role. If a point could be reached where mining companies could explore without fear of having any commercial discoveries capriciously lost to them, and where private mineral owners could be assured that the mining companies would treat them fairly, there would be little need for further intervention. In the US for example, mining companies often appear to be able to negotiate mutually satisfactory arrangements with private mineral owners without major difficulty. The Minerals Development Act (1979), by vesting the right to work minerals in the Minister, may however, make such a two-party negotiating approach redundant.

Lease Terms

At present, each mining lease for State-owned minerals is negotiated on a case-by-case basis. There are two advantages to this approach. First, it maximises the flexibility of the Minister and his or her civil servants in responding to changes in the political mood. Secondly, it means, in theory at least, that the lease terms can be tailored to the individual circumstances of each mine, thereby maximising net returns. However, there are a number of disadvantages. The most important drawback is that it simply adds an additional imponderable to the already uncertain environment faced by the potential investor in exploration. Minerals policy is a popular focus for public interest and scrutiny, and this means that every lease negotiation concerning a substantial orebody will probably be both protracted and acrimonious. The ideological cudgels will be unsheathed and all the old battles re-enacted. This can have the positive aspect of adding colour and vitality to sometimes lacklustre political debate, but it can be ruinous financially for the company involved. If significant pre-development e.g. sinking shafts, etc., has had to be made in proving the deposit, the firm can find itself with substantial

outgoings, but with the onset of revenues postponed as negotiations proceed. This can impose financial difficulties resulting in an over-leveraged investment when production does finally get underway, while it also facilitates the take-over of the firm making the discovery by larger firms with more ready access to capital. The delay may also mean that the mining company misses producing output at the high point of the mineral's price cycle. Finally, while it is not inevitable, there will be a tendency for the Government of the day to have to 'prove' its ability to negotiate successfully with the mining interests involved. Since symbol is at least as important as substance in such matters, this can give rise to rhetoric which feeds back to inhibit investment in the discovery part of the cycle.

We feel that on balance, it would be far preferable to have publicly available fixed lease arrangements in existence which would comprise the core elements of all State mining leases. These provisions would have to be so calibrated that they captured some (but not all) of the so-called windfall gain in terms of high prices, with the proportion of the take reducing as profits fall. It would need to be applicable to a variety of mines, ranging from those producing large scarcity rents to those which are economically marginal. Finally, and most important, it would have to be perceived as fair and satisfactory by a large majority of the citizenry. Anything less would inevitably result in continuous pressure to change or modify the provisions as each discovery was made, thereby negating the advantage of fixed lease arrangements.

At the conclusion of our discussion of taxation we set out three taxation/royalty/state equity options which in our view provide a sensible basis for considering alternatives. These and/or other alternatives should be widely circulated and discussed, with a view to arriving at a widely acceptable set of lease provisions which will maintain a desirable level of activity in the mining sector. The time would appear to be propitious for this type of dialogue. We have learned a lot in recent years about the operation of the mining industry; the passionate intensity which characterised earlier debate has matured to a more realistic understanding of the possibilities. If on the other hand we do not move towards fixed lease terms, and another major discovery is made, the debate on lease policy will re-commence, but in an atmosphere much less congenial to rational discussion than before.

State equity

The extent, if any, to which the State should take an equity share in companies mining a State or privately owned ore body is an issue requiring particular attention. To a large extent it is a matter of political philosophy, but it may be useful to mention the non-ideological advantages and disadvantages of equity participation. One important advantage is that it can help give the

public confidence that their interests will be protected; whether this feeling is warranted or not is a separate issue. It can also help educate the Government officials, through its nominees on the board, concerning the intricacies of company operation. In particular, if a company is pursuing policies inimical to the welfare of the general public, for example, by using low transfer prices for its products, thereby reducing or avoiding tax payments, the Government's nominees can, in theory at least, become appraised of it and take appropriate action. However, it is important to note that the board on which the Government sits is typically a subsidiary. If the majority of the equity is held by the Government, the overall policy and management direction will of course reflect the public interest as perceived by the directors and the Government of the day.

Among the potential problems are the familiar difficulties of effectively managing a firm where there are several potentially competing objectives to be aimed for. In the case of minority equity participation it may be difficult for the Government nominees to work for profit maximization on behalf of the firm, and also represent the public interest in other, often not clearly defined, aspects. At worst, this can have an immobilising effect on the firm if the Government nominees have to frequently refer back to the Government before they can take a position on major issues. We are informed that this latter situation has not as yet arisen in Ireland. The taxation-related problems with free State equity are discussed in chapter 13.

It is difficult to assess the impact on private sector investment of a firm policy on the part of the State to take equity in the company formed to mine a State-owned ore-body. Companies are resilient and will adapt to such a provision fairly readily if there are still profits to be made. However, because of the potential administrative and other complications noted above, many companies on balance, probably prefer, for example, an arrangement whereby 60% of profits were paid to the Government through the medium of taxes and royalties than pay the same amount, but as a result of equity share by the Government.

In evaluating the desirability of direct State participation, the following issues need to be addressed:

- (1) In what manner, and to what extent, do the actions of the private firms result in a divergence from the public interest, as expressed in terms of scarcity rent, foreign exchange earnings, employment, etc. foregone?
- (2) What are the opportunity costs (benefits foregone), if any, required to achieve "convergence" with the public interest?
- (3) Are there other means whereby the public interest can be served?

The minerals policy framework now in existence in Ireland allows us to ensure that private sector behaviour works harmoniously in the public interest. With a few minor modifications, taxation and royalty charges can be used to capture the bulk of the scarcity rent for the public.

The job generating capacity of the mining sector *per se* is modest. It is a very expensive means of generating employment. To illustrate this point, we can take the case of Avoca Mines Ltd. Over the years the State has committed about £4 million in support of this company, an average of £18,000 per worker employed; this compares with an average total capital cost per job provided in overseas grant-aided firms of £15,500 in 1977. It is true that the State support to Avoca is an advance, secured by the assets of the company. However it does indicate the magnitude of investment required to sustain employment in this sector. Employment at a particular mine is by definition of finite duration, and the skills acquired are not especially transferable to other occupations. All of these considerations taken together lead us to conclude that mining is a particularly inappropriate vehicle for subsidising employment. One can't easily therefore justify using State equity (or other rationales) to maintain or expand employment beyond what would be sustained on commercial grounds. However, this justification for State equity has never been proposed in Ireland.

The lease specifications can be used to ensure a degree of compliance with other State objectives. In the case of mining, therefore, the taxation, royalty and lease provisions taken together can be used to ensure fairly close coincidence of private firm behaviour with perceived public objectives. This is not of course by any means a conclusive argument against State equity. It is quite clear from experience in Ireland and in other countries that if necessary people will forego efficiency and other benefits in order to have the psychic satisfaction of full day-to-day collective control over the management of their resources. The extent to which this sentiment exists in Ireland and is reflected in policy is a matter for political judgement.

We have confined the discussion of State participation up to this point to the case where a private company finds an economically exploitable, State-owned ore-body. It has recently been suggested that a State Mining and Exploration Company be established.

State Mining and Exploration Company

The proposal to establish a State Mining and Exploration Company was announced by the Minister for Industry, Commerce and Energy on June 20, 1979. However no definite terms of reference had been announced at the time of this writing (September 1st, 1979). However, we understand that if a decision is made to create a public company of this nature, it will operate as a

limited company entirely separate from the Department of Industry, Commerce and Energy, including the Geological Survey Office. It will not receive preferential treatment in terms of access to technical data, in the allocation of prospecting licences, etc., and it will explore for the full range of minerals.

The key advantage of a State Company of this sort is that, in the event that it discovers an economically exploitable deposit, presumably a larger share of the scarcity rent accrues to the public than would be the case if it were found and exploited by a private concern. If the equity/royalty/tax share amounts to a 60% share of the private sector mining profits, the remaining 40% is available as return to the investor; it is the desirability of capturing this return for the general public rather than the private investor which provides the key rationale for State involvement. Of course out of this 40% must be paid the "normal" return on invested capital; the true "scarcity rent" available may be negligible. There are two ways in which any available surplus could be lost to the public. If the State mining company were less operationally efficient than the private firms, a portion, or all of the available surplus could be dissipated through inefficiency. The second potential source of loss would be if the State company, instead of distributing dividends (over and above normal taxes and royalties) to the shareholders (the public) were to consistently retain all or most of the funds for relatively unproductive investment. This could result over time in over-investment, i.e. the dissipation of the surplus in non-commercial investments which had insufficient countervailing social merit. These are difficulties which an appropriately chartered company with effective management can overcome.

The less tractable problem results from the potential for negative interaction between the public company and its private sector competitors. A threshold effect is likely to manifest itself here. If the public company competes aggressively with the private companies, there is a good chance that they will feel that the competition is unfair, and reduce their exploration activity or withdraw entirely. Conversely, if the State Mining Company is punctilious about avoiding the appearance of being favoured, it will probably remain confined to a minor role.

Useful arguments can be made for two modes of State involvement different from that now envisaged. The first would be to explicitly confine the State Company to those areas and/or minerals which are not now very actively being pursued by the commercial interests. The economic rationale for this approach is that the market incentives fail in the sense that companies are myopic and risk-averse in their investment and decision-making, tending to confine exploration to areas and minerals with proven potential. The role of the State Company would be to establish the commercial credibility of

unproven areas and minerals, thereby encouraging private exploration investment in these areas. If commercial deposits are discovered, they could be sold by sealed bid auction to private investors. While in theory the State can spread its risk more readily than can a private company, in practice the necessity of short-term public accountability may make public sector decision-makers more risk-averse than their private sector counterparts.

The second approach would be quite the opposite of that described above, namely the development of the State company as the predominant force in exploration. As noted earlier, this may happen by default as a result of the favoured position of the State Company, (whether real or not) as perceived by the private companies. In exploration there are substantial economies of scale in information gathering and interpretation. The company which has the whole background on an area will typically have more than twice as much information as two competing firms each of whom have half the story. In theory a single company could take advantage of these economies. The apparently successful mineral exploration and development efforts of some of the centrally planned Eastern European countries provide evidence that monopoly power and State control need not be inimical to minerals' discovery and extraction, in spite of the inevitable loss in diversity and competitive spirit.

We touch on these matters not with the intention of recommending a particular level and form of State involvement, but rather to identify some possible implications of various approaches. We do feel that if the private sector is to be encouraged to continue to participate, where possible the degree of uncertainty facing decision-makers in the business should be reduced, with particular reference to taxation/royalty/lease terms.

CHAPTER 8

INSTITUTIONAL CONSIDERATIONS

Minerals policy has evolved and changed rapidly in Ireland over the past decade. We have moved from an approach with minimal direct State involvement to one where the State is a substantial shareholder in mining enterprise.

There are two units of Government primarily involved in helping develop and implement minerals policies. The Minerals Exploration and Development Division of the Department of Energy plays the central role in developing and implementing policy. The Geological Survey Office helps implement policies concerning the issuance and renewal of exploration licenses, does basic geologic mapping and a very modest amount of exploration work. The issues concerning which the Survey provides advice to the Department include lease terms, prices to be charged for some State minerals, and the manner and extent to which the State should support mining companies which are in financial difficulty.

The Minerals Division in the Institute for Industrial Research and Standards (IIRS) provides technical expertise regarding the industrial uses of minerals, and also provides information concerning mining and minerals, primarily through the medium of *Technology Ireland*, a journal sponsored by the IIRS. In addition to these three, there are other Government units which are active on the periphery in implementing minerals policy. These include the National Board for Science and Technology (NBST), which plays a planning and co-ordinating role vis-a-vis research funded in part by the EEC, and the Department of Labour which employs Mine Safety Officers. We have already discussed the issue of a State Mining Company, and will not examine the matter further here.

How appropriate is this institutional framework for developing policy options, and for implementing policies, once adopted? Since 1967 a sustained effort has been made to expand the Geological Survey Office, while the IIRS and NBST have also initiated and then expanded their involvement within the past decade. There is a separate Minerals Exploration and Development Division in the Department of Energy dealing with land-based minerals. Thus there has been quite a significant investment by the State in minerals-related expertise in recent years. The following issues are of interest:

- The extent to which it would be useful to re-group or consolidate the existing organisations and personnel.
- The extent to which the skills now at the Government's disposal are adequate.

Re-Organisation of Existing Units

It was suggested to us by a number of individuals that either of the following two approaches would improve effectiveness:

(a) Concentrate all of the necessary skills and expertise at the Departmental level. In this framework, the required individuals from the Geological Survey Office, the Institute for Industrial Research and Standards, etc. would all be formed into an integrated team under a single director, operating within the Department. Appropriate persons would be hired to provide any necessary skills which are not already available in the Government service. This system has been implemented in the case of the Petroleum Affairs Division, to deal with off-shore leasing and development. We were unable, in the time available to us, to independently evaluate the success of this approach. However, a number of knowledgeable individuals indicated informally to us that it was quite effective and successful. The situation with regard to land-based minerals differs at least in degree from that which obtains in the case of off-shore petroleum. In the case of the former, there are a much wider range of minerals to be dealt with. As a result, geological and economic circumstances, legal aspects, etc. all vary widely, and there are a large number of clients. The size of the team required to effectively manage the diversity of minerals and interests involved might be too large to easily become an integral part of the Department.

(b) Another institutional mode which has been suggested is the formation of a semi-state body such as a Minerals Development Board. This unit would be responsible for implementing minerals policies. Analogous to the case of (a) above, most of the necessary expertise would reside in the staff of the Board. This would be accomplished by transfer of the relevant personnel in the Geological Survey Office, IIRS, etc. to this unit, and by adding skills not already available. There would, in addition, be a small minerals policy group within the Department, responsible for policy development. This approach seems to be consistent with the organisational concepts propounded by the Devlin committee. It would have the following advantages:

- (i) the Board would be relatively free of the requirements to justify budget expenditures, personnel hiring, etc. on the item-by-item basis which characterizes routine civil service operations. This flexibility would increase the speed with which the organisation could respond to changing needs and circumstances.

- (ii) the Board could easily engage in commercial transactions, such as, for example, acting as a holding company for State equity in mining companies, or investing in joint ventures.
- (iii) the Board could readily become a service unit, encouraging and assisting the mining companies by providing geological information, maps, rapid processing of exploration licence requests, information on mining techniques, minerals markets, safety and environmental regulations, etc. Informing the public regarding the mining sector would also be a specific responsibility.
- (iv) the policy unit in the Department would be freed from routine work, and could concentrate its efforts on the analysis of major policy issues, the answering of parliamentary questions etc.

The services listed in (ii) and (iii) above are already available in some degree from various sources. We are suggesting that it may be possible to improve the timeliness and quality of what is offered by vesting responsibility for their provision in a single organization which has both a clear mandate to promote minerals exploration and development, and the budget, managerial flexibility and personnel to do so.

This approach also has disadvantages. Any re-structuring is disruptive in the sense that time and resources are necessarily absorbed in adjusting to the new situation; these resources would presumably otherwise be used to help fulfill the primary responsibilities of the agencies involved. There may be costs incurred, in terms of lower morale and effectiveness, in the units which "lose" personnel. For example, the Geological Survey Office might be impaired in these respects as a result of enactment of this proposal. Finally, if an organization such as this is very successful, it can achieve an autonomous political momentum which makes it all but immune from policy guidance.

There are other choices, such as maintaining the existing organizational structure, and adding personnel where required. What skills are lacking in the existing State system?

Skills

Although much of the impetus to expand and upgrade the Geological Survey Office appears to have been provided by the activity in the minerals sector, we were surprised to find that only 5 full-time professionals are engaged directly in helping administer minerals policy.

Among the Government units that deal directly with policy development and implementation, there appear to be few, if any full-time personnel available with a thorough professional training and accreditation in the following areas; economics, management science, mining engineering (except for mine safety

officers in the Department of Labour), accountancy, and law. The need for mining engineering skills appears to be especially pressing. The lack of in-house expertise in these areas makes it difficult for policy-makers to respond effectively and expeditiously when policy issues requiring resolution arise. In these cases it is necessary to either make do with the expertise that is available, or hire consultants to provide the required information and analysis. In either case, since many of the issues are in any event highly sensitive politically, the natural and sensible tendency to proceed with caution will be intensified unduly, resulting in unwarranted delays and, perhaps, less than optimal decisions. It might be argued that the Government can draw on professionals in these areas on an *ad hoc* basis, as required. This may be true, but these individuals are unlikely to be available exactly when needed, and in any event this approach will not provide the invaluable accumulation of experience which results from continuous day-to-day contact with the problems and personalities involved, and with developments in other countries.

In suggesting amplification of effort in these areas, we want to emphasize that no criticism is implied of those individuals now responsible for guiding and implementing policy. Indeed, considering the resources available to them in this regard, it is remarkable what has been accomplished.

It was suggested to us that the pay scales and career structure in the public service are not competitive with opportunities in the private sector, and that therefore the appropriate calibre of individual could not be attracted to work for the Government in these capacities. This is really a Government-wide issue which falls outside of our terms of reference. However in this regard we are encouraged by the fact that there are now some individuals of exceptional ability in Government service who, thus far at least, have resisted the attractions of private sector employment.

Conclusions

We conclude that there is a compelling need for making expertise in economics, management science, accountancy, mining engineering and law available on a continuing basis to policy-makers. With ready access to these skills and the ability to marshall them effectively, the calibre of policy analysis will be improved, and decisions will be more appropriate and timely than would be the case without this access.

We feel also that the State should be seen, both symbolically and practically, to be aggressively encouraging the mining industry. At present there are delays in processing applications for exploration licenses, and much of the information on exploration which all of the mining companies provide to the Geological Survey Office remains to be compiled and analysed. The up-dating

of the basic geological maps (these are of value for many other purposes besides minerals exploration) proceeds very slowly. We understand that these deficiencies are a consequence of insufficient personnel (geologists, cartographers, computer programmers, etc.) to do the necessary work.

With a tax regime in place that will ensure that the public gets a substantial proportion of any scarcity rent accruing from the exploitation of its mineral resources, it is in the public interest to facilitate the discovery and exploitation of these resources. We believe that adding a small cadre of professionals — probably not more than 3-5 individuals in all — in economics, mining engineering, etc., would repay the expenditure required several-fold. We also feel that increasing the number of staff in existing positions is warranted so as to expedite routine processing of requests for exploration licenses, and information, and for compiling, analysing and releasing (where appropriate) geological interpretations of exploration and other data. The extent to which additional resources should be allocated to the preparation of basic geological maps is an important issue, but one to which we did not address ourselves; as noted earlier, these maps are also basic to several other functions of the Geological Survey Office.

In the time available to us we were unable to undertake an adequate analysis as to which institutional framework would be most effective. Whether the existing organizations simply incorporate new skills, or a new unit or units are established, as discussed earlier, the body(ies) responsible for analysing and implementing minerals policy should have the following characteristics:

- (a) Have the analytical and technical skills available in-house to analyse the economic, technical and administrative implications of alternatives, and be able to act quickly and effectively in reaching or recommending decisions.
- (b) Adopt an unambiguously positive and business-like approach to minerals exploration and development, and be seen to be doing so, by expediting Government transactions with mining units, and by providing an array of information and services.

Acting in this fashion will simply expand on initiatives already embarked upon. Since we are talking mainly of adding additional professional personnel in the order of 3-5 persons, the additional cost of implementing these suggestions (including support personnel, equipment, etc.) should not exceed £0.25 million (1979 £) annually.

SECTION III

TAXATION AND ROYALTY CHARGES

Major changes in minerals taxation were enacted in 1974. The legislative background leading up to these changes is reviewed in chapter 9. In chapter 10 the effects of alternative tax regimes on a mining firm's decision-making are discussed conceptually. In chapter 11 Irish minerals taxation (including royalty charges) is compared with the situation obtaining in other countries. The details regarding other nations are presented in Appendix A. We recommend that discussions be initiated with a view to arriving at fixed taxation/royalty terms which would obtain for new discoveries of various mineral categories. In chapter 12 and 13 three very different alternative taxation/royalty choices for base-metals in order to provide some basis for this discussion.

CHAPTER 9

LEGISLATIVE BACKGROUND

After independence and prior to World War II the amount of legislation affecting Ireland's mining industry was minimal. This is no doubt related to the commonly held belief that Ireland possessed little mineral wealth as well as concern about the development of other economic sectors such as agriculture and manufacturing. Mining firms, like other corporate firms, were subject to income and profits taxes and were thus affected by the various laws and rulings enacted during the period.¹

The first major mineral legislation was enacted in 1940 and was called: The Minerals Development Act.* Kearns (1976) notes that this Act was a result of a re-examination of old mineral workings to meet shortages created by World War II. This legislation empowered the Minister for Industry and Commerce and the Mining Board (established by an earlier Act) to act as the Government's agent in the orderly development of mining exploration. The most important features of the Act were: (1) establishing the State as the sole agent in granting prospecting licenses and mining leases; (2) establishing guidelines for the rights and responsibilities of prospectors, operators and owners of surface and/or subsurface rights; (3) empowering the Minister of Industry and Commerce with the right of entry and in some cases the right of compulsory acquisition of mineral lands (with compensation) on behalf of the State; and (4) empowering the Minister for Industry and Commerce to establish fees and royalties.

The Government holds the mineral rights for approximately 60-65% of the mineral resources; this Act attempted to clarify the previous uncertainties over mineral ownership as well as establishing procedures for obtaining licenses and leases.

The 1940 Act was amended in 1960 by the Petroleum and Other Minerals Development Act and by The Minerals Development Act (1979); new

*This includes many provisions from the earlier Mines and Minerals Act 1931.

¹There was a Mines and Minerals Act of 1931 which was repealed by the 1940 Act. Since the concern of this review is with recent policy developments the earlier Act will not be reviewed.

prospecting rules were issued in March 1976.² Under the current system exploration licenses are awarded for two years with normally only one renewal. Each year the licensee must spend at least £1,000 per year on an exploration program. After the first four year period renewal is on an annual basis but only under the condition that the licensee increases his expenditure on more advanced prospecting. Finally a £10 per square mile fee must be paid annually by each licensee.

The legislation described above established the ground rules for State-owner-company relationships. The second area of major legislation has been in the field of taxation. The first of these initiatives was the Finance (Profit of Certain Mines) (Temporary Relief from Taxation) Act of 1956 and it reflected the Government's view that incentives were necessary to induce investment in the mining sector.³ The major provision of the Act was a four year tax holiday for mines which began production prior to April 1961. In addition, only half the profits from operations in the next four years would be subject to tax. A variable royalty was negotiated on base metals which ranged from 4 to 10% of operating profits. In 1959 these benefits were extended to mines which began production prior to April, 1966; and then an additional ten year extension was provided to cover mines which began production prior to April, 1976.

The Finance Act of 1967 extended the period of complete tax exemption to 20 years for all scheduled minerals.⁴ While this may be considered an extreme measure and high benefit to the private mining interests, the legislation must be put in proper context. During this period Irish agriculture was not taxed. The manufacturing industry in some areas benefited (and still does) from free depreciation.⁵ Company profits earned by manufactured exports were exempted from taxation as well as "Shannon" profits.⁶ Therefore, the tax relief afforded mining operations, while extreme, was in line with the tax treatment of other major corporate sectors at the time.⁷

The next legislation, the Finance (Taxation of Profits of Certain Mines) Act of 1974, was a reversal of the trend which increased the tax incentives in the mining sector. Mining firms would now be taxed at the full rate (45%), but

²Department of Industry and Commerce, *Mineral Development*, March, 1976.

³Kearns (1976, p. 53) notes the lack of domestic expertise in mining and the poor condition of the National Geological Survey. Because of these facts, Kearns states that it was decided that mining investment would be best handled by the private sector (probably foreign) rather than the State Mining company established in 1941.

⁴The scheduled minerals include: barytes, feldspar, serpentinus marble, quartz rock, soapstone, copper ores, gold ores, iron ores, lead ores, manganese ore, molybdenum ores, silver ores, sulphur ores, zinc ores. (See Appendix A).

⁵See Minister of Finance, *Company Taxation in Ireland*, 1972, p. 23 for details.

⁶Shannon profits are those derived from sales of goods and services carried on in the customs-free area of Shannon Airport. *Ibid.*, p. 21.

⁷The Act also included items on exploration and development expensing. However, in view of the twenty-year tax holiday these provisions were not necessary.

would benefit from certain expensing provisions. The Act allowed immediate expensing of exploration and development. It extended "free depreciation" to the mining sector for plant and machinery.⁸ Also mines would be allowed an additional 20% write-off for these categories. In effect, mines could then expense 120% of exploration and depreciate 120% of its plant and equipment. A depletion allowance was introduced which allowed the firm to write-off acquisition costs using a straight-line method over the life of the operation.⁹ The current policies are summarised in Table 9.1.

Since 1974 the mining sector has not benefited from tax concessions extended to other sectors.¹⁰ For instance, manufacturing profits are currently taxed at a 25% rate as a temporary measure provided that certain sales and employment goals are obtained.¹¹ Also, effective in 1981 it is planned to tax all manufacturing company profits (both domestic and export earning) at a rate of 10%.¹² The mining sector has not shared any of these incentives. In addition, base-metal mines pay royalties based on a progressive rate using a net income concept.

In summary the developments of Irish mining policy is typical of experience in other parts of the world. Ownership claims are established and exploration begins with generous tax concessions serving as inducements.¹³ Minerals are found and tax policy is adjusted to collect a part of the profits from the established firms. The years following 1973 were a watershed for tax changes throughout the world and the Finance (Taxation of Profits of Certain Mines) Act of 1974 in Ireland was no exception to this trend. This period was one of increasing price for most minerals and began an era of concern about exhaustible resources and nationalistic concerns over control of a country's use of its resource base.¹⁴ While the general trend is the same, it will be shown that relative to major mining countries, the Irish system is still a generous system.

⁸Free depreciation gives the firm the option of writing-off up to 100% of its investments in the year of purchase. It further gives the firm the option to time its depreciation schedule to minimize its tax payments.

⁹Grimes (1978) notes that the 1974 Act affected only two mines in operation at the time, Tynagh and Silvermines.

¹⁰The Finance Act of 1976 was mainly a consolidation Act which brought an end to the two-tax system on corporate income. No new changes were introduced regarding the mining sector in this Act.

¹¹The Revenue Commissioners, *Leaflet No. 4: Outline of the Principal Tax Reliefs Having Special Importance in Relation to Industrial Production*. September, 1978, p. 5.

¹²Interviews with officials of Department of Finance, June 10, 1979. This reduces the tax rate on domestic production while repealing the export tax relief.

¹³For a description of this changing process in various countries see Smith and Wells (1975), Gillis *et al.* (1977) and (1978).

¹⁴Ireland's nationalistic and environmental concerns have been expressed by the Resources Study Group in its various publications.

TABLE 9.1

Summary of Current Irish Mining Tax Policy

Income Tax	
Rates	45%
Major Items	Lease and acquisition cost amortized over mine life using straight-line method.
	Exploration currently expensed at 120% of costs.
	Development currently expensed (including interest).
	Free Depreciation of capital. Up to 100% of cost may be deducted in any year (up to 120% in some cases).
	Marginal Mine allowance.
Royalties: (State-Owned only)	
Base Metals	Progressive Royalty based on corporate income tax definitions. Rates vary across mines between 3%-10%.
Industrial Minerals	2%-5% output tax on Gross Value. Fixed payment per ton.
Equity	
The State also holds non-dilutable equity of 25% in Tara Mines Ltd., provided for no financial consideration and 49% in Bula Ltd.; 25% of the total Bula equity was provided for no financial consideration.	

CHAPTER 10

THE EFFECTS OF MINERALS TAXATION
(INCLUDING ROYALTIES)

The imposition of taxation¹ on the mining firm may affect all of the firm's decisions previously discussed in Chapter 3. In this chapter we review briefly the economic effects of severance taxes and profits (income) taxes.

This discussion will be entirely descriptive and intuitive; in Appendix K a rigorous derivation of these results is presented using simple mathematics.

Severance Taxes (Royalties)

These are generally of three types: a fixed charge per ton of ore extracted; a fixed payment, in nominal terms, per ton of concentrate; a percentage of the sale price. This method of collecting the rent has the important advantage that it is very easy to administer. The Government only needs to know and monitor the production and — where the percentage of sale price is used — the output price. For this reason it has been a popular rent collection device. However it has a number of disadvantages. Since this mining company must make the payment regardless of profitability, this increases the downside risk for the firm, which discourages investment. In addition the fixed charge per ton increases the marginal cost per ton produced by this amount; ore will therefore be left un-extracted which in the absence of the charge would be mined. This in turn will result in a smaller investment and shorter mine-life.

Profits Taxes (Royalties)

A pure profits tax has the advantage that it will not affect the short-run behaviour of the mining firm. For a given level of investment, the firm will extract every ton of ore which contributes anything to profits, i.e., which yields a return above marginal extraction costs. In addition, since no tax is payable when losses are incurred, there is no tax-induced downside risk, and therefore no disincentive to invest is provided on this account. However, any tax will lower the net of tax return, so that in the long-run, a profits tax will reduce the aggregate level of investment in mining. Administering a profits tax requires a much more sophisticated managerial/administrative system than that needed to implement a severance tax scheme, since the definition of

¹The terms "taxation" and "taxes", as used in this chapter should be understood as generic terms which include royalties.

"profit" is an elastic concept subject to myriad interpretations by creative accountants. A key consideration in this regard are the expensing provisions, to which we now turn.

Expensing Provisions

Mining companies are usually allowed to take advantage of special tax provisions regarding exploration and development. The justifications for these privileges are: 1) mining is risky relative to other investments; 2) development is mine specific with no salvage value; and 3) the firm needs to finance development with large debt in early years, and therefore it needs sufficient cash-flow to repay principal and interest.

There is no doubt that the benefits from exploration are uncertain, but there is a question about Governments, including Ireland, allowing complete write-offs of these expenses against ordinary income as they are incurred. From an economic perspective exploration is an *investment* made by a firm to obtain a stream of future benefits. As with all risky investments economic agents choose a strategy to minimize these risks. Mining companies achieve this by: 1) forming exploration companies that legally separate the risks from these activities from other income; 2) pooling risks by buying interests in other deposits held by other companies and selling interests in their own; and 3) exploring a number of deposits in a variety of areas at one time to spread the risk within the company.² Given this ability of individual economic agents to adjust for uncertain future profits, excessive Governmental inducements will merely transfer resources from other sectors toward the mining sector.

With regard to development expenditures it is true that they are mine specific. A mine shaft is of no value to anyone else except the operating firm. But that is not the point. Development is a capital investment made in order to capture a stream of future benefits. As such, conventional accounting and economic practices usually dictates that such expenditures be amortized or depreciated through time to off-set these costs as the benefits are received³.

In the Irish context, the ability to expense these capital expenditures will attract capital to the mining sector, but the benefits may not be captured by the people of Ireland. First, foreign buyers of concentrate may receive price reductions and other incentives from Irish producing companies to ensure markets. This happens because these privileges may increase the rate-of-return above the minimum necessary for the firm to invest. Therefore, selling

²Harberger (1965) discusses such means of reducing risks. An indication of relative risk is the interest rate demanded by investors for long-term bonds issued by companies. A survey of New York Stock Exchange bonds clearly shows that the return from mining firms is no higher than other industries.

³For instance, most mining operations in Ireland use the "unit of production" method to amortize development.

on a competitive world market may mean that some of the benefits available to the investor may be passed-through to the buyer with little or no overall benefit to the domestic economy.

The other way benefits are passed-through the company is by repayment of debt and equity. It is true that such expensing provisions increase cash-flow in the early years, but the issue is: "Who gets the benefits?" The increased cash-flow makes financing easier to obtain, but if the lenders are foreign banks and persons then the tax benefits will be paid to non-residents.

In sum, just as taxes may be exported, tax benefits can be exported. Given the oligopolistic nature of the European purchasers and the expertise of banks that deal with mining companies, this may likely be the case. This means that these privileges may have little or no effect on the firm's behaviour and thus the domestic economy. Rather, they may act to subsidize the income of foreign producers and banks.

The final argument about the need for these privileges is the need to increase cash-flow in early years due to large debt repayments. This argument has several flaws. First, if mining is as risky as some have claimed, prudent bankers would never lend money to them. Second, as noted above, they may not affect anyone's behaviour but just transfer income to banks. If they do affect behaviour, then they may induce banks to lend funds on a more risky prospect, which weakens the financial structure of the firm by being too dependent on debt. Therefore, in addition to transferring income out of the country, the probability of bankruptcy may be increased, which may force further Government investment either in the form of loans, loan guarantees, or outright operation of a mine that should not have been opened.⁴

In summary, income taxation should recognize the risk and expenditures made by the mining firm, but this manner of recognition should be tempered by sound analysis. It should be emphasized that the discussion above is not limited to "multinational firms." As long as concentrate is exported and funds are obtained from abroad, even a company owned completely by the Irish Government could be subject to these effects.

Progressive Income Taxes (Royalties)⁵

These taxes are becoming increasingly popular instruments. They have the advantage of recognizing costs and thus do not affect risks as much as

⁴Tara's recent experience is a case where debt had to be rescheduled. It is not claimed that the provisions are the sole factor explaining such behaviour, but it must be considered a contributing factor.

⁵The analytics of progressive taxes are quite complex. For a more rigorous treatment see Conrad and Hool (1979c).

progressive severance taxes. The Government shares both the risks and rewards of the operations in a more equitable manner. These benefits are tempered in part by the increase in complexity and costs of administration both by the firm and the Government.

The taxes also affect the mine's behaviour. First, the firm may reallocate extraction between periods because of changes in the marginal tax rate, i.e., the firm can transfer extraction (and therefore income) from periods with high marginal tax brackets to periods with lower marginal brackets. By implication this will tend to even out extraction and prolong the life of the mine.⁶ Furthermore, development of marginal areas is not as affected as in the proportional tax case. This is because areas with lower yields will pay proportionately lower taxes.

It is difficult to assess the impact of this type of tax on overall investment. Like any other tax it will discourage investment, but the magnitude of the effect is hard to calculate. It may increase uncertainty to some extent because firms now must estimate the Government's share of income. Also, the timing of the revenue collections will fluctuate with profitability and may force the firm to change its strategy.

The above discussion has shown that mining (like all forms of economic activity) will be affected by taxation. Given that costs of administration and revenue stability may also be an important consideration for Governments, trade-offs must be made between yield and administrative costs on the one hand and distortionary effects on the other. In addition, the effect of tax policy will vary across mines because of the geological composition of the ore bodies. For instance, severance taxes may have little or no effect on large mines with ores that are evenly distributed throughout the deposit, while small mines with ores that vary substantially in quality may close down. Therefore, tax policy must be designed in a way that each factor be considered in the context of goals established by the Government.

⁶See Conrad and Hool (1979a).

CHAPTER 11

MINERAL TAXATION AND ROYALTY CHARGES IN OTHER COUNTRIES

Introduction

Since 1973 there have been numerous changes in the methods and levels of taxation in the major mining countries. This has resulted for several reasons. First, the rapid rise in resource prices following the oil embargo gave countries an opportunity to share in what was perceived as a wind-fall. Second, concern over conservation, internal development and nationalism fostered demands by many countries for an increased share of the country's natural resource wealth. Third, tax authorities have become increasingly sophisticated in negotiating and designing tax policy.

The present survey is limited to 14 major producers of base metals plus six Canadian provinces, and a brief description of tax policy used at the State and local level in the United States. This sample was chosen to be representative of major trends in mining taxation in order to compare current Irish practice. The data on these countries are presented in Appendix A.

Overview

Prior to 1965, the major form of taxation collected from mining firms was output based. These taxes were relatively easy to administer and collect, and, with the exception of the major developed economies, most countries had not developed strong administrative staffs and procedures to oversee complex methods. When methods that were difficult to administer were used, in particular income and profits taxes, several countries claimed that the laws were manipulated by the companies to escape taxation.¹

Recently this situation has changed dramatically. Countries have developed new methods to capture an increased share of mining profits. Because the mineral rights in most countries are vested in the State, profit sharing, production sharing and service contracts have evolved. Profit sharing amounts to equity participation by the Government in a mining venture. This participation is either purchased from, or granted free, by the firm. Under such agreements, the country shares in the after-tax dividend payments in

¹For an example, see Gillis' description of Guyana and Reynolds metals. Gillis', *et al.* (1978), p. 123.

proportion to its equity holdings. Production sharing is a method where the Government either gets part of the sales or part of the production and markets it themselves. While varying from country to country, these agreements in essence are little more than severance taxes from an economic perspective.² Service contracts are a method whereby the firms are paid for extracting and processing the ore. The Government owns the operation in most cases and the firms are paid for their expertise and services.

Both income and output based taxes are used in combination in most countries (except Bolivia). Export taxes are also employed in varying degrees (see Appendix C). Income taxes are imposed at more or less the same rates that apply to other corporate sectors. Expenses particular to mining are reflected in various ways in the tax accounting process. Output based taxes are generally ad valorem and rates vary across minerals and countries.

Irish Tax Policy in Comparison to Other Countries

A review of the tax policies listed below reveals that Ireland's tax policy towards minerals is more lenient than that of most of the countries surveyed. While the rates of income taxation are similar, the methods of expensing are what makes Ireland's tax policy so mild. With the exception of Zambia, Ireland is the only country that allows immediate write-off of ore exploration, development and capital expenditures combined. However, Zambia owns at least 51% of each mine.

For instance, exploration can only be immediately expensed in three countries (Zambia, Australia, Canada). The United States offers the option of immediate expensing, but they are subject to recapture. Only two countries (Zambia and the US) allow immediate expensing of development. Finally only one country (Zambia) allows 100% optional depreciation on capital investments, much less the ability to deduct more than the investment costs.³ Lease and acquisition costs are the only main item that Irish tax policy treats in a manner similar to most other countries. Like Ireland, no country allows immediate expensing of these costs.

Several countries have placed restrictions on certain items to avoid traditional forms of transfer pricing. Mexico does not allow home office charges as deductions when the home office is not in Mexico. Liberia allows a deduction for interest payments to affiliates only if the debt-equity ratio is less than 3.5. Also, most countries impose withholding taxes to capture at least part of the repatriated income to foreign parents.

²For instance, suppose a country's "share" of output is 25% of the reserves. In effect, this is a royalty on the value of the firm's production.

³Mexico's "current exploration expensing" is only available to a mine seeking to expand its reserves from an operating mine. Canada offers 100% on certain limited categories.

In addition to more stringent expensing requirements, most countries have more stringent output and royalties charges. Ireland's base metal royalty uses the same tax framework as the income tax except interest is typically not deductible. In other countries there exists windfall profits taxes in addition to more traditional forms of royalties, export and severance taxes. Each of these taxes are in addition to equity participation or production sharing agreements.

CHAPTER 12

TAXATION AND ROYALTY RECOMMENDATIONS: BACKGROUND

Introduction

The previous discussion has shown that State revenues (dividends, royalties and company taxes) are likely to be the most significant benefit that will accrue to Ireland from exploitation of its mineral endowment. This does not imply that tax rates can be set arbitrarily to reap the greatest return. Any form of taxation will reduce a firm's profitability, reduce investment, and thus affect tax revenues. On the other hand, excessive tax incentives will provide subsidies to inefficient firms or redistribute income from other sectors of the society to the mining sector. Trade-offs must be made between the desire for capital intensive mining enterprises, revenue and the adverse incentives which any system will create.

In general, the tax/royalty system should be calibrated, other things being equal, so as to maximise the present value of net revenues provided to the citizenry. Clearly a balance must be struck at the margin between inducing investment on the one hand and achieving a net revenue to the nation on the other. The extremes can readily be dismissed as inappropriate. No taxation will, *ceteris paribus*, maximize the level of mining investment, but we have seen that this can impose substantial social costs while providing relatively modest social benefits. At the other extreme, a tax/royalty regime which reduced investment to zero, and therefore eliminated the prospect of future increments in revenue to zero, would likewise be inappropriate. The task then is to identify the regime falling between these two extremes which will approximate our objective. Conceptually, this can be said to occur at a tax level where the (time-adjusted) net revenue yielded by an additional increase in taxation just equals the revenue foregone at the margin as a consequence of the reduction in investment thereby resulting. Since we cannot tell what the return to future investment might be, this cannot be used empirically as a guiding criterion for evaluating policy. Thus we do not have an unambiguous and definitive criterion for evaluating tax and royalty policy.

However, by examining the issue from a number of perspectives we can discern some useful pointers for policy. The following are among the important considerations in this regard: the neutrality of the tax/royalty regime vis-a-vis other investment opportunities and the efficiency implications thereof; the extent to which a conceptual distinction is clearly maintained

between the returns to capital invested on the one hand and the rental accruing as a consequence of minerals ownership on the other; vulnerability to changes in the tax laws of the home countries, in the case of investment from abroad; the influence on the extent and timing of exploitation; the surity of the taxation/royalty terms from the prospective investors' point of view.

The methods employed for mineral taxation in Ireland are based on sound economic criteria. However, while the tax structure itself is sound, there are a number of modifications in the present system which deserve serious attention for the following reasons. First, we discuss below the fact that the current method of corporate taxation may favour capital intensive investments which substitute for labour rather than being complimentary to it. Second, there is the need for adequate revenue generation and better timing of tax payments. Finally, the tax system should be made more neutral with respect to foreign investments. The current tax system offers a number of advantages to foreign investors, which are effective only because they are tolerated by the tax authorities of the home countries. If the tax authorities in the home countries change policy, these incentives will disappear and Irish mineral investments will be reduced and/or greater amounts of the return to capital investments in Ireland will accrue to the home countries in the form of tax revenue.*

Below an analysis of the current tax system is made, and three modifications of this system are discussed. Since we made the case in an earlier chapter for fixed lease arrangements which include a known tax/royalty/equity regime for the firm, it follows that two components of the tax proposals should be:**

- (1) They should be readily applicable to mines of varying sizes and profitability
- (2) They should be acceptable to a broad spectrum of popular and political opinion.

If either of these conditions is not satisfied then the pressure to change the tax regime in times of major discoveries and/or high (or depressed) prices may result in changes which will generate uncertainty about investments and a subsequent decrease in mining activity.

The alternative proposals are made in order to provide a basis for informal discussion. We do not claim that any of these proposals is the best possible alternative. Such a determination must be based in part on the administrative and political factors which are beyond our competency to properly evaluate.

*Where mining workers would otherwise be unemployed, that portion of their income paid in taxes is also a contribution.

**It should be noted, however, that no Government will bind itself irretrievably to any given tax regime.

We do feel, however, that these proposals would increase revenue and move the tax system toward a more neutral posture vis-a-vis other sectors of the economy. Any changes should only be applied to "new" mines; they should not be applied retrospectively to mines now operating.

The Current Tax Regime

The Corporation Profits Tax

The intent of the corporation profits tax is to tax part of the return which accrues to invested capital. In the context of mining, this means that, ideally, the tax should be related to the profitability of mining investments and not necessarily as a means to collect natural resource "rents". In the absence of externalities, the tax should be administered in a manner consistent with the concept of "tax neutrality." That is, the tax itself should not give incentives to or discriminate against one sector of the economy over another. Thus, the tax should be designed so that both the "gross" and net of tax returns to capital are equalized for all types of investments.¹

The concept of tax neutrality is not merely an abstract concept, because the violation of it has very real consequences to the economy. A market economy will allocate investments until the "net-of-tax" returns are equalized. If a tax incentive is created which favours one sector over another, then capital (and labour) will move between the sectors until the net of tax returns are equal.² The result is of course that the favoured activity has a lower gross of tax return than the sector which was not favoured. The reason why this result is not desired is that the economy now is operating at less than maximum output. That is, a system can be devised in a way to encourage the desired result which will simultaneously yield a greater net output than the distortionary incentive.

An example will be helpful in making this point. It is well-known that accelerated depreciation favours heavily capital intensive activities.³ The system thus encourages these sectors relative to others, and thus drives a wedge between the gross-of-tax and net-of-tax returns, creating an inefficiency. A better way to achieve this result would be to not allow rapid depreciation, but to have a system of tax credits available to all sectors. The tax credits would not create any "relative" incentives and thus maintain the neutrality of the system. However, a system of credits would result in a higher gross national product than the accelerated depreciation while achieving the desired result.

A second reason why neutrality is important in the Irish context is Ireland's desire to attract foreign investors. Foreign capital can be (and usually is) an aid to an economy as it develops through time. However, it is not the capital "itself" that aids the economy, but the employment benefits (if any) and the social return which is retained in the country that are the major benefits. If neutrality is not a goal of the host Government then several adverse effects could result. First, for those investments which would have been made in the absence of the incentives, a redistribution of income will result from the citizens of Ireland to foreigners. This could result from: (1) increasing the net of tax rate of return to foreign investors; (2) decreasing the price of exports (in effect subsidising the price of the good to foreign consumers); or (3) increasing the tax revenues to foreign home Governments. In effect, the tax incentives merely transfer wealth out of the country in this situation.

For those investors who, but for the incentives, would not have invested in Ireland there are additional costs as well as benefits. First, they may receive the benefits of Irish social goods and services for less than their costs. Second, the firms, being marginal by definition (otherwise they would have invested without the incentives), are more vulnerable to risks and cycles in the world markets. Thus, the Government may find itself in the position of having to finance the firms through difficult periods which further increases their social costs. Finally, the host Government runs the risk of losing any advantage at the discretion of the home tax authorities.

The above discussion in no means implies that foreign investments are neither desirable nor essential for the development of the Irish economy. It only means that excessive tax incentives are a poor (and expensive in social terms) mechanism to achieve the desired level of foreign investments. A well-designed system of uniform effective tax rates across the board (given the home country policies) combined with explicit grants and/or subsidies can achieve the same results with less cost to the economy.

The case was made to us that, since Ireland has not adopted a policy of tax neutrality in the past, this of itself provided *prima facie* evidence that it was not a valid concept for this country; the frailty of this reasoning requires no elaboration.

The current Irish corporate tax has been applied in a way which indicates that capital intensive investments are favoured over less capital intensive ones. Since mining is a capital intensive method, the mining industry has accordingly reaped the benefits of this system at the expense of less capital intensive industries and other forms of economic activity. In general, free depreciation lowers the cost of capital for more capital intensive industries than for less capital intensive ones. This occurs because free depreciation

¹Neutrality is a well established economic criterion for evaluating tax policy. For instance, see Boadway (1978) for a complete introduction.

²See Harberger (1965) for complete development.

³Sunly (1976) demonstrates this point.

increases the present value of the tax savings more for capital intensive investments. In addition, the longer the life of the investment, the greater is the present value of the tax savings from free depreciation.⁴

Other things being equal, free depreciation will lower the effective rate of taxation for mining investments by more than for other types of corporate activity; this results in more mining investment and less other investment than would be the case without this provision.

In addition to free depreciation of capital, mines are currently allowed to expense exploration and development. This expensing is justified in part because of the risk associated with mining. However, it was noted earlier that the private market has mechanisms to account for risks and such incentives may induce excessive leveraging which may weaken the financial structure of the firm. In summary, all corporate investments in Ireland have benefited from the allowance of free depreciation compared to other sectors of the economy (such as labour). However, mining investments have had additional benefits because of their relatively capital intensive nature.

Royalty

A mining firm employs capital, labour, and ore reserves to produce a marketable product. This means that ore reserves are an input into the production process. In a perfectly competitive economy the firm will employ each factor until the value of its marginal product is equal to the market determined price of the input. This fact raises two important issues. First, since ore is of no social value in its natural form, capital and labour must be used in combination with reserves to produce a product which has a positive market value. It is clear that ore reserves are "essential" for production of mineral products, but it is equally clear that capital and labour are also "essential". Second, ore reserves should have a positive price which reflects the value of their contribution to the production process, i.e., the price which the mining firm is willing to pay for the ore.

A competitive economy would allocate the revenue from mining activities according to the relative productivities of each factor. Labour would receive the market wage, capital would receive a competitive return and the owner of ore reserves would receive a "rent" or royalty payment. The royalty will reflect the quality of the deposit, the ease of extraction and relative access to markets. Also, the value of reserves will fluctuate with market conditions for final output.

In a market where mineral rights are privately held, such as the United States, a mining firm must pay a royalty or pay a lump sum to the owner of the mineral

⁴*Ibid.*

rights based on market conditions, relative bargaining skills, and preference regarding risks. A common procedure is for the firm to pay the owner a fixed percentage of the total revenue generated before any costs are deducted. Therefore, a resource owner gets his share before costs are deducted and does not care how the residual is divided between debt and equity or between capital and labour. The US federal government collects no royalties (except from mines on public lands), but it does collect taxes from both the firm and the resource owner. The firm is taxed on its "capital" income and the resource owner is taxed on his "royalty" income.

In most countries, such as Ireland, a substantial portion of the mineral rights are held by the State. This means that the State is only the trustee for the mineral rights and that the true ownership is vested in the people of the country. A royalty paid to the Government is not a tax in this context, but a payment to the agent of the country's populace in exchange for a scarce factor of production. Therefore, the determination of the type of payment should be in accord with basic economic principles. Of course, the Government can adjust the payment for external effects and other social goals that a private owner will have no incentive to account for in determining the rate. This means that a public royalty can be used to ensure orderly extraction and development in the context of the economy's structural goals, account for externalities and other social costs and benefits which are not part of private arrangements in addition to collecting the resource rent.

If social costs and externalities are small or non-existent, a prudent policy would dictate that the people of the country are entitled to a payment from each and every ton of ore extracted which varies with its quality and value. Private individuals would insist on appropriate payments and the Government as the public's agent should demand no less. If the royalty is too low then income (or rent) accrues to firms rather than to the owners, which causes a misallocation of resources and a change in the distribution of income.

To examine the implications of such distortions recall the discussion regarding the distortionary effects of severance taxes.* There it was shown that such taxes may change the level of extraction, the intertemporal allocation of the resource and the total quantity of reserves recovered. The crucial assumption of this analysis was the nature of the firm's supply curve. That curve reflects *all factor payments* including the payments to the owner of the resource. Therefore, a governmental royalty, being a factor payment, partly determines the supply curve. The severance tax is then a payment *in addition* to factor costs and thus results in distortion. The burden of such a tax will then be borne by capital, labour, and resource owners according to the technological relationships.

*Severance taxes do not exist in Ireland except for the cheaper types of minerals.

If governmental factor payments are too low, then distortionary effects will also occur. First, given the rate of extraction, a low royalty will merely transfer income from resource owners (the people of Ireland in this case) to mine operators. Second, the low price will encourage faster extraction and recovery of ore that would otherwise not be recovered. It should be emphasised that the socially optimum level of extraction is not always more today and that the socially optimum level of recovery may not be 100%, or all ore in the ground. Such a policy would only induce capital to flow into the mining sector at the expense of other sectors and create increased dependence on the mining sector, i.e., it creates economic waste. Therefore, the Government of Ireland should insist on collecting the value of its reserve base. If implemented successfully, such a policy will provide a fair return to the people of Ireland and a fair return and only a fair return to invested capital with the associated benefits of an orderly development of the industry.

While simple in concept, such a determination is very difficult in practice. The quality and extent of reserves are uncertain and vary across properties. The value of the final product is uncertain and varies with market conditions. Finally, the real world does not always operate in accord with economic theory; market failures and externalities exist as well as lack of perfect information and oligopolistic behaviour. The theory, however, can be used to point toward an appropriate policy. First and foremost a factor payment is required. If no payments are made then a misallocation will certainly occur. An analogy would be helpful. If labour were paid in the mining sector less than the value of its productivity then capital and resource owners would gain at the expense of labour. Extraction would be faster than socially optimal and too much reserves would be extracted. The same would be true if capital were underpriced. Since no-one argues that capital and labour should decrease their returns below their value to ensure resource development, the Government as the people's trustee should demand no less for the reserves themselves.

Second, the resource owner should assume part of the risk associated with the investment. That is, the royalty should vary with the value of output. If prices are high the owner should share in the benefits and if prices are low the owner should bear part of the costs, either by a decrease in price or a decrease in the rate of extraction.

Third, the payment should reflect the quality of the resource. That is, high quality deposits should receive greater payments than low quality ones. Finally, the royalty should reflect payments other factors receive, i.e., it should recognise costs. Since reserves are an input, its value will be determined by the technology as well as market forces and this fact should be recognised.

These considerations must be weighed against the costs of administration, ease of enforcement and compliance, the importance of the mineral sector in the economy's overall development profile, and the ability to negotiate on a mine-by-mine basis with incomplete information.

The concept of a royalty based progressively on profits as currently used for Irish base metals is a sound method for the public sector to collect natural resource rents. Being based on profits it recognises costs and thus the Government gets a share of the residual. When profits are low the taxes are low and down side risks are not increased as much as with other types of taxes. The progressive rate structure compensates the resource owner for sharing the risks and for the loss of revenue during periods of start-up and low prices. Therefore, such a royalty meets all the basic criteria mentioned above.

While sound in theory, this royalty is flawed in practice. The base of the royalty is the same as the base used in calculating the corporation tax (with the exception of not allowing interest payments in some cases). Therefore, the generous expensing privileges for depreciation, exploration and development reduce the payments. These privileges serve as investment incentives. Using them in calculating the royalty will always underestimate the value of the royalty. This will lower the value of the revenue either by deferring royalty payments or eliminating part of them completely.

In addition to the low base, the rate structure of the current system is too low. Given the fact that mines have high start-up costs, there will be a period when extraction is positive but cash-flow may be negative or very low. If a royalty were on a per unit basis, a payment would be required regardless of low cash-flow. Since the royalty is based on profitability the State is in effect lowering the price of the resource in these periods. Therefore, the rates should be high enough so that the State can be adequately compensated for the deferral of the collections. Also, the Government is incurring more risk under this system than under other methods. Therefore, the rate structure should also reflect this fact.

Below we outline three proposals which reflect the concerns discussed above. Three proposals are offered because they demonstrate the flexibility available to the Government in the natural resource area. The discussion has concentrated on the conceptual distinction between a tax on the return to capital and a factor payment for the resource. In practice, there are a variety of tax regimes which can accomplish the same results. For instance, if the corporation tax rate for other industries is 40%, then the Government could impose a tax of 55% on mining operations. Forty percent would be a "tax" on the return to capital and 15% would be the "rent" from the resource.* In such

*If the mining is financed by foreign investments, the additional 15% may not be a creditable tax.

a case no "royalty" per se need be imposed. The particular combination of profits taxes and royalties employed will depend on administrative feasibility and the particular goals upon which the system is based. Each proposal outlined below is a two tax system and thus preserves the technical distinction between royalties and capital taxes. We feel that such a method is appropriate because it helps clarify the issues involved, and not because either one is superior to some other method to collect both components of governmental revenue. For each tax/royalty combination, if for any reason the basic corporation profits tax rate were to be reduced, the royalty should be commensurately increased.

CHAPTER 13

TAXATION AND ROYALTY RECOMMENDATIONS: THREE OPTIONS

OPTION I

The Corporation Tax

As noted above, the purpose of the corporation income tax is to gain a share of the profits which accrue to the sources of capital. In the absence of externalities and other market failures, the neutrality concept implies that this should be applied so that the effective rate of taxation is the same for all industries. In this context, mining should be treated exactly the same as any other corporate enterprise, i.e., the same privileges (or lack of them) extended to other industries for invested capital should be granted to mining. In addition, any tax treatment of items unique to mining should be treated in a manner which maintains neutrality.

In the Irish context, neutrality can be encouraged by keeping the tax rate for mines and other like investments the same. Therefore, if the tax rate for manufacturing is changed to 10% in 1980 as discussed,* the mines should benefit as well. It was noted by a number of commentators of an earlier draft that, while the new corporation tax rate on manufacturing would be 10%, the current rate — 45% — would continue to apply to all other sectors, including mining. It was argued that it was invalid therefore to assume that neutrality would be enhanced by reducing corporate taxation of the mining sector to 10%. However, metals are primary exports, the metals mining sector is, in general, much more Capital intensive than the service sectors, and it is largely controlled by foreign firms; in a word it is much more akin to manufacturing in Ireland than it is to the non-manufacturing sectors. Free depreciation should be maintained for mines as long as it is available to other sectors. Also, the tax treatment of foreign investment for all sectors should be the same, i.e., interest payments, head office charges, management fees, withholding taxes, royalties, etc.

Exploration, development and pre-production expenses are unique to the mining industry. However, they are still capital expenditures which are made to capture an expected future stream of benefits. Conventional financial

*We are aware that the reduction of the manufacturing tax rate was made to meet EEC criteria. However, a lowering of the tax rate for mining would bring consistency to the Irish tax system. In addition, a lower tax rate combined with more stringent expensing provisions would attract more capital to the mining sector without incurring the efficiency costs associated with expensing provisions.

standards usually recommend that the timing of such deductions should be related to the realisation of income. For instance, most mining firms in Ireland use the "unit of production" method for development and pre-production expenses.¹ It is also common practice for exploration expenditures for unsuccessful searches to be written off only after abandonment and that exploration expenditures of successful finds be amortized.² The current tax methods may induce firms to explore less promising prospects, induce excessive leveraging, or merely transfer income to the mining sector with no change in behaviour. Therefore, we recommend that the tax treatment of these items be more in accord with standard practice.

If the Government wants to provide an additional incentive for exploration, it can do so without the loss in revenue that it currently incurs. One method would be to allow immediate expensing of exploration, but enforce "recapture" of this deduction at a later date. This could be accomplished by merely adding back the deduction at some point after the mine becomes profitable and treating it as ordinary income.³ If the mine never becomes profitable, then the expensing is the same as it is currently, but if profits are generated the Government shares at least in part from the incentive it gave the firm. The firm gains the present value of the tax savings and given any reasonable expected rate of return, this inducement is sufficient for most types of minerals.

The straight line depreciation of lease costs is in accord with world practice and should be maintained. The marginal mine "allowance" should be repealed for three reasons. First, given the incentives currently available, a "marginal" mine in all likelihood should not be developed. Second, taxes are paid only if a mine makes a profit. Profitability is the usual test for success and if profits are "low" a mine pays less taxes. Third, the determination of what constitutes a "marginal" mine is unclear and may be arbitrary in its application. It is simply better to leave such a judgement to an objective test such as profitability.

From an administrative perspective, a few additional factors should be emphasised. "Arms-length" pricing of purchases and sales should be strictly enforced. Information exchanges between Governments should be made to ensure that management fees, head-office charges, etc., are made in accordance with standard practice. Interest rates on intrafirm loans should be in line with current bank rates. In the case of petroleum, the licensing and participation agreements endeavour to take care of these points; suitable accounting rules are provided for, as is State membership of the management committee.

¹Annual reports of various Irish firms.

²Whin Creek Consolidated Annual Report (1978).

³Such a method is an option for recapture in the United States.

Royalty

It was noted above that a royalty should be based on the value of the resource. In order to more accurately reflect the value, we propose the following adjustments to the present system, to apply to all minerals where the royalty is taken as a share of the profits. Later on we discuss briefly an appropriate royalty system to apply to some relatively low-valued industrial minerals.

1. Depreciation of plant and equipment should be made according to the straight-line method over twenty years or the estimated life of the mine, whichever is less. *No free depreciation.*
2. Development and other pre-production expenses should be amortized on the unit of production method or straight-line method at the producer's option.
3. Pre-production exploration expenses should be amortized over the first ten years of production. Post-development exploration should be treated as a development expense and amortized according to (2).
4. Interest payments should not be allowed as a deduction.
5. No foreign management fees and royalty payments should be allowed as a deduction.
6. Payment of royalties to private mineral owners should be a credit.
7. The royalty should be recognised as a deduction for income tax purposes as currently is the case.
8. The same rate structure should apply to all base metals.

Points 1-3 are standard practices for income taxation of minerals throughout the world as well as standard procedures used by the industry. They are based on the principle that capital expenditures should be expensed as income occurs. While any method of depreciation and amortization is somewhat arbitrary and may not be in line with true economic depreciation, the methods recommended will at least provide a basic estimate of capital usage to determine the value of the resource.⁴

Interest payments are the share of capital income that accrues to lenders. From the resource owner's perspective, it makes no difference how capital income is divided between debt and equity. Since dividends and capital gains are not deducted, neither should interest payments. Also, as previously mentioned, this gives the firm no added incentive to be excessively dependent on debt, tending to strengthen the financial structure.

Point 5 reflects an attempt to calculate the royalty based on productive uses of capital. These expenses are either arbitrary allocations of firms or are intentionally used to avoid paying taxes. Since they are recognised for income

⁴An exception may be made in expenditures to meet environmental and other regulations. Speedy recovery of these costs limits the burden of the regulations on the firm and is paid in part by the citizenry who received the benefits.

tax purposes, they should not be deducted again for collecting the royalty. In summary, points 1-5 related to defining the "surplus" or basic residual on which the royalty will be paid.

Point 6 relates to privately held resources in Ireland. Only about 65% of the resources are vested in the State. Therefore, any royalty payments made to private individuals should be recognised as factor payments. In order to treat all mines equally the public royalty rate should be payable to the State, but any royalty paid to private individuals can be used as a credit in this regard. What is being addressed here is the case where a mining company is extracting privately owned minerals. The royalty rate — assume simplistically that it is 25% of profits — which is payable on State-owned minerals is due to the Government also in this case, but with the very important proviso that payments by the company to the private owner can be used as a credit against the Government liability. Thus, if the owner were paid 20%, this would be creditable against the Government liability, so that the company would simply pay the balance — 5% — to the Government. Since the company will be indifferent as to whether it pays the individual or the Government we can expect that the full State-royalty rate (25% in our example) will be paid to the owner. Thus, the royalty terms for State-owned minerals will tend to set a floor for payments by the industry to private owners.

This approach may need to be modified to make it consistent with the terms of the 1979 Minerals Development Act. This approach would have the great advantage of regularising transactions in this area, by providing minerals owners with some protection in resource price-setting, and removing some of the uncertainty.

The Government deserves a share because it issues licences, provides public reviews, etc. However, just as the split of capital's share between debt and equity should be neutral, the mining firm should be indifferent as to who gets the factor payments. This will probably induce the firm to increase the royalties to private individuals (up to the Government royalty). However, this income will be taxed by the Government by the individual income tax and thus the Government will still get a share. This procedure will also establish guidelines for negotiating private royalties. Individuals can use Government rules in determining how much the deposit is worth and thus use it as a bargaining tool.⁵

Point 7 recognises the fact that a royalty is a factor payment and should be reflected as such in the corporate tax accounts. Finally, point 8 is proposed to eliminate uncertainty and to ease the administrative procedures. Ideally,

⁵It is important to emphasise that the intent of the royalty is to collect a payment for a factor of production. If the private landowner gets all the payments and the Government none, a payment which ensures the orderly development of the mining industry has still been made.

royalties should reflect quality and other deposit-specific characteristics. Since these are not known with certainty, any attempt to determine a mine-specific royalty rate will be arbitrary and based on relative bargaining power. By establishing one set of rates and procedures the firms will know the rules of the game in advance and cannot attempt to manipulate the system or be punished unduly by it.⁶

The rates should be progressive because the resource owners should share in any gain which results in increased prices. Capital's share will also rise in a boom period, but not as fast as the resource owners'. The following rate structure is one which might be considered:

<i>Rate</i>	<i>Range of annual income after deductions</i>
10%	up to 200,000
20%	200,000 to 500,000
30%	500,000 to 1,000,000
40%	1,000,000 to 1,500,000
50%	1,500,000 to 2,500,000
60%	2,500,000 and up.

These rates combined with the corporation tax of 10% imply that the maximum marginal rate is 64%. While high, the average paid to the State will still be well below effective tax rates in many parts of the world. To ensure that the State receipts are based on the "real" value of the resource, the rates can be indexed to account for inflation in the Irish economy (unless accounting practices reflect inflation, which would make indexing the rates unnecessary).

This procedure is designed to ensure a minimum payment by the firm for a scarce resource. It is flexible and fairly recognises costs. It should be noted, however, that this method has one liability. Being a factor payment, it will not be recognised as a creditable tax for determining the tax liability of a foreign firm in the home country. In the United States and Canada only "income and profits" taxes are creditable. While the base of the proposed royalty is net income, the "intent" of the tax is to collect a factor payment, thus disqualifying it as a creditable tax.

Some commentators of an earlier draft argued that the progressive royalty would tend to "discriminate" against large investments with relatively low returns, compared with lower investments yielding relatively large profits. Thus, it was averred that a £1 million investment yielding £0.5 million annual profit would pay proportionately less in tax/royalty than a £20 million investment yielding annual profits of £2 million. However, comparisons across different rates of return is not the most useful means of looking at this issue. There is a

⁶Quality differentials are captured in part by the progressive structure of the tax.

substantial difference between "profit" and cash flow, when expensing is incorporated into the analysis: we have seen that the tax/royalty terms only become applicable after the capital and other costs have been deducted: presumably all investments will be undertaken, large and small, which can cover their costs and meet the opportunity costs of capital to the prospective investor. It is, nevertheless, true that there is some "inequity" involved, a condition however, which is shared by all Corporations who pay 45% (or 10%) on taxable income, regardless of the capital employed to generate this income.

Equity Participation⁷

Equity participation (either granted by the firm or purchased) has a certain amount of political appeal. If a Government has an operating interest in the mine then it is perceived to gain influence in the board room and reap additional income through dividends.

If a Government does not purchase the equity then the participation is a form of royalty. Suppose the Government demands 25% equity participation in a project with no compensation. The owners of the equity see that their return after dividends paid to the Government is reduced by 25% and will accordingly reduce their investment in a manner consistent with a 25% tax rate on their return. In addition to the investment aspects, there are a number of other disadvantages; while, in effect, a tax on capital's return, they are not creditable in the home countries of multinational firms. This means that a firm would be willing to pay more revenue to the Irish Government in the form of income taxes than it pays in dividends because of the tax savings generated by the increased credits.

Second, the revenue generated to the Government may be lower under equity sharing than through direct taxation. Dividends are paid on the residual of income after repayments of both principal and interest on the debt and after provision of funds out of profits for retained earnings; repayments of principal are not deductible for computation of taxable income. This means that tax and equity participation rates are not equivalent on a one-to-one basis; a 25% equity participation will yield less to the exchequer than a 25% tax. There is also the possibility that an incentive is created for that firm to use inter-affiliate transactions (especially management fees and head office charges) to decrease the size of the total earnings which can be distributed. However, this can be controlled for to some extent via lease specifications. Also inter-affiliate debt reduces the dividend because principal repayment is an after-tax obligation (i.e. it is not deductible for tax assessment purposes) and a firm can use "debt" to reduce dividend income. Of course, the Government can

stipulate that maximum dividend distributions be made in order to reduce this incentive.

Governments like to become involved in equity participation for more than merely financial reasons. It is a popular concept that equity is related directly to the power to influence on-going decisions. This argument is flawed for two reasons. First, it ignores the power that the Government can use without having membership on the board. It can tax, stipulate certain requirements such as the proportion of domestic nationals to hire or the share of total purchases which must be made locally. In fact, it can demand regular reports and audits if it chooses. Indeed, a Government can appoint members to a board even when no state equity is held. Second, unless the members designated by the Government are experienced in both financial and engineering analysis and are willing to get involved in daily decisions, then governmental influence will be only a minimum in relation to the legal power it has at its disposal. In addition, the board on which the Government sits is typically that of a subsidiary; many of the key decisions may be made at "head-office". Based on both the financial and managerial difficulties associated with equity participation, we recommend that unless a strong case is made on other grounds for such representation, equity participation be avoided in the future. However, there is an excellent argument for being fully appraised of what the company is up to, and for the resource owner — the Government — having the technical, economic and financial skills to evaluate choices. This can all be achieved without equity, and will not necessarily be accomplished with it.

⁷See Smith and Wells (1975) for a detailed description of the pitfalls associated with equity participation.

OPTION II

It was noted earlier in the discussion that while a tax on the return to capital and a factor payment for the resource are conceptually distinct, there are numerous ways to achieve the same result. The second option outlined below is presented to show how this can be done. It should be noted that it is not the purpose of this option to show how a Government can (or should) adjust tax rates and definitions. Rather, it is an exercise to show how various tax policies can be used to achieve the same economic objectives. The final choice will be based on the administrative, political and economic circumstances which prevail.

The Corporation Tax with Equity Participation

Under this option the tax rate is 50%. Exploration and development expenses should be capitalised and deducted in accord with the method proposed in Option I. In addition, free depreciation will be repealed and replaced with either straight line or declining balance depreciation over 20 years or the life of the mine, whichever is less. These provisions will increase the tax payments in earlier years and generate more revenue by the corporate tax.

The Government would also have equity participation if it wished to be purchased and limited to 48% of the total participation. The degree of ownership and the purchase will be made before the mine begins operations.* In addition, the participation will allow a voice in the decisions regarding operation in proportion to the size of the Government's participation. Purchase is suggested because of the perception that free participation is a means to get a share of the benefits with no costs. However, the last section demonstrated that such is not the case. Free participation is, in reality, a method of taxation which further distorts the allocation of the economy's resources. It is better for the Government to buy the shares, share the risks, and fully participate financially, which alleviates the distortion. If the difficulties inherent in arranging the pre-development purchase of equity by the State prove to be insurmountable (a not unlikely prospect), the precedent established for petroleum leases might be followed, whereby the State takes X% of equity in the company, and agrees to pay X% of the development costs out of its share of the profits. While this re-introduces some of the difficulties associated with "free" equity, it has the virtue of practicality. However, the difficulties of controlling for inter-affiliate transactions which were noted in regard to "free" equity will remain a problem with purchased equity.

*However, the difficulties inherent in arriving at the free market price were well illustrated by the Bula case.

Royalty

Since the corporation tax has been increased and the Government will share in the after tax profits, the royalty can correspondingly be reduced. A royalty of 5% of total revenue based on the average market price of the mineral over the past ten years is suggested.⁸ In addition, the rate should be adjusted one-quarter of one per cent for each 5% change in the market price in each period. This method allows revenues to fluctuate according to market conditions. Since the base is total revenue and not total profit the rate is correspondingly lower to reflect the increased base and the larger downside risk because the tax is paid regardless of positive cash flow.

The overall effect of this proposal is to shift the major revenue collections from the royalty to the income tax and the return to equity. In addition, purchase of equity will not distort the investment for any economic reasons, and the Government will have full participation in the decisions of the firm.

There are three advantages of this system. First, the royalty is relatively easy to administer, which decreases costs of enforcement and administration. Second, by shifting the major source of revenue from the royalty to the profits tax there will be corresponding increase in the value of taxes which are creditable under the home country tax rules for foreign investors. Other things equal, the greater the share of total governmental payments of a given revenue that are creditable, the more favourable the investment as perceived by the foreign investors. Finally, the share of returns yielded from the equity participation will be retained in Ireland and will not be transferred out of the country. This proposal, however, suffers from the increase in downside risks associated with payments made before costs are considered. However, the shift of the bulk of the tax burden from the royalty to the profits tax should offset some of this increased risk.

⁸The average is used to ensure that both peaks and troughs of the price cycle are taken into account.

OPTION III

The two options outlined above have been made as a basis for discussion about long-term developments in Irish mineral tax policy. As such, we hope that they will stimulate discussion about their relative strengths and weaknesses. They do, however, highlight some basic criteria which can be used to design tax policy. These basics are also used in the current option; this proposal may be seen as a compromise between the current system and the first two options.

Under this option, the following structure and rates would be maintained for both the corporate tax and the royalty. The corporation profits tax would be maintained at its current level of 45%; royalties as a % of annual income after deductions should be assessed in the range of 0-25%, where assessable income is defined as in Option I. The same income levels as were suggested for Option I might be considered:

<i>Rate (%)</i>	<i>Range of Annual Income after Deductions (£)</i>
0	Up to 200,000
5	200,000 - 500,000
10	500,000 - 1,000,000
15	1,000,000 - 1,500,000
20	1,500,000 - 2,500,000
25	2,500,000 and up

This would yield a maximum marginal rate of 58.75%.

With regard to the corporation tax, free depreciation would be allowed but limited to 100%. Development and exploration expenses could be written off at 100%, but would be subject to recapture when (and if) the mine becomes profitable. These changes would generate about the same revenue over the life of the mine that occur under the corporate tax proposal under Option II, except most of the tax payments, would be deferred to later in the life of the mine, reducing their present value.

The free depreciation would eliminate the subsidy element of the current law, while the expensing and recapture rules will provide adequate incentives for exploration and development with only a loss in the present value of the tax revenues to the Government.

The royalty would be at the specified structure and rates, and the methods of expensing outlined for the royalty under Option I (points 1-8) would be adopted. As previously noted, the purpose of the royalty is to collect the factor price for the reserves. While far from perfect, the expensing options outlined are a move toward a more accurate determination of the factor price of the reserves. This option would have the institutional advantage of being the least disruptive, in the sense that it is a modification of existing practise.

It would also be somewhat similar to the approach adopted vis-a-vis petroleum leases awarded after 1975. In this case, in addition to the corporation profits tax, a royalty rate ranging from 8% to 16% in 2 per cent increments will be assessed as production ranges from 40,000 barrels per day to over 350,000 barrels per day, based on value. There is also provision for up to 50% State equity participation in a commercial development, financed by the State's share of output.

Summary

We emphasise once again that these options are suggested as a basis for informed discussion. Our concern has been to ensure that mining firms be treated in an equitable manner under the tax/royalty system and that the people of Ireland get a fair return for the extraction of their non-renewable resources. Future modifications of the tax system, if any, will be based on a number of factors in addition to economic criteria.

SECTION IV

SUMMARY AND RECOMMENDATIONS

The commissioning of this study was opportune. The mining industry and the Government have both had time to digest the changes introduced in 1974; the bellicosity and acridity which characterised some of the rhetoric in years past has abated, and an opportunity now exists to continue to refine and improve policy in an atmosphere conducive to constructive change. It is important that this opportunity be taken while it is still available; a number of things, such as a major discovery or a dispute over minerals' ownership, could polarise the situation once more. In Chapter 14, the history of Irish mining and its contributions to the economy are summarised. In Chapter 15, our recommendations are presented.

CHAPTER 14

SUMMARY

For a number of reasons, the past decade has been rather traumatic for almost all of the parties directly involved with developing and implementing Irish metal minerals policies. The dramatic minerals price increases which occurred in 1973-1974 resulted in euphoric predictions on all sides concerning the future contributions which the mining industry might make to both profits and the economy as a whole; the subsequent price collapse punctured these expectations, and it has been difficult to adjust to the new realities. An extremely indulgent Government tax policy was replaced rather suddenly by a significant profits tax. Because of the court's interpretation of provisions of the Minerals Development Act (1940), the assurance that a firm discovering an ore body would be allowed to extract the minerals was called into question. Finally, no significant commercial discoveries have been made since 1970 in spite of the fact that a significant level of exploration activity has been maintained.

Much (by no means all) of the dissonance and tension which have characterised the development and implementation of minerals policy have now abated. Given this tranquility there may be natural tendency among policy-makers to "let sleeping dogs lie", and eschew policy initiatives in this area. This will be especially likely if issues concerning off-shore oil and gas development achieve prominence in the coming years. We feel, on the contrary, that the time is now most opportune to make refinements in policy. In the current environment, proposals are more likely to be examined on their merits. If we wait for a "crisis" to emerge before acting, emotional (and not necessarily rational) forces may dominate the policy debate. Before providing specific recommendations, we give a brief overview of the historic development of minerals policies, and the contribution of minerals to the economy.

History

In the 19th century, Ireland had a significant mining industry, with copper in substantial quantity being extracted from mines in Bunmahon, Co. Waterford and Allihies, Co. Cork. Lead was mined in Glendalough, Co. Wicklow. Towards the end of the century, as grade quality became lower, unit production costs increased, and this combined with lower world mineral prices to severely curtail or eliminate output of most minerals. Then followed the

interregnum; from then to the second World War, only the production of the various aggregates used in construction expanded, and Ireland achieved its reputation of being a mineral-poor country.

The Minerals Development Act of 1940 laid the basic statutory framework for Irish minerals policy. *Inter alia*, it provided for the State: to undertake prospecting and award prospecting licenses; to compulsorily acquire unworked minerals; to issue state mining leases for the working of State-owned minerals, and to impose a charge for same. This was followed in 1941 by the Minerals Exploration and Development Act, which provided for the setting up of a wholly-owned State Mining Company (Mianraí Teoranta) with authority to prospect for, mine, process and market minerals. The State confined its direct involvement in the minerals sphere largely to producing pyrites at Avoca, Co. Wicklow, for the war-time sulphuric acid industry; millions of tons of low grade copper were also proved at Avoca.

In order to encourage private investment in mining, in 1956 legislation was enacted exempting from tax profits accruing to mining companies in the first four years of profitable operation; profits in the following four years would be taxed at half the normal rate. In 1961 a rich lead-zinc-silver orebody was discovered at Tynagh, County Galway. This find stimulated a six-fold increase in the level of exploration; commercial discoveries were made of lead-zinc-silver at Silvermines, County Tipperary and copper at Gortdrum, County Tipperary.

In 1967 the period of complete exemption from taxes for firms mining non-bedded minerals was extended from 4 to 20 years. In late 1970 a find which proved to be the largest zinc-lead deposit in Europe was made by Tara Exploration and Development Company at Navan, County Meath. A portion of this orebody was privately owned, and was purchased from the owner by Bula Limited. The Government issued a compulsory acquisition order for these privately owned minerals, but the order was declared invalid by the courts. Following a change of Government in 1973, effective from April 1974 the 20 year tax exemption was withdrawn; mining firms were to pay the prevailing corporate profits tax rate which is now 45%. However, for estimating taxable income, provisions for deducting prospecting, exploration and mine development expenses and plant and machinery depreciation were made more generous than heretofore.

In 1975 an agreement was signed between the Government and Tara Mines specifying the lease terms under which the State-owned minerals portion of the Navan orebody would be extracted and paid for. The Government is given a free, non-dilutable equity participation of 25%. Royalty payments amounting to 4.5% of pre-tax income are to be paid, in addition to the normal

corporate tax payments. The Government also reached agreements with Bula Ltd. whereby the State is given a 25% share in Bula Ltd. *gratis*, with a further 24% to be purchased from the shareholders; payment for this share — totalling £9.54 million — has already been made. There have been continuing, but so far unsuccessful, efforts to encourage commercial development of a zinc smelter in Ireland.

In 1979 legislation was enacted vesting the right of working minerals exclusively with the Minister, who may work them himself or grant a lease or licence for their working; it also provides for appropriate appeals by the owner in the event that there is a dispute between the State and the owner concerning the appropriate amount of compensation. It is expected that this will help ensure that the discoverers of minerals will, in all cases, be allowed to share in the profits resulting from mining these deposits.

Minerals and the Economy

The above discussion is addressed entirely to policies relating to non-bedded minerals, primarily the metals. This is appropriate because there are few major issues of policy concerning the other minerals, particularly the aggregate minerals used in construction. However, when we turn to an examination of economic contribution, we find that extraction of the aggregate minerals — stone, slate, sand and gravel — the processing of some of these minerals into cement, structural clay products, etc., together with the extraction of energy resources (coal and turf) — make a much larger total contribution to the economy in terms of employment generated than does the metallic minerals sector.

Employment, foreign exchange earnings, linkage effects, increased net revenue to Governments, and impacts on deprived regions comprise the contributions to the economy which are analysed.

Employment

Employment estimates in selected years for the relevant sectors are presented below in Table 14.1

There is little prospect of any significant increase in employment in coal mining and turf production. Activity in stone, slate, etc., and structural clay products, cement, etc. is induced by production in the construction and related sectors; there is little scope for autonomous export-led expansion in these minerals sectors. With regard to the minerals which are internationally traded, employment prospects depend crucially on continuing discoveries; the finds of the early 1960s which are still being worked — the mines at Tynagh and Silvermines, Co. Tipperary — will close in the early 1980s.* This will leave Tara

*The Tynagh mine has already closed.

TABLE 14.1

Employment in the Minerals Sector, 1970-1978

	1970	1972	1974	1976	1978
Minerals for Domestic Consumption:					
Stone, Slate, Sand and Gravel	4.0	4.0	4.1	3.7	3.6
Structural Clay Products, Cement etc.	4.9	5.92	6.95	6.52	6.45
Coal, Turf Production, Bug Development	5.3	5.0	4.9	5.1	5.4
Total	14.2	14.92	15.95	15.32	15.45
Internationally Traded Minerals (mainly metals)	1.37	1.65	1.78	1.5	2.10
Grand Total	15.57	16.57	17.73	16.82	17.55
Internationally Traded Minerals as % of total	8.8	10.0	10.0	8.9	12.0

Mines Ltd., and Avoca Mines Ltd., providing about 800 and 225 jobs respectively, as the only significant employers. When Bula comes on-stream an additional 200-400 jobs will be provided. However, the mine closures that are in prospect mean that without new discoveries, direct employment in the mid 1980s will fall from the current level of 2100 to about 1400. Furthermore, the continuing financial viability of Avoca Mines Ltd. depends on good copper prices, while a collapse in world zinc prices could threaten Tara and Bula. It was estimated from an input-output table (Henry, 1980), that, on average for every 1 job provided in mining, there would be a maximum of 0.76 jobs in the sectors supplying the mining industry (backward linkage). Thus with 1400 employed directly in mining, there will be approximately a further 1000 jobs generated in the backward linked sectors. Making the extremely optimistic assumption that finds in the aggregate of the magnitude of the Navan orebody were made every 7 years, this would add 2-3000 direct jobs by the year 2000, with an additional 1500-2300 jobs generated in the backward linked sectors. Adding these numbers to the 1400 + 1000 jobs which will be provided from existing mines yield total employment in the range of 5900-7700 under this most optimistic of scenarios. Since current employment generated by the export minerals mining sector is about 3700 (2100 + 1600), this represents a marginal gain over the 20 year period of 2200-4000. It is clear that mining *per se* cannot be looked to as a significant source of employment to meet the job requirements of a rapidly increasing workforce.

Foreign Exchange Earnings

Only the foreign exchange implications of the internationally traded minerals sector were examined. Virtually all of the output of this sector is exported. In 1977 total exports were valued at £41.123 million, and it was estimated that the

net contribution to the balance of payments would fall in the £14-18 million range. The value of mineral exports as a percentage of total exports value peaked in 1969, when it comprised 5.7% of the total; although it was at almost the same level in constant dollars terms as 1969, in 1978 mineral exports as a percentage of the total had fallen to 1.66%, but increased to 2.28% in 1979 as Tara approached full production.

Linkage Effects

The backward linkage effects have already been touched on in the discussion of employment. Our discussion of forward linkage focused on the potential for downstream processing of metals, notably the possibility of a zinc and/or lead smelter. If a zinc smelter of the most frequently discussed size range — 100,000 to 130,000 tons of metal produced per annum — were built it would provide 450 jobs with an annual payroll of about £2.5 million. Electric power costs comprise about 20-25% of non-capital costs for electrolytic zinc smelters, and electricity is expensive in Ireland compared to costs of our European competitors in this regard. In addition, vis-a-vis existing competing smelters, the costs of providing infrastructure for a new facility exceed the operational cost savings associated with a new plant. For these and perhaps other reasons, including the depressed market for zinc during the past 5 years, no firm has been prepared to invest in a smelter in Ireland, in spite of active encouragement by the Government to do so. Much has been made of the propulsive impact a smelter would have in terms of generating further activity downstream in the minerals processing and metals fabricating industries. We were not able to find analyses which look carefully at the extent to which a smelter would provide Ireland with an overall comparative advantage in generating this type of activity. However, experience in the Netherlands is not encouraging in this regard (Ministry of Economic Affairs, 1981).

Increased Net Revenue to the Government

A major portion of the direct revenue potential of minerals derives from the fact that a scarcity rent can accrue to them; these rents exist "whenever a payment to any factor owner in a particular occupation exceeds the minimum payment required to retain a factor in that use" (Gillis, 1979, p.98). As noted above, in 1974 tax policy was modified so as to transfer a portion of this scarcity rent to the Government; the 25% public equity in Tara Mines Ltd. and the 49% equity share in Bula Ltd. will also serve to capture some of the rent for the Exchequer.

The direct returns to the Government, comprised of royalties and taxes paid by the mining companies, and income tax paid by employees, are presented below for selected years (000s £ current):

	1969	1971	1974	1975	1976	1977
Royalty	393	362	700	90	293	455
Tax	42	49	2127	1215	3359	1400
Total	435	411	2827	1305	3652	1855
Employee Income Tax	272	512	1045	1260	1540	2357
Total	707	923	3872	2565	5192	4212

It was also estimated that the indirect and income tax payments generated in the backward-linked sectors during the 1974-77 period about equalled the direct tax effects. For the future it was estimated that at full production and after repayment of debt, combined annual tax, royalty and dividend payments from Tara Mines Ltd. should fall in the £6-21 million range; it was not possible to anticipate potential revenues to the Government from other operations.

Impacts on Deprived Regions

Most of Irish minerals production, including minerals sold domestically and exported, takes place in rural areas which experience relatively low income and high unemployment. The spending of wages and salaries in these communities by miners etc., can have a rejuvenating effect on such local economies. Kearns (1978) observed that Loughrea had been transformed into a relatively prosperous and thriving community by the discovery and development of the Tynagh mine. Mining can also result in the provision of infrastructure; in this category are the port facilities at Foynes, Galway, Arklow and Dublin which have been built to ship concentrate. There may also be negative effects. The high wages and salaries paid may inhibit other firms from locating their operation in the area. There will be increased use of public services and facilities; it may not be possible to re-coup from the new users the full additional costs imposed.

Mine closure poses special problems for the people of an area who have adjusted to a periodic payroll injection into the local economy. The painful transition to a no-mine local economy has already been made in the environs of Gortdrum mine, in Co. Tipperary; the problem must now be faced in Loughrea, since the adjacent mine at Tynagh has closed.

The Gortdrum mine closed in 1975. At peak production about 240 had been employed; 102 of those employed at the time of the closure were interviewed. More than a fifth of the respondents have had difficulty finding work, and are now unemployed. Those who are working have had to accept a drop of 33% in real wages. It is clear that, in this case at least, adaptation to the closure has proved difficult for many of those directly involved. The analysis from which these data are derived is presented in Appendix J.

Minerals Taxation

It was noted earlier that, as did many other countries, in 1974 Ireland instituted a radical change in its tax regime; instead of being virtually tax exempt, as heretofore had been the case, profits accruing since April 1974 are subject to the full corporate tax rate, now 45%. However, the sector does benefit from certain expensing provisions. Immediate expensing of exploration and development is permitted, while "free" depreciation of plant and equipment outlays is allowed; mines are also allowed an additional 20% write-off for these categories, i.e., they can expense 120% of exploration costs and can depreciate 120% of outlays for plant and equipment.

In spite of the increase in minerals taxation, we found that in comparison with minerals taxation obtaining in a wide range of the other countries, Ireland's tax regime is not unduly severe. The generous expensing provisions comprise the chief means by which Ireland's system appears to be relatively indulgent. In the case of State owned minerals, a royalty, which takes the form of a percentage of profits, is also assessed. Paradoxically while in the international context Ireland's mineral tax provisions appears to be quite generous, tax rates are high when judged in terms of general corporate taxation of returns to industrial investment.

In concept, the Irish minerals tax regime is soundly based. In the short-run, profits taxes are non-distortionary. Although they reduce investment in the long-run, they can be designed so that neutrality can be maintained between mining and other forms of corporate activity.

CHAPTER 15

RECOMMENDATIONS

We have been favourably impressed by the changes which have characterized Irish minerals policy during the past decade. Of particular merit have been the attempts to improve the services provided by the Geological Survey Office and the effort to capture through profits taxation some of the scarcity rent associated with minerals. However, there are aspects which in our view provide opportunities for improvements. We have analyzed them in the pertinent chapters of our report. Here we provide a summary of our recommendations.

A. Pre-Determined Lease Terms

A major source of *uncertainty* for the mining companies is the fact that in the case of State-owned minerals, the terms of the mining lease are not negotiated until the minerals in question have been discovered and proved. This was not a disincentive to investment so long as there was a *de facto* understanding that, whatever the precise nature of the terms negotiated, they would consist of only a modest royalty charge in the form of a share of the profits. However the change in the tax regime in 1974, combined with the protracted lease negotiations involving Tara, permanently disposed of the earlier congenial (to the mining companies) arrangement, without replacing it with a new set of conditions which the mining firms can expect to obtain when it comes time to issue a lease. The presumed advantage of flexibility which such a policy confers on the Minister is likely in most circumstances to be a chimera. Minerals policy is a popular focus for public interest and scrutiny, and every lease negotiation concerning a substantial orebody will probably be both protracted and acrimonious. The range of options realistically available to policy-makers will be severely constrained by the highly charged nature of the political arena in which the decision will be made. Delays in reaching agreement can be very expensive for the mining companies involved, and therefore for the State, since its take is normally in the form of a profit share. The negotiations can give rise to rhetoric which feeds back to inhibit investment in the discovery part of the cycle.

Finally, the case-by-case approach implies that the Government can readily bring the requisite knowledge — geology, mining engineering, economic and financial analysis, accounting and legal skills etc. — to bear in determining the optimum taxation/royalty package. In practice, it is often difficult to do so; the

resulting lease package will typically owe more to relative bargaining skills and the politics of the moment than to the objective merits of the case, assuming even that the latter can be adequately discerned with the data and skills available.

We feel that it is very desirable to have publicly available fixed lease terms in existence which will comprise the main elements of all State mining leases. These provisions would have to be so calibrated that they capture some of the increased profit resulting from high prices, and should be applicable to a variety of mines, ranging from those producing large scarcity rents to those which are economically marginal. Finally, and most important, they would have to be perceived as fair and satisfactory by a large majority of the citizenry. Anything less would inevitably result in continuous pressure to change or modify the provisions as each discovery was made, thereby negating the advantage of fixed-lease arrangements.

It may be argued that it is impossible to design an immutable lease terms framework which will be appropriate for all of the circumstances which could conceivably arise in the future; in support of this contention, it can be observed that most countries do have fixed-lease terms, and in 1973/74 almost all of these nations changed their rates and conditions of minerals taxation. However, most of the pre-1973 lease-terms were very poorly designed (and many of them still are). In any event it is better to have a framework which can be modified as circumstances permit, rather than proceeding on a discovery-by-discovery basis, as is now the case. Thus we envision the fixed lease terms as providing the norm which the mining companies could expect to obtain in the event of a discovery. In presenting these terms the Government should explicitly reserve the right to change the terms, but make it clear that such would only be contemplated in the event of an exceptional deposit or a substantial change in general circumstances.

Recommendations: We recommend that a wide-ranging analysis and discussion be initiated, with the purpose of defining the principal features of fixed lease terms which can be expected to obtain for all future commercial discoveries of State-owned minerals. The Government would not of course be bound for all time to honour these terms. It would reserve the right to alter them if circumstances changed sufficiently. Other things being equal, the reduction in uncertainty and the savings in time (and therefore money) resulting will encourage investment. We outline three possible options in this regard below, when we discuss taxation.

B. Staffing and Institutional Aspects

We enthusiastically endorse the efforts which have been made to expand the capability of the Geological Survey Office. However, we feel the Government

still does not have at its disposal all of the skills which would enable it to take policy initiatives, evaluate policy proposals and implement policy in an optimal manner. By "an optimal manner" we mean having all of the necessary capabilities available so that decisions can be made expeditiously and with full cognizance of the important variables involved. Personnel with the following professional skills should be an integral part of the Government's minerals unit; mining engineering, economics, management science/accounting and law. In addition, skills in communicating with the general public, and with potential investors in mineral's exploration and development, would be valuable. Finally, increasing the existing in-house capability to provide more rapid processing of exploration license requests, to help computer process and interpret the geological data available so that it can be of value in exploration, etc., would be useful. That there are deficiencies in the current capabilities of the Government is not at all a criticism of the performance of those now responsible for the development and implementation of policy; indeed it is remarkable how well these duties have been discharged, given the limited resources and skills available.

Recommendations: We recommend that the Government organize its minerals policy initiation and implementation efforts so as to project a dynamic, development, service-oriented image. This can be done by expanding existing service capacities (processing of applications, computer coding, analysis and interpretation of data etc.) and by improving analytical capabilities through the addition of such full-time professional in-house skills as mining engineering, economics, management science/accounting and law. We examined alternative ways of organizing these resources, ranging from simply adding the necessary personnel to the existing structures to establishing a Minerals Development Board to implement policy, with policy analysis being conducted by a small core group within the Department of Energy. We were unable to undertake a comprehensive evaluation of the institutional constraints and possibilities, and so we make no recommendations in this regard.

C. Terms of Taxation and Royalty Payments

We cannot predict what impact a given tax/royalty regime will have at the margin on exploration, and what success will attend the latter. It follows that, in designing a tax system which will apply only to prospective discoveries, there is an element of subjective judgement involved in trading off adequate rent capture on the one hand with the encouragement of minerals exploration and development on the other.

It is important that the tax system does not encourage the development of marginal deposits of the type which yield no rent, provide (by definition) only temporary employment and impose high social costs in terms of planning

requirements, depreciation of public infrastructure, environmental disruption, transfer payments to redundant miners, or (in the worst case) subsidy by the taxpayer of uncommercial operations. It is important on the other hand that the discovery and development of net rent-yielding deposits be encouraged, with adequate provision to return a sufficient share of the rent to the resource owners, namely the public (in the case of State-owned minerals).

Maintaining a clear distinction between the tax on capital — corporation profits tax — and the charge for the publicly owned mineral — the royalty — is important. If the distinction is not clearly maintained public (and perhaps official) perceptions of the issues involved become confused and minerals "taxation" issues become mixed up with general tax policy; the simply stated objective — to ensure that the resource owners get a fair price for their mineral endowment — should be a clearly delineated and separable component of tax/royalty policy.

We noted earlier that the tax/royalty scheme now operational in Ireland is theoretically sound, in that the State take is in the form of a share of the profits. For a given level of investment, the maximum amount of ore will be extracted; the taxpayers share the risk of the venture by reducing — sometimes to zero — the "price" charged for ore in bad times, while also sharing commensurately in the benefits where profits are high. The progressive (very mildly so in Ireland) nature of the royalty will encourage stretching out the period over which the ore is extracted, which is usually desirable. On the negative side, the unusually indulgent expensing provisions reduce the rental and may encourage the development of marginal deposits which can impose heavy costs for very little gain; they may also encourage over-leveraging of investment, wherein the proportion of the investment borrowed is so high that in adverse market and/or production conditions the viability of the enterprise is affected and the return to the resource owners is unduly deferred.

The tax/royalty arrangements already negotiated should of course be fully adhered to. The adjustments under discussion here would apply only to new discoveries.

We outline three possible options relating to State-owned base-metals. Each of them have the following common features:

- (i) They provide fixed lease terms — the mining companies should know what to expect in the event of a discovery.
- (ii) A clear conceptual distinction is maintained between taxing the returns to capital (corporate taxes) and the payments required for the use of a scarce publicly owned resource (State-owned minerals).

In computing the royalty; provisions (iii) through (vii) should apply:

- (iii) Limited or no free depreciation.
- (iv) Development and other pre-production expenses should be amortized at the producer's option on the unit of production or straight-line method.
- (v) Pre-production exploration expense should be amortized over the first 10 years of production. Post-development exploration should be treated as a development expense and amortized according to (iv).
- (vi) Interest payments should not be allowed as a deduction; the royalty should continue to be so allowed in computing taxable income.
- (vii) No foreign head-office charges, foreign management fees and royalty fees should be allowed as a deduction.
- (viii) Payment of royalties to private mineral owners should be a credit.
- (ix) The same tax/royalty rate structure should apply to all *new* mines.

Option I

The corporate tax rate will be 10%, as is now proposed for all manufacturing industry. This would maintain neutrality between taxation on returns to capital investments in manufacturing industry and returns to investments in mining. The payment to the Government for the State-owned minerals (royalty) will take the form of a progressive share of annual income after deductions. The following rate structure might be considered:

Rate	Range of Annual Income after Deductions (£)
10%	Up to 200,000
20%	200,000 to 500,000
30%	500,000 to 1,000,000
40%	1,000,000 to 1,500,000
50%	1,500,000 to 2,500,000
60%	2,500,000 and up

These rates can be indexed to adjust for price inflation in the economy, unless accounting practices already reflect inflation. The highest marginal tax rate will be 64%. A major liability of this approach is that the royalty, being a factor payment, will not be recognized as a creditable tax for determining the tax liability of a foreign firm in its home country.

Option II

Under this option the tax rate would be 50%. A royalty of 5% of *total revenue* based on the average market price of the mineral over the past 10 years would be assessed. In addition, the rate should be adjusted one-quarter of one percent for each 5% change in the market price in each period. This method

allows revenue to fluctuate according to market conditions. Since the base is total revenue and not total profit, the rate is correspondingly lower to reflect the increased base and the larger downside risk because the tax is paid regardless of positive cash flow. While the total effective tax rate will be about the same as in Option I (55% if costs are one-half of total revenue), the mine will pay proportionately more income taxes and less royalties. Under this alternative Government may purchase equity in the mining firm.

There are two advantages to this option: the royalty is easy to administer, thereby decreasing costs of enforcement and administration, and, by shifting the major source of revenues from the royalty to profits there will be a corresponding increase in the value of taxes which are creditable under the home-country tax rules for foreign investors.

Option III

The corporation profits tax would be maintained at its current level of 45%; royalties as a % of annual income after deductions should be assessed in the range of 0-25%, where assessable income is defined as in Option I. The same income levels as were suggested for Option I might be considered:

Rate %	Range of Annual Income after Deductions (£)
0	Up to 200,000
5	200,000 to 500,000
10	500,000 to 1,000,000
15	1,000,000 to 1,500,000
20	1,500,000 to 2,500,000
25	2,500,000 and up

This would yield a maximum marginal rate of 58.75%. This option has the advantage of being most similar to the existing taxation/royalty framework.

It is also somewhat similar in concept to the taxation/royalty structure applying to Petroleum Leases awarded after 1975. In addition to the corporation profits tax, there is an output royalty ranging from 8 to 16% in 2 per cent steps as annual production increases from up to 40,000 barrels per day to over 350,000 barrels per day.

These are only three of a variety of possible tax/royalty options. We emphasise again the desirability of initiating an informed debate with the purpose of deriving tax and royalty terms which will apply to future mineral discoveries. As noted earlier, for those mines concerning which terms of ownership, royalty, etc., have already been determined, we feel that they should continue to operate under the existing terms and agreements.

Monitoring Tax Policy

Data on income from royalties are readily available, since payments are made to the Department of Energy, and the amounts are published semi-annually. However, tax payments are made to the Revenue Commissioners, and these data are not available. Without the permission of the companies involved, the Commissioners will not usually make available the total tax payments made in the aggregate by the firms in a particular sector. Thus it is difficult to monitor the effectiveness of the change in minerals taxation initiated in 1974, or to continue to monitor progress in this regard.

Non-Metallic Minerals

The discussion of royalty charges in Option I, II and III above pertained to the metallic minerals only. The State owned non-metallics, primarily gypsum, barytes, dolomite and coal — are typically disposed of for a fixed amount per ton. In the case of those long-term contracts which specified such a price without a proviso for adjusting for inflation, it is clear that, over time, the real price will approach zero. The contracts which have most recently been negotiated or re-negotiated have included provision for price indexing to account for inflation. This is an appropriate pricing mechanism, and can be shown to be relatively non-distortionary. This is because, unlike base-metal deposits, the marginal cost per ton extracted tends to stay stable as the deposit is depleted. However, its adequacy depends crucially on the rigour with which the "base price" has been derived. It is especially difficult to arrive at the correct residual price for minerals *in situ* when they are further processed (as is the case with gypsum and dolomite) or transferred to parent or related firms abroad, as in the case of some barytes' exports. In such cases it is necessary to have information on; the prices obtaining if there are any firm-to-firm transactions within Ireland; the international market price, if the mineral is marketed in its unprocessed state; the returns to labour, capital and non-mineral materials for the firms involved — the residual value accruing to the mineral can be estimated by deducting from total revenue these "normal" factor returns.

Recommendation: We recommend that it be an integral part of lease policy that mining firms allow the Revenue Commissioners to provide aggregate information on tax payments. We suggest that, in the case of the non-metallic minerals, the firms involved be required to provide all of the cost and price information necessary for deriving the appropriate value of the minerals *in situ*.

D. State Equity and a State Mining and Exploration Company

State Equity

The Irish Government owns 25% of Tara Mines Ltd. and 49% of Bula Mines Ltd. The stake in Tara and 25% of the Bula holding were not charged for.

However, these shares, although perceived of as "free" have a number of disadvantages. Since the free equity participation is in essence a tax, the mining firm will see its net return reduced, and with other things being equal, reduce its investment; the level of investment, output, employment, etc., will be less in a mine with "free" equity participation than in one without such participation. A 25% equity stake will not return as much to the State treasury as a 25% income tax, since fewer deductibles are allowed in computing taxable income than are included in estimating profits. While the dividend payments made to the Government are, in effect, a tax, they are not creditable as such in the home country of multinational firms. Incentives are created to use interaffiliate transactions and the like to decrease the size of the total earning which can be distributed. The day-to-day management of the company may be complicated by a board membership, some of whose members are answerable to both the shareholders in general and the Government. Finally, there may be greater tendency to use taxpayers' money to keep a loss-making mine with Government equity open than would be the case with a wholly private company.

There are important symbolic and psychic advantages to state equity. It can help give the public confidence that their interests will be protected; this can be especially valuable when the balance of the equity is held by multinationals. Government, through its nominees on the boards, can learn about the intricacies of company operation, and identify and act upon corporate actions inimical to the public interest. In practical terms, if the combination of taxation and royalties does not capture an "adequate" return for the public, then the return to State equity can help fulfill this role.

However, the existing framework can be used to ensure that the appropriate amount of return is achieved through the taxation/royalty mechanism. Lease terms can be specified so that access is assured to whatever information is required, while they can also be drafted to ensure compliance with other State goals. Thus, the taxation, royalty and lease provisions taken together can be used to ensure a close coincidence of private firm behaviour with public objectives.

State Mining and Exploration Company

It has been proposed that a State Mining and Exploration Company be established, operating as a limited company, to explore for the full range of minerals; it would not receive preferential treatment in terms of access to technical data, in the allocation of prospecting licenses, etc. This proposal in essence calls for the resuscitation in a slightly modified form of Mianrai Teoranta, the defunct but never formally abolished State Mining Company established in 1941. The Geological Survey Office does a little exploration, but mainly for minerals or in areas not now of interest to the private mining companies.

A key rationale for direct State intervention would be evidence of market failure, that is, evidence that the "normal" market incentives are not functioning adequately, resulting in underinvestment in the sector. The uncertainty engendered by both lack of pre-specified lease terms and the minerals ownership issue has probably resulted in a less than optimal level of investment in exploration. Ironically, if a State company competing aggressively with private firms was perceived by the latter to be favoured (correctly or not) in terms of access to data, allocation of licenses, etc., this would comprise an important source of market failure; private firms would reduce or eliminate entirely their exploration efforts in deference to the "unfair" competition. Given the mild parancia which seems to characterise some segments of the Irish mining industry, this is a possible consequence of establishing an active State mining company which must be considered seriously.

Recommendations: With regard to State equity, from a strictly economic prospective we feel that it is better to use the lease provisions combined with the tax/royalty terms to achieve policy objectives, rather than take "free" equity in the mining companies for this purpose. However, we recognize that there are other non-economic factors involved.

With regard to the proposed State Mining and Exploration Company, we feel that it would be pre-mature to establish such a company at this time. It would be wiser to wait and see if appropriate fixed lease terms, a minerals policy unit with more skills in the relevant professional areas combined with the actions already taken regarding minerals ownership, will be sufficient to ensure an adequate level of private investment. It would, however, be wise to continue and perhaps expand State investment in exploration in areas and/or for minerals not now actively sought by commercial firms. The terms of reference of this operation should be clearly specified.

For the longer term, in the event that private sector investment diminished significantly, consideration should be given to the possibility of establishing a State Mining Company which would have access to all of the technical data available, would schedule exploration in an optimal manner, etc. The company which has the whole background on an area will typically have more than twice as much information as two competing firms each of which has half the story.

E. Minerals Ownership

Legislation has been enacted vesting the right to work minerals in the Minister for Energy, and it is hoped that this will mitigate the uncertainty concerning ownership.

Recommendations: In anticipation of possible future lawsuits, an independent study should be initiated which rigorously outlines, in both theoretical (anatomy of market failure, etc.) and practical terms (income and employment foregone, etc.) the public interest involved in assuring security of tenure. The logic of using this legislated approach versus other methods should be carefully developed, with special reference to experience in this regard in other countries. Unless this type of analysis is done before-hand by recognised experts, the courts will have inadequate background concerning the tradeoffs involved when judgements must be made.

Another complementary approach to the ownership issue which has merit is to assist private mineral owners to understand what is a reasonable and mutually advantageous negotiating stance. In particular, the concept of a contract which would give the explorer a legal right to any mineral rights, with negotiating terms specified in the event of a commercial discovery, could be developed and promoted.

F. Downstream Development

We did not find any studies which clearly indicated how and to what extent an Irish zinc smelter would provide Ireland with a comparative advantage vis-a-vis further minerals processing and metal fabricating. Without this evidence, we feel that grants, incentives, Government equity, etc. beyond what a smelter would warrant in its own right as a generator of income, employment, etc., should not be provided. This position appears to reflect current Government policy.

G. Marginal Mines

Since payments by mining companies to the Government (taxes and royalties) take the form of a share of the profits, if there are no profits there will be no payments. We have noted already that mining is a particularly inappropriate vehicle for generating employment using public funds; it is highly capital intensive, of finite duration and many of the skills acquired are of limited value in other occupations.

To put all of this in context, we note that the average grant cost per job approved in new overseas industry amounted to £7,063 in 1979 (IDA *Annual Report 1979*, p. 7). If we make the arbitrary assumption that, at the margin, it requires £10,000 of tax-payer subvention to attract the other overseas capital necessary to generate a job in Ireland, we can get a sense of the opportunity costs involved. When, say, £4 million is provided to support a loss-making mine, 400 reasonably permanent and presumably typically self-sustaining jobs are being foregone elsewhere in the economy as a result. This is a vast oversimplification, but the central implication — that subvention means foregoing economic activity elsewhere in the economy — cannot be gainsaid.

Recommendations: We recommend that no public funds be employed to support "marginal" mines. Funds so used would in all likelihood be better employed elsewhere in the economy. In the event that a royalty unrelated to profits was assessed (e.g. the 5% of total revenue, as suggested in Option II above), then, in exceptional circumstances a portion or all of this income to the Government could be deferred.

H. Industrial Minerals

In our recommendations concerning taxation (item C), with regard to State-owned non-metallic minerals, we suggested that the firms involved in their development be required to provide all of the cost and price information necessary for deriving the appropriate value of the minerals *in situ*; this would in turn provide the basis for the State's minerals pricing policy. In our recommendations regarding a State Mining and Exploration Company, we suggested that it would be wise to continue and perhaps expand State investment in exploration and/or for minerals "not now actively sought by commercial firms", and that the terms of reference of this operation should be clearly specified.

In addition to these two actions, which concern industrial minerals primarily, we feel that a policy addressed specifically to the discovery and development of industrial minerals should be articulated and implemented. For purposes of this discussion we define industrial minerals as those which are not metallic and not aggregate minerals (stone, sand and gravel). Giving industrial minerals a sharper policy focus is warranted for a number of reasons:

Since the industrial revolution of the 19th century bypassed most of Ireland, the intensive exploitation of industrial minerals which has taken place in most European countries for more than a century has not occurred in Ireland; other things being equal, Ireland should have a much larger reservoir of undiscovered minerals of this type than the "old" industrialised nations.

The current exploration efforts are predominantly concentrated on metals. It is quite conceivable that a company could have economically exploitable industrial mineral deposits in its leasing area and never discover them, because it was not looking for these types of minerals.

Because of problems of transfer pricing, vertical integration etc., it can be difficult to arrive at appropriate pricing and lease terms for many of these minerals. Rather than proceed on an *ad hoc* basis in these regards as each discovery is made, it would be preferable to have coherent price and leasing policy in place so that each case can be viewed and analysed in an overall policy context.

The capital required per employee engaged in the mining of industrial minerals is typically an order of magnitude less than that which is necessary in metals mining. In many (but not all) cases this increases the probability that relatively small local companies will be able to finance (and therefore control) the exploitation of these minerals.

It is unlikely that the existence of an economically exploitable industrial mineral will of itself be sufficient in most cases to attract downstream industry; for example we would not expect a cut-glass factory to locate in Ireland simply because there were appropriate silica-sand deposits available. However, Ireland's industrial base is now such that the availability of a variety of competitively priced industrial minerals could be a very useful complement in attracting industrial investment. In many instances, the economic "fit" is likely to be much better between industrial minerals and downstream processing than is the case with the metals.

The Geological Survey Office has undertaken some exploration and mapping work regarding industrial minerals, and staff-members have provided summary descriptions of known deposits. At the Institute for Industrial Research and Standards there has been an attempt to identify the role which the development of industrial minerals could play in servicing the raw material needs of both the existing and an expanded industrial base. Recent leases of State-owned industrial minerals incorporate provisions for price-indexing. Implementation of our recommendations below would build on these initiatives.

Recommendations: The Government has a number of mechanisms which can be employed to enhance the prospects of industrial minerals discovery and development. These include advertising and support services for the private sector, the use of exploration lease terms to encourage exploration, and the undertaking by the State of exploration.

We recommend that an integrated programme embracing all three of these approaches be mounted. All of the existing knowledge concerning industrial minerals needs to be compiled, packaged and presented to potential explorers in a manner which facilitates the latter's involvement. Exploration lease terms, and the assignment of leases, should encourage exploration for these minerals, while, as recommended earlier, the State's direct exploration role should be formalized and expanded. Also, as suggested earlier in the discussion of lease terms, the royalty terms obtaining in the event of a discovery should be outlined. Activity in most of these areas is already underway; what is needed is an effort to crystallise these efforts, market the opportunities regarding industrial minerals, and in general give the potential for industrial minerals exploration and development a higher profile.

J. Issues not Considered

It is a frustrating feature of policy studies that inevitably a variety of fascinating topics emerge which cannot be adequately addressed with the time and resources available.

The following is a partial listing of such issues:

- Environmental Aspects. The general environmental management mechanisms which are available to the Government are summarized in Convery (1978). We did not evaluate the adequacy of these strategies vis-a-vis mining. If economically exploitable deposits of uranium are discovered, environmental management issues will assume particular prominence.
- Safety and Health of Miners. There have been a number of fatalities in Irish mining. Safety regulations are promulgated and enforced by the Department of Labour.
- Education and Research. There is a mining engineering diploma offered by Athlone Regional Technical College, while a geosurveying course is provided at Bolton Street College of Technology. Some research is carried on at the Universities and by the mining companies. The EEC provides funds for research through what is known as the CREST programme; these are administered by the National Board for Science and Technology.
- Industrial Concentration. One company has significant shares of various segments of the aggregate minerals extraction and processing markets. We did not explore the extent to which this would translate into market power, or what the efficiency implications of the latter might be. The mechanisms for dealing with monopoly power in the economy as a whole were not examined.

The Future

There has been no discovery of a major economically exploitable deposit in Ireland for a decade, and two mines which started operating in the mid-nineteen sixties—Tynagh and Silvermines—are expected to close within the next few years. There are periodic reports of promising indications of minerals occurrence in economically exploitable quantity—uranium in Donegal, copper in Co. Mayo, etc.—but none of these have yet been confirmed. In the case of metals, primary activity for the next decade will center on the exploitation of the Navan deposit. Unfortunately, the near-term outlook for zinc metal prices is not promising, while costs continue to increase. It is clear that the mining industry faces a very challenging period; every effort needs to be made to ensure that resources engaged in the mining sector are employed as efficiently as possible. We believe that implementation of our suggestions would contribute to this end.

Summary

The scarcity rent which minerals can yield comprises the primary benefit of the mining sector in the Irish economy. Capturing this rent and investing it productively in the Irish economy comprises a primary policy objective. The corollary of this view is that care should be taken not to dissipate the rent on relatively unproductive investments such as unprofitable mines, downstream manufacture with little propulsive potential, or State exploration and mining ventures which inhibit private investment.

Effort should be clearly directed to maximizing before tax profits in the sector, and then ensuring that a large proportion of the profits so generated are "captured" for re-investment in the economy. To this end, we recommend that fixed lease terms be specified which will obtain for most categories of State-owned minerals. Adding personnel with skills in economics, mining engineering, management science/accounting, law and communications to the Government's policy initiation and implementation unit(s) would be a worthwhile investment, as would increasing existing capability to process exploration license applications and information. Some institutional adjustments to project a more development/service oriented image may also be warranted.

Once appropriate lease terms are in-place, there is little economic (rent-capture) rationale for State equity in mining companies, but we recognize that there may be other issues involved. With regard to the proposed State Mining and Exploration Company, we feel that it would be pre-mature to initiate such an endeavour without waiting to see whether the actions proposed above, together with existing policies, will be sufficient to ensure the requisite level of private sector investment. However, expanding and formalizing the current exploration effort by the Geological Survey Office in areas and for minerals not now of commercial interest is warranted. Efforts should be initiated to demonstrate the public interest in achieving some surity of tenure for the discoverer vis-as-vis privately-owned minerals. Information on aggregate taxes paid is necessary in order to monitor policy effectiveness in this regard. Permission to the Revenue Commissioners to make such aggregate data available should be a condition of lease-terms. In the case of the non-metallic minerals, it is suggested that the firms involved be required to provide all of the cost and price information necessary for deriving the appropriate value of the minerals *in situ*.

Finally, it is suggested that industrial minerals development be encouraged by providing advertising and support services for the private sector, by using exploration lease terms to encourage exploration and by having some exploration undertaken by the State.

The policy initiatives suggested are in a sense rather marginal, and are unlikely to cost in excess of £0.5 million for a year. However, we feel that implementing our proposals would contribute greatly to the prospects for enhancing the net return of the mining sector to the nation.

GENERAL REFERENCES*

- Abelson, Philip H. and Allen H. Hammond (Eds.), *Materials: Renewable and Nonrenewable Resources*. American Association for the Advancement of Science, Washington D.C., 1976.
- Baker, T. J. "Building and Construction" in *Irish Economic Policy: A Review of Major Issues* edited by B. R. Dowling and J. Durkan, The Economic and Social Research Institute, Dublin, 1978, pp. 125-149.
- Barnett, H. J. and Morse, C., *Scarcity and Growth*, John Hopkins University Press, Baltimore, 1963.
- Baroch, Charles T. and Charles J. Baroch, "Nuclear Energy Fuels and their Utilisation" in Vogely and Risser 1976, pp. 498-510.
- Blake, John, "The Smelter Russian Deal Founders". *Irish Mining Review* 1(2), March 1978, pp. 8-10.
- Blake, John, "Barytes: Ireland — A World Leader". *Irish Mining Review* 1(3), 1978, pp. 10-12.
- Bleicken, Kurt, "Lead" in Novick *et al* 1976 pp. 148-157.
- Bleicken, Kurt, "Zinc" in Novick *et al* 1976, pp. 130-139.
- Boadway, Robin W. *Public Sector Economics*, Cambridge, MA: Winthrop 1979.
- Bureau of Mines. *Bulletin 667. Mineral Facts and Problems, 1975*. US Government Printing Office, Washington D.C., 1976.
- Byrne, R. F. and Sparvero, L. J. "A Study and Model of the Exploration Process in the Non-Fuel Mineral Industry", report to United States Bureau of Mines 1969. Available through Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia, PB 183 526.
- Cammarota, V. A., Jr., H. R. Babitzke, and J. M. Hague. "Zinc" in Bureau of Mines 1976, pp. 1-19.
- Conrad R. F. "Royalties, Cyclical Prices and the Theory of the Mine", *Resource and Energy* 1 1978, pp. 139-150.
- Conrad, R. F. and Hool, B. "Reserve Determination, Output Effects and Mining Taxation", Unpublished: Duke University, 1979a.
- Conrad, R. F. and Hool, B. "Progressive Profits Taxes and the Mining Decision", Unpublished: Duke University, 1979b.
- Convery, Frank J. "Some Environmental Policies — Review and Outlook". *Issues in Irish Economic Policy: A Review*, edited by B. R. Dowling and J. Durkan, The Economic and Social Research Institute, Dublin, 1978, pp. 355-387.
- Cook, Earl, "Limits to Exploitation of Nonrenewable Resources" in Abelson and Hammond (Eds.), 1976, pp. 62-67.
- Cunningham, M. A. "History", *Mining Ireland*, 1973, pp. 18-22.
- Dowling, B. R. "Main Impact of Mining Operations will be on Trade Statistics", *Irish Times*, June 30, 1977, p. 26.
- Dowling, Brendan R. "Valuations of Bula", Letter to the *Irish Times*, 21 February, 1977.
- Dreyer, Robert M. "Construction Minerals" in Vogely and Risser 1976, pp. 578-587.
- Farmer, M. H. "Making the Most of Metallurgy", *Irish Engineers* 28(7), August, 1975, pp. 22-26.
- Finlay, Sean. "The Future: A Favourable Environment for Expansion", Paper presented at the Conference on Irish Mining and Exploration by the Irish Mining and Exploration Group, Confederation of Irish Industry, Dublin, June 20th, 1979.
- Frohling, Edward S. and McGeorge, Robert M. "How Stepwise Financing Can Turn Your Prospect into an Operating Mine", *Mining Engineering* 27, September, 1975, pp. 30-32.
- Gardiner, Piers and Ralph Horne, "Mining Geology: What's Where in Ireland". *Mining Ireland*, 1973, pp. 27-38.
- Geary, Patrick T. and Edward McDonnell, "The Cost of Capital to Irish Industry: Revised Estimates", *Economic and Social Review*, 10(4), 1979, pp. 287-299.

*Further detailed tax references are available from the NESCI.

- Gillis, Malcolm, Bucovetsky, Meyer W., Jenkins, Glenn P., Peterson, Ulrich, Wells, Lovis, T., Wright, Brian D. *Taxation and Mining*, Ballinger Publishing Company, Cambridge, Mass., 1978.
- Grimes, T. A. "Base Metal Production and the Irish Economy", Central Bank, Annual Report, Dublin 1978.
- Hails, J. L., Bellum, P. P. and Lewis, C. K. "The Determination of Optimum Ore Reserves and Plant Size by Incremental Financial Analysis", *American Institute of Mining, Metallurgical and Petroleum Engineers - Society of Mining Engineers*, preprint February, 1969.
- Hayes, Earl T. "Energy Implications of Materials Processing" in Abelson and Hammond (Eds.) 1976, pp. 33-37.
- Harberger, A. C. "The Taxation of Mineral Industries", *Federal Tax Policy for Economic Growth and Stability*. Washington D.C. GPO, 1955, pp. 439-449.
- Henry, E. W. Irish Input-Output Structures, 1976, *Paper No. 99*, The Economic and Social Research Institute, Dublin, 1980.
- Hoskold, H. D. *The Engineers' Valuing Assistant*. London: Longmanus, Green and Co., 1977.
- Just, Evan. "The Production Process", *American Institute of Mining, Metallurgical and Petroleum Engineers*, 1967, pp. 379-402.
- Kane, Robert. *The Industrial Resources of Ireland*, Hodges and Smith, Dublin 1844. (Reprinted Irish University Press, Dublin 1972).
- Kearns, Kevin C. "Some Contributions of Irish Base Metal Mining", *Irish Geography*, Vol. 8, 1975, pp. 126-131.
- Lewis, P. J. and C. G. Streets. "Analysis of Base-Metal Smelter Terms", *Proceedings of the Eleventh Commonwealth Mining Conference*, Hong Kong, 1978, published in London, 1979.
- Lindley, A. H. et. al. "Mineral Financing", *American Institute of Mining, Metallurgical and Petroleum Engineers* 3 1976, pp. 420-32.
- Luke, Gerald. "Tara - On the Tightrope". *Business and Finance*, July 5, 1979, pp. 6-7.
- Lyons, F. S. L. *Ireland Since the Famine*, Weidenfeld and Nicolson, London, 1971.
- McArdle, P. and D. Naylor, "Geological Indications of Future Potential in Irish Mining", *Technology Ireland* 9 (6), pp. 20-23, 1977.
- McGrath, Brendan. "Arigna: Technology to the Rescue", *Irish Mining Review* 1 (2), March 1978, pp. 12-13.
- McGrath, Brendan. "Mineral Exploration: A Period of Transition?" *Irish Mining Review*, 1 (4), 1978, pp. 8-13.
- McGrath, Tom. "The Wheel Turns Full Circle at Ballingarry". *Irish Times*, July 26, 1979, p. 10.
- McKenzie, B. W. "Economic Evaluation Techniques Applied to the Mine Development Decision", Society of Mining Engineers Preprint 69K 326, Society of Mining Engineers Fall Meeting, Salt Lake City, September 1969.
- MacKenzie, B. W. "Evaluating the Economics of Mine Development", *Canadian Mining Journal*, 91, December, 1970 pp. 43-47 and March 1971 pp. 46-52.
- McKinstry, H. E. *Mining Geology*. New York: Prentice Hall, 1948.
- Maximov, A. Miloserdina and Eremin, N. *Short Course of Geological Prospecting and Exploration*; Moscow, Mir Publishers, 1973 (First English Translation).
- Mikami, Harry M. "Refractories" in Vogely and Risser 1976, pp. 622-632.
- Miller, R. H. "Computer Programs for Economic Evaluation of Underground Bituminous Coal Mines". Washington: Department of the Interior, Bureau of Mines, 1971.
- Mitchell, Frank. *The Irish Landscape*, Collins, London, 1976.
- Neligan, David. "The Need for National Control", *Management*, November 1974, pp. 36-37.
- Novick, David, K. Bleicken, W. E. Deputy Jr., Stanley A. Hutchins, J. W. Noah, and M. B. Novick. *A World of Scarcities*, Halsted Press, New York, 1976.
- O'Sullivan, Aidan. "Could Castlecomer Come Through with the Goods?" *Irish Times*, August 13 1979, p. 11.
- Patterson, J. A. "Estimating Ore Reserves following Logical Steps", *Engineering and Mining Journal* 160, September 1959.
- Pfleider, E. P. (ed.). *Surface Mining*. New York: *American Institute of Mining, Metallurgical and Petroleum Engineers*, 1968.
- Preston, L. E. *Exploration for Non-Ferrous Metals*. Baltimore: John Hopkins, 1960.
- Raymond, L. O. "Valuation of Mineral Property", *AIME Economics of Minerals - 1976*. 1976.
- Roff, Arthur W. and Franklin, James C. "A Statistical Mine Model for Cost Analysis, Planning and Decision Making", *Quarterly of the Colorado Mines* 59 October, 1964, pp. 915-24.
- Ruane, Frances, "Project Analysis and Industrial Employment in Ireland" in *Quarterly Economic Commentary*, by J. Durkan and B. O'Loughlin, Economic and Social Research Institute, Dublin, June 1979, pp. 17-34.
- Schultz, Richard W., "Mineral Exploration". *Mining Ireland*, 1973, pp. 42-52.
- Smith, D. and L. Wells, *Negotiating Third World Mineral Agreements*. Lexington: Lexington Books, 1975.
- Stahl, J. E. and Lazzirowicz, J. "Mining Investment Evaluation Techniques: A Comparative Analysis", *The Canadian Mining and Metallurgical Bulletin* 67 (August 1974), pp. 115-17.
- Strauss, Simon D., "Nonferrous Metals", in Vogely and Risser (Eds.), 1976.
- Sunley, E. M., "Tax Neutrality Between Capital Services Provided by Long-Lived and Short-Lived Assets", OTA Discussion Paper 410, US Treasury, 1976.
- Tansey, Paul. "Looking for Buried Treasure Under Irish Soil", *The Irish Times*, July 5 1979, p. 10.
- Teeling, John J. "World Economic Trends and Their Effect on Metal Markets". Paper presented at the Conference on Irish Mining and Exploration by the Irish Mining and Exploration Group, Confederation of Irish Industry. June 20th 1979.
- Thomas, L. J. *An Introduction to Mining*. Sidney: Hicks Smith and Jones, 1973.
- Vogely, William A. and Hubert E. Risser, Editors, *Economics of the Mineral Industries*, 3rd Edition, American Institute of Mining, Metallurgical and Petroleum Engineers, Inc., New York, 1976.
- Walsh, Francis. "The Smelter". Letter to *The Irish Times*, July 24 1979.
- Whelan, Brendan J. and Brendan M. Walsh. Redundancy and Re-employment in Ireland, *Paper No. 89*, Economic and Social Research Institute, Dublin 1977.
- World Bureau of Metal Statistics, *World Metal Statistics* 32 (7), London, July 1979.

APPENDIX A

INTERNATIONAL SURVEY OF TAX, ROYALTY AND STATE EQUITY PROVISIONS

Countries Surveyed:

Australia
Bolivia
Brazil
Canada
Chile
Indonesia
Ireland
Liberia
Malaysia
Mexico
Peru
Thailand
United States
Zambia

SURVEY OF TAX LAWS

Australia

Income Taxes

Rates: 45%. Prior to 1974, 20% of mining profits were exempt.

Major Items: Costs of leases and concessions not deductible.

Exploration deductible in year incurred to current income. Remainder carried forward.

Development deductible using declining balance method over mine life or 25 years, whichever is less.

Capital expenditures for mine depreciated using straight line or declining balance over mine life. Other depreciable items use asset guideline range.

Home office charges, interest and training costs are deductible.

Losses carried forward for seven years.

Withholding Taxes: 30% on dividends (reduced to 15% under various treaties).

10% on interest.

Output Taxes: Royalties vary among states and are deductible from federal taxes.

Bolivia

Income Taxes: None.

Output Taxes:
Export Royalty: Rates on progressive scale from 2.5c to 53.2c per ton based on price. Based presumptive market price and costs.

Export Tax: Rates vary across minerals: 2% on zinc to 7.5% on high-content copper. Based on gross value.

Government Participation: Government owns largest mining company and tin smelter.

Brazil

Income Taxes
Rate: 30%. An additional 5% imposed on distribution to nonresidents.

Major Items: Lease and concession acquisition costs deductible on unit of production method.

Exploration amortized on unit of production method. Option to use percentage depletion for first 10 years subject to a maximum of 20% of gross receipts at mining stage in any year.

Development: unit of production method.

Fixed assets: straight line depreciation or unit of production method at firm's option.

Home office charges are subject to negotiation.

Interest is fully deductible when paid to unrelated parties. Interest on intrafirm loans not deductible if debt/equity ratio exceeds 3.5.

Unlimited loss carry forward.

Withholding Taxes:

15% on dividends and interest paid to financial institutions.

30% on all other interest payments.

Output Taxes:

.05c (US) per ton plus 1% in excess of ten-year price average over 115%.

Income Taxes

Rates:

46% and 10% credit for provincial taxes.

Major Items:

Exploration expensed to current income.

Development: 30% declining balance method.

Depletion: 25% current profits subject to new exploration and investment limitations.

Resource Allowance: 25% operating profit deduction.

Provincial taxes are not deductible.

Interest and home office charges deductible.

Withholding Taxes:

25% unless modified by treaty.

Canada — British Columbia

Income Taxes:

Mineral Resource Tax: 17 ½ % on each separate mine's income. Federal tax base plus resource allowance.

Mining Tax: 15% of mining income not covered under Mineral Resource Tax. Base is same as Mineral Resource Tax. (Applies only to coal and industrial minerals.)

Output Taxes:

Coal Tax: \$1.50 per ton of metallurgical coal and 7.5% per ton of thermal coal.

Canada — Alberta

Incomes Taxes:

15% using federal definitions.

Output Taxes:

Variable royalty on coal and oil (5% to 35%).

Gross royalties on other minerals.

Canada — Saskatchewan

Income Taxes:

14% using federal definitions.

Output Taxes:

2.5% gross value of potash.

Progressive Reserve Tax on Remaining Reserves (cost not considered).

Progressive royalty on uranium based on ratios of profit to capital expenditure (15% to 50%).

3% basic uranium royalty.

Canada — Manitoba

Income Taxes:	14% using federal definitions.
Specific Mineral Taxes:	Metallic Minerals Royalty Act: 15% on rate of return below 18% and 35% on rate of return above 18%. Basis is inflation adjusted depreciated investment. Mining Royalty and Tax Act (Industrial minerals): 6% on first \$50,000 of income. 25% on balance.

Canada — Ontario

Income Taxes:	12% using definitions similar to federal rules.
Specific Mineral Taxes:	Mining Tax Act: Progressive rates from 0% to 45% on income of \$40 million. Based only on production.

Canada — Quebec

Income Taxes:	12% using definitions similar to federal rules.
Specific Mineral Taxes:	Minerals Duties Act: Progressive rates from 0% to 31% on mining profits.

Chile

Income Taxes:	
Rates:	35%.
Major Items:	Depreciation must use straight-line method. Exploration currently expensed. Loss carry-forward 2 years.

Withholding Taxes: 40%.

Output Taxes: 2% ad valorem on all minerals.

Government Participation: Major mines were nationalised in 1971.

Indonesia

Income Taxes:	
Rates:	48% on tin. 45% on nickel, cobalt and bauxite. 52% on other minerals.
Major Items:	Exploration, development and lease acquisition costs are amortized using a straight-line method over first eight years of production. Fixed assets are required to use straight-line method. Interest is deductible. Home office charges generally deductible. Losses carried-forward for four years. 20% investment allowance.
Withholding Taxes:	10% on dividends and interest under third-generation contracts.
Output Taxes:	Ad valorem on presumed market price ranging from 1% on gold and silver to 10% on tin.
Government Participation:	All foreign investment is under some form of production sharing agreement.

Republic of Ireland

Income Taxes:	
Rates:	45%.
Major Items:	Lease and acquisition cost amortized over mine life using straight-line method.
	Exploration currently expensed at 120% of costs.
	Development currently expensed (including interest).
	Free Depreciation of capital. Up to 100% of cost may be deducted in any year (up to 120% in some cases).
	Marginal Mine allowance.
Other Taxes:	
Base Metals:	Progressive tax based on corporate income tax definitions plus interest. Rates vary across mines between 3% — 10%.
Industrial Minerals:	2% — 5% output tax on Gross Value.
Government Participation:	25% equity in Tara. Equity in Bula, 24% acquired, 25% for no financial consideration.

Liberia

Income Taxes:	
Rates:	50%.
Major Items:	Acquisition costs and fixed assets depreciated either by straight-line or unit of production method. (200% of declining balance may be used in some cases as an incentive.)
Government Participation:	Equity-Sharing agreements in force up to 50%.

Malaysia

Income Taxes:	
Rates:	40% on undistributed profits.
	10% on excess over "standard" level.
	5% Development tax (surcharge) on all business income.
Major Items:	60% initial investment allowance for mining plant and machinery. Remainder is amortized.
	Abortive exploration is deductible currently.
	Excess profits tax based on value of metallic content of concentrate.
	Unlimited loss carry-forward.
Withholding Taxes:	15% for non-treaty countries.
Output Taxes:	
Export Tax:	Rates progressively based on price of tin from 15c/lb. to effective 16% ad valorem rate.
	Progressive surcharge also on tin up to approximately 17% of price.
	Other minerals have ad valorem rates from 2.5% on gold to 15% on iron.
Government Participation:	Large direct investment by Government since 1970.

Mexico

Income Taxes:	
Rates:	5% to 45% (New mines eligible for 40% reduction over 12 years if Mexican controlled).
Major Items:	Exploration and development, fixed assets and mineral acquisition costs recovered by unit of production method.

Exploration in current operations is currently deductible.

Home office charges not deductible.

Interest is deductible.

Losses carried forward for three years.

Special incentives for exports (including zinc) and for investments in less developed regions.

Withholding Taxes:

25% on dividends and interest. If dividends are greater than 12% of capital a progressive supplementary tax is imposed.

Output Taxes:

Production tax at varying ad valorem rates. Range 2% (zinc) to 20% (gold).

Export tax 20% to 35% (reduction of 50% to 70% if Mexican controlled).

Government Participation: Government owned firms and equity participate in private foreign firms. Foreign firms must have less than 49% of equity.

Peru

Income Taxes:

Rates: 20% to 40% progressive. (Linked to cash-flow.) Plus 30% additional on foreign-owned mines.

Major Items:

Exploration expensed or amortized at producer's option.

Development capitalised at 10% per year.

Other capital depreciated at 20% per year.

Loss carry-forward 4 years.

Withholding Taxes:

30% dividends.

40% on interest (rates vary).

Output Taxes:

4% metallics.

2% non-metallics.

Government Participation: Equity interest in most operations through two state mining companies.

Thailand

Income Taxes:

Rates:

20% base to 30% on income over 1,000,000 Bahl.

Major Items:

Exploration and concession costs amortised over 10 years.

Development is treated like other capital and is depreciated.

Loss carry-forward 5 years.

Withholding Taxes:

25%.

Output Taxes:

Productive Royalty:

Ad valorem varies from .5% on non-metallic to 10% on gold.

Business Tax:

4% sales tax.

United States

Income Taxes:

Rate:

46%.

Major Items:

Exploration currently expensed but subject to recapture.

Development is based on unit of production method.

Percentage and Cost Depletion allowed at operator's option.

Depreciation — Class Life Method.

State and Local Taxes currently deductible.

10% Investment Tax Credits.

United States — Common State and Local Taxes

Income Taxes: Usually based on US rules, rates range from 1% to 12%.

Output Taxes: Net Proceeds Taxes (paid in lieu of property taxes), progressive tax on income.

Property Taxes: Both per unit and ad valorem taxes used with rates varying across minerals and states.

Ad valorem taxes based on assessed value of the mine.

Zambia

Income Taxes: Rates: 45% on all companies plus additional 51% on copper, 20% on lead and zinc, 10% to 15% on other metals.

Major Items: Mineral tax deductible from company tax.

Withholding Taxes: Generally 20%, but modified by treaty.

Output Taxes: None.

Government Participation: 51% equity in country's two largest mines.

APPENDIX B

TABLES: EMPLOYMENT AND EARNINGS IN PRODUCTION OF DOMESTICALLY CONSUMED MINERALS

TABLE A

Natural Clay Products, Goods, Plaster and Cement

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Employment (000s)	4.87	5.05	5.25	5.73	4.90	6.30	5.97	6.87	6.95	6.57	6.52	6.45	6.45
Average Weekly Earnings (£)	12.82	14.54	15.00	17.13	18.10	24.67	28.93	34.29	39.85	47.51	57.31	64.74	78.04
Average earnings per week (in 1968 £s)	13.87	15.34	15.40	16.21	16.25	19.80	21.37	22.73	22.59	22.28	22.77	22.64	23.80

TABLE B

Stone, Slate, Sand and Gravel

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Employment (000s)	3.9	3.8	3.8	3.9	4.0	4.1	4.0	4.0	4.1	3.8	3.7	3.6	3.6
Average Weekly Earnings (£)	12.88	14.18	14.59	17.25	20.33	26.17	27.00	30.65	37.72	42.50	52.41	74.86	86.66
Average earnings per week (in 1968 £s)	43.94	14.95	14.59	16.32	17.77	21.00	19.94	20.32	21.38	19.93	20.83	26.18	28.14

TABLE C

Coal and Turf Production and Bog Development

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Employment (000s)	6.1	6.1	8.7	5.5	5.3	5.1	5.0	4.8	4.9	5.0	5.1	5.3	5.4
Average Weekly Earnings (£)	12.15	13.94	14.42	15.68	20.36	25.93	25.68	29.45	33.97	41.84	52.25	56.57	59.23
Average earnings per week (in 1968 £s)	13.15	14.70	14.42	14.83	17.79	20.81	18.96	19.52	15.26	19.62	20.88	19.86	18.03

TABLE D

Sum of Employment and Earnings 1966-1978 for Tables (A, B and C)

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Employment (000s)	14.89	14.95	14.75	15.13	14.20	15.50	14.92	15.67	15.95	15.37	15.32	15.35	15.4
Average Weekly Earnings (£)	12.62	14.22	14.86	16.69	19.60	25.59	27.20	31.50	37.18	43.95	53.99	65.39	74.6
Average Earnings per week (in constant 1968 £s)	13.65	14.99	14.86	15.79	17.13	20.54	20.07	20.89	21.07	20.61	21.46	22.87	24.25

NATIONAL ECONOMIC AND SOCIAL COUNCIL PUBLICATIONS

NOTE: The date on the front cover of the report refers to the date the report was submitted to the Government. The dates listed here are the dates of publication.

<i>Title</i>	<i>Date</i>	
1. Report on the Economy in 1973 and the Prospects for 1974	April	1974
2. Comments on Capital Taxation Proposals	July	1974
3. The Economy in 1974 and Outlook for 1975	Nov.	1974
4. Regional Policy in Ireland. A Review	Jan.	1975
5. Population and Employment Projections: 1971-86	Feb.	1975
6. Comments on the OECD Report on Manpower Policy in Ireland	July	1975
7. Jobs and Living Standards: Projections and Implications	June	1975
8. An Approach to Social Policy	June	1975
9. Report on Inflation	June	1975
10. Causes and Effects of Inflation in Ireland	Oct.	1975
11. Income Distribution: A Preliminary Report	Sept.	1975
12. Educational Expenditure in Ireland	Jan.	1976
13. Economy in 1975 and Prospects for 1976	Oct.	1975
14. Population Projections 1971-86: The Implications for Social Planning - Dwelling Needs	Feb.	1976
15. The Taxation of Farming Profits	Feb.	1976
16. Some Aspects of Finance for Owner-Occupied Housing	June	1976
17. Statistics for Social Policy	Sept.	1976
18. Population Projections 1971-86: The Implications for Education	July	1976
19. Rural Areas: Social Planning Problems	July	1976
20. The Future of Public Expenditures in Ireland	July	1976
21. Report on Public Expenditure	July	1976
22. Institutional Arrangements for Regional Economic Development	July	1976
23. Report on Housing Subsidies	Feb.	1977
24. A Comparative Study of Output, Value-Added and Growth in Irish and Dutch Agriculture	Dec.	1976
25. Towards a Social Report	Mar.	1977
26. Prelude to Planning	Oct.	1976
27. New Farm Operators, 1971 to 1975	April	1977
28. Service-type Employment and Regional Development	July	1977
29. Some Major Issues in Health Policy	July	1977
30. Personal Incomes by County in 1973	July	1977
31. The Potential for Growth in Irish Tax Revenues	Sept.	1977
32. The Work of the NESCC: 1974-1976	Sept.	1977
33. Comments on Economic and Social Development, 1976-1980	July	1977
34. Alternative Growth Rates in Irish Agriculture	Oct.	1977
35. Population and Employment Projections 1986: A Reassessment	Oct.	1977
36. Universality and Selectivity: Strategies in Social Policy	Jan.	1978
37. Integrated Approaches to Personal Income Taxes and Transfers	Mar.	1978
38. Universality and Selectivity: Social Services in Ireland	June	1978
39. The Work of the NESCC: 1977	June	1978
40. Policies to Accelerate Agricultural Development	Sept.	1978
41. Rural Areas: Change and Development	Sept.	1978
42. Report on Policies for Agricultural and Rural Development	Sept.	1978
43. Productivity and Management	Feb.	1979
44. Comments on Development for Full Employment	Dec.	1978
45. Urbanisation and Regional Development in Ireland	June	1979
46. Irish Forestry Policy	Sept.	1979
47. Alternative Strategies for Family Income Support	April	1980
48. Transport Policy	Mar.	1980
49. Enterprise in the Public Sector	May	1980
50. Major Issues in Planning Services for Mentally and Physically Handicapped Persons	Oct.	1980
51. Personal Incomes by Region in 1977	July	1980
52. Tourism Policy	Dec.	1980
53. Economic and Social Policy 1980-83: Aims and Recommendations	Nov.	1980
54. The Future of the National Economic and Social Council	Feb.	1981
55. Urbanisation Problems of Growth and Decay in Dublin		
56. Industrial Policy and Development: A Survey of Literature from the Early 1960s to the Present	Feb.	1981
57. Industrial Employment and the Regions, 1960-1982	May	1981
58. The Socio-Economic Position of Ireland within the European Economic Community		
59. The Importance of Infrastructure to Industrial Development in Ireland		