

operating period of up to 30 years but this can be extended as appropriate.

Price Waterhouse (PW, 1993: 102-103) mention the above phases but also note that the exploitation of minerals is regulated by mining authorizations, kuasa pertambangan (KP). Foreigners are not permitted to hold KP and would have to negotiate with Indonesian entities and then the government to participate in a CoW. A PMA (see 3.2.1) entity is set up to sign and take responsibility for the CoW.

Papua New Guinea

As in the case of Chile and Indonesia, ownership of minerals is vested in the State. The basic procedural guidelines for doing business in PNG have been discussed above but, of specific relevance to mining, the following stages are recognized:

Prospecting Authority: This gives the holder the right to explore for gold, or specified minerals, for two years in an area not exceeding 25 000 square kilometres. An unlimited number of two year extensions to the initial period are allowed provided the area is reduced by 50 per cent each time, to a minimum of 250 sq. km. Annual fees are payable by the holder.

Mining Leases: Although the usual authority granted is the Special Mining Lease (SML) there are the Gold

Mining Lease and the Mineral Lease agreements. Title may not be transferred without the consent of the responsible Minister. The process for the issuing of the relevant Lease is contained within the Mining Development Agreement (Contract) which has been discussed above (section 3.2.1 - PNG).

South Africa

The S.A. mining title code is quite different to many other countries because mineral rights can be privately owned, as opposed to being vested in the State. In consequence to the political transitions that have taken place in S.A. there has been considerable debate about the effectiveness of this system. The main issues which have been under scrutiny are noted (Kruger and de Wit, 1987: 10-11):

- * The mineral rights can be held indefinitely with very little cost to the holder, thereby increasing the chances of sterilizing the land from exploration and development.

- * There is a problem with 'fragmentation' of mineral rights where tracing all the owners becomes extremely time consuming, let alone the difficulties in reaching an agreement (see also von Below, 1990: 314).

Various proposals have been put forward and mainly revolve around ways to transfer the private ownership of mineral rights back to the State. The major problem with this is that the system, which has evolved over a period of some 100 years, will be extremely difficult to reverse equitably (Segal, 1994). Significant funds have been spent on exploration and acquisitions so that a sound basis for subsequent valuation and compensation would be extremely complicated.

Nevertheless, as Segal points out, the effectiveness of the regulatory and permitting procedures should be given more credit. Notwithstanding the above areas of difficulty, the right to prospect, and to mine, can still only be authorized by the State. After all, the S.A. mining industry has worked and generated enormous wealth for the region; the underlying system cannot all be bad.

The very basic elements of the permitting procedure are noted (Minerals Bill, 1991):

The prospecting permit: Upon lodging the appropriate documentation concerning mineral right ownership and proper conduct while prospecting, authorization is given to prospect for a period of twelve months. At the discretion of the respective authority this period can be extended on written application within a month of expiry.

The mining authorization: Upon submission of detailed documentation pertaining to the method of extraction, funding and rehabilitation of a mineral bearing area, an authorization to mine is issued.

The critical factor in S.A. currently is the appropriate system for the future, but extreme care must be given to counting the costs and benefits by changing the status quo. Drawing on the findings of the surveys and the literature, investors loathe uncertainty and the potential for drastic change. Unfortunately, this is precisely the factor that the indecision and acrimonious debate on S.A. mineral tenure is likely to instil in the minds of investors.

As has been highlighted previously many other developing countries are attracting the attention of mining investors. It appears that the challenge is not only from within but also from outside competition. Investment funding will flow to where the risks and rewards are considered favourable; the simulation framework implicitly addresses this fundamental principle.

Zimbabwe

All rights to minerals in Zimbabwe are vested in the State, similar to the situation in many countries. The State maintains control (in the positive sense) of exploration and mining activities through a claim

staking procedure which is administered by the respective Mining Commissioners. Ownership to the claims is perpetuated by the issue of an annual inspection certificate from the Commissioner (Kruger and de Wit, op. cit.: 14).

Another facility, the Exclusive Prospecting Order (EPO), can be issued to individuals or corporations in respect of the prospecting of large areas. In this case the government becomes involved and ratifies the terms of the programme to the satisfaction of the Mining Affairs Board.

The system appears to have worked well for many years, having been retained by the new government after independence in 1980.

3.4 Fiscal Regime

One of the most important aspects that must be considered by any investor is the level of taxation applied to corporate earnings. The salient components of the fiscal regimes pertaining to the five selected countries are summarized below.

3.4.1 Production royalties

Of the five selected countries, Indonesia and Papua New Guinea levy production-type royalties. Further details

are provided in Appendix G under the respective countries, but some brief comments:

- * Indonesia's royalty on gold and copper sales is formula based (INGMI, 1993b: 20) and ranges between 1.5 - 3.5 per cent of sales of copper and from 1.0 - 2.0 per cent on gold sales.
- * Until recently PNG's royalty was a flat 1.25 per cent of sales value (Coopers & Lybrand, 1991: 75) ; (INGMI, 1993c: 21) but the Mining Journal (1995b) reports that this is to be increased to 2.0 per cent, although adjustments to other criteria are to be made as well (see corporate tax below).
- * PNG also levies a royalty of 5 per cent on alluvial gold sales (Coopers & Lybrand, 1991: 75) ; (INGMI, 1993c: 22).

Kumar (1991: 137) discusses some of the implications attached to this type of royalty. Generally, it is not a popular tax with the investor, especially the revenue - based version, because it favours the very profitable operation. The marginal or low profit operation may not have sufficient funds to pay the royalty. The World Bank (1992: 28) also comments that profit-based taxes are far more preferable to the revenue-based royalty.

The impact of the royalty is covered later in section 5.0 in the discussion of the results from the simulation framework.

3.4.2 Corporate taxation

The different levels of corporate taxation for each of the five countries are described briefly below. Further details have been provided in Appendix G.

Chile

A First Category Tax of 15 per cent is applied to accrued taxable income from mining businesses. A Secondary Tax (or Additional Tax) of 35 per cent is levied when any profits are remitted abroad. In this instance the first tax would be credited against the Secondary Tax and the effective tax rate would then amount to 35 per cent (PW, 1994a: 89, 125).

Indonesia

Corporate profits are taxed at the top rate of 35 per cent (PW, 1993: 138).

Papua New Guinea

Corporate profits are taxed at the top marginal rate of 35 per cent (PW, 1990a: 157). The Mining Journal (1995b) reports that the PNG government has proposed that this rate be reduced to 25 per cent. Adjustments have also been mooted, however, to the production royalty (from 1,25 to 2,0 per cent) and landowner

carried interest (5,0 per cent), negating to some extent the benefits of the tax reduction.

South Africa

Gold mines' profits are taxed according to a formula whereas other companies are taxed at a rate of 35 per cent plus a Secondary Tax on Companies (STC) of 25 per cent on dividends paid to shareholders.

The current formula tax for gold mines which have not opted for the STC format (PW, 1994b: 180):

$$Y = 58 - 290/X \quad \text{where;}$$

Y is the percentage applied to taxable income, and X (P/R) which is the taxable income (P) divided by total revenue (R), written as a percentage.

The formula works on a sliding scale where the more profitable mines pay a higher percentage of taxable income. Dividend payments to shareholders by most gold mining companies are not subject to the STC.

Non-mining profits earned by gold mines, such as interest from cash balances invested, are taxed at a rate of 48 per cent.

Zimbabwe

The general tax rate on corporate profits was reduced from 42,5 per cent to 37,5 per cent as from 1st April 1995 (Deloitte & Touche, 1994: 2, 24) ; (PW, 1990b: 120). Unfortunately for mining companies this benefit was largely negated by the removal of a 5 per cent depletion allowance (see below). A branch office of a foreign company is subject to an additional 8,4 per cent tax liability, resulting in a total effective tax rate of 45,9 per cent.

3.4.3 Additional profits tax (APT)

Of the five countries reviewed only Papua New Guinea levies an APT, sometimes referred to as a 'windfall' tax. Kumar (1991: 144) describes the terms attached to the APT in more detail and the probability of the tax coming into effect appears to be quite low. The APT is calculated on the basis of an accumulated return on capital invested, the thresh-hold rate being based on a 12 per cent premium to the U.S. prime rate or a flat 20 per cent (PW, 1990a: 108). In other words, the initial amount of capital invested is netted off progressively against annual net earnings discounted by the thresh-hold rate until exceeded by the latter. The excess amount is then taxed at a rate of 70 per cent less the prevailing corporate tax rate (35 per cent at present).

The APT can be a disincentive (World Bank, 1992: 33) because investors believe that mineral development is a very risky business and they should be entitled to the

full rewards. If the APT is to be considered at all by government authorities it should be by those countries with a track record of quality projects and highly prospective geology.

3.4.4 Investment recovery period (IRP)

Papua New Guinea is the only country (of the five under review) which specifically recognizes a tax holiday to shorten the payback period for investors, i.e. the investment recovery period (PW, 1990a: 108)⁶. During the IRP, capital expenditure can be written-off against taxable income faster than would ordinarily be case under the normal depreciation rules (see below 3.4.7). This reduces the tax payable, thereby increasing investors' earnings, which in turn shortens the payback period needed to recover the original investment.

Once the capital expenditure has been recouped then the calculation for the additional profits tax commences, which has been discussed previously.

3.4.5 Loss carry forward period

The period allowed for the carry-forward of tax losses to be off-set against future profits varies from country to country (PW, reference pages as shown):

⁶ Coopers and Lybrand (1991: 73-74) mention the IRP but the terms are more complex than those given by Price Waterhouse. IWGMI (1993c: 15-16) give similar terms to Coopers and Lybrand.

Chile	:	Indefinite	(1994a: 96)
Indonesia	:	8 years	(1993: 146)
PNG	:	7 years	(1990a: 101)
South Africa	:	Indefinite	(1994b: 172)
Zimbabwe	:	Indefinite	(1990b: 120)

There are no allowances for carry-back of losses in the above countries. Kumar (1991: 142-143) notes that this privilege applies to projects in Canada and the USA for a three year period, and the UK for one year.

In South Africa an allowance of 12 per cent per annum on all unredeemed balances of capital expenditure is given to new mines until taxation first becomes payable (van Blerck, 1992). This provision was introduced to counter the effects of inflation which would otherwise shorten the tax 'holiday' period, i.e. unredeemed balances in previous years' money terms being off-set against taxable income in later years' escalated terms.

3.4.6 With-holding taxes

With-holding taxes are levied in many countries on various categories of income remitted to foreign investors; on dividends, interest on loans, royalty payments and management or service fees. The levels imposed are variable and can be quite high in some cases, thereby acting as a disincentive to many investors to repatriate certain categories of income. Details of the various with-holding taxes for the five

countries have been provided in the tables and notes under Appendix G.

The view of the host government might be that foreign investors should re-invest their earnings in the country of origin (Kumar, 1991: 145-146). The problem with this is that the foreign investor may not see the particular country the same way because there may be numerous alternate avenues for investment. It should be appreciated that investment information flows faster around the world, and in a more structured format, than ever before.

There are usually double taxation agreements between countries so that income remitted abroad is not taxed twice.

3.4.7 Depreciation for tax purposes

The rate at which companies are allowed to 'write-off' capital expenditure against taxable income is an important (dis)incentive. The faster the rate at which capital expenditure can be written off the lower the amount of tax payable. The provision can also alter the amount of tax losses carried forward, thereby lengthening the period before tax becomes payable.

The levels of depreciation and methods applied can be highly variable between countries. The details in respect of each of the five countries have been

provided in Appendix G, together with explanatory notes where necessary.

3.4.8 Value added tax (VAT) or GST

For the countries under review there were two forms of consumption type tax levied, namely; the value added tax (VAT) and/or general sales tax (GST).

Only Zimbabwe levies GST on goods and services, and to some extent Papua New Guinea where sales tax is administered at the provincial level. Chile, Indonesia and South Africa have adopted the VAT system and, as applied to exports, is zero rated. This means that the VAT paid on goods and services (inputs) can be reclaimed because there is no VAT paid on the exported product.

3.4.9 Sundry duties

There are numerous other smaller duties and types of tax imposed, for example, stamp duties on cheques and legal documents, company formation expenses, capital taxes and transfer taxes on property. These were found to be extremely variable and details have been provided in Appendix G where practicable. These levies have not been included in the simulating framework (see section 4.0 later) because of their variability and appear relatively small in the context of a mining project's life cash flows. Kumar (1991: 137) alludes to this by

commenting that countries place most emphasis on royalties, corporate tax, additional profits tax and with-holding tax.

3.5 Social Security Payments

Most countries legislate some form of social security responsibility for employers in respect of employees:

Chile

Employers are required to cover an accident and death insurance ranging between 0.9 to 3.4 per cent of salary. The amount varies according to the degree of job risk.

Any training costs up to a maximum of one per cent of annual salary are allowed as a credit against the First Category Tax (PW, 1994a: 97).

Only employees contribute 10 per cent of taxable salary to a pension fund, up to a maximum of 60 development units monthly; Ch\$654 000 = approx. US\$1635 as of May 1994 (PW, 1994a: 61-62). Employees are also required to contribute 7 per cent of salary to medical cover and 3.3 per cent for death and disability coverage.

Indonesia

Employers with a labour complement of more than 10 persons participate in the Worker's Social Insurance Program (ASTEK). There are three components to the scheme (PW, 1993: 109-110):

Accident insurance: Paid by the employer and ranges between 0.24 and 3.6 per cent of the employee's basic salary.

Retirement (pension): Contribution of 2.5 per cent of salary; comprising 1.5 per cent from the employer and 1.0 per cent from the employee.

Death insurance: Paid by the company at 0.5 per cent of the employee's basic salary.

Papua New Guinea

Companies employing 25 or more staff have to register with the National Provident Fund. Membership is compulsory for employees working more than 59 days in a three month period. Employers must contribute 7 per cent of gross salary and employees a minimum of 5 per cent, and up to 10 per cent on a voluntary basis (PW, 1990a: 63) ; (INGMI, 1993c: 24).

Foreign companies have to submit a training programme to the Labour Department and should include reasons for employing expatriate staff and proposals for training local personnel (PW, 1990a: 61). 500 kina is payable by

the employer for each expatriate employee. A training levy of 2 per cent of taxable salary is payable by employers with payrolls over specified amounts (IWGMI, 1993c: 25).

South Africa

There is a limited government administered social security system. Companies and individuals must make provision for pensions and retirement. Normally the employee and employer would each contribute approximately 5 per cent of gross salary (PW, 1994b: 107-108).

Companies also contribute to medical aid schemes for employees and the amount can vary quite widely. On average the employer would contribute approximately 6 per cent of gross salary, and the employee a similar amount.

Unemployment insurance contributions are payable by the employer and employee at a rate of one per cent of salary each, in respect of employees earning less than R58 188 per annum.

Zimbabwe

Most companies organize a pension scheme, either managed by themselves or a financial institution. The employer and employee each contribute approximately 6

per cent of gross salary. Medical aid contributions are also payable by both employer and employee (PW, 1990b: 71).

3.6 Employees' Share of Profits

Profit share schemes are generally implemented at the discretion of the company. Chile, however, stipulates specific guidelines for a minimum profit share arrangement. The following paragraph from PW (1993: 58) explains the terms:

' the law provides that companies must distribute 30 per cent of profits to workers. The basis used to determine the percentage is taxable income less 10 per cent of net equity. However, if the employer pays a bonus of 25 per cent of the yearly income, up to a maximum of 4.75 monthly minimum wages (1994: CH\$247 000 = approx. US\$525), the profit sharing obligation disappears'.

It would seem that the employer pays a profit share bonus using whichever arrangement proves the least costly.

3.7 The Mineral Development Agreement

The executive survey, the referenced surveys and the summaries of country investment codes have demonstrated the range of criteria associated with international mineral development. Considering the complexities and the large sums of capital usually involved in the development of a mining project, all participants (both governments and investors) are likely to be extremely cautious in their dealings. These sentiments would apply particularly in respect of the developing countries where a previous track record of mining investment may be non-existent.

The underlying issues investors are the stability of the operating environment for the duration of the project and the distribution of the benefits that will accrue. To minimize the chance of abrogation of the conditions of development and investment, a mineral development agreement (MDA) would be drawn up. The various forms of this document have been mentioned above, such as the Contract of Work (CoW) in Indonesia and the Mineral Development Contract (MDC) in PNG.

The MDA is likely to be a complex and lengthy document which would need a separate research effort to cover adequately. However, in the context of this particular assessment, the point of emphasis is that negotiation between the participants and contractual documentation is a very necessary part of the mineral investment process.

For illustration purposes, Otto and MacDougall (1994) discuss the MDA and highlight its importance in respect of the project financing arrangements. Project financing packages usually involve several parties ranging from equity and debt investors, to product consumers, to engineering service and equipment suppliers. It would be essential for project participants to obtain guarantees of conditions for payment of interest on loans, profits (returns) and settlement of project operating and capital costs. As most of the country criteria summarized above would have an impact on cash flows, they would need to be specified in the MDA. It is also likely that the host country (represented by the government) would be a signatory. Some important areas that would have to be addressed in the MDA:

Nationalization: Guarantees against expropriation of assets and for compensation should this occur.

Provisions for default: Lenders would need procedural clauses in the event of default on payment of loan interest and principal.

Product marketing: Investors regard government interference in the marketing of minerals as contrary to competitive sales practices.

Settlement of disputes: Foreign investors may be unfamiliar with local laws and, in the event of

disagreement, would prefer access to international arbitration, e.g. ICSID - the International Centre for the Settlement of Investment Disputes - which is affiliated to the World Bank.

Environmental factors: Environmental issues need to be stipulated from the point of view of estimating initial capital costs and determining liabilities during the project's life. The distribution of liabilities between the venture partners needs to be clearly determined.

Otto and MacDougall make the point that, even if the terms of agreement are not particularly favourable in relative terms, at least they should be rigidly enacted and steadfastly supported by a stable, credible legal framework.

Brower (1987: 47) addresses many of the issues mentioned by Otto and McDougall but also highlights the project's infrastructure requirements. Relevant to this heading would be, housing, rail and road links, power and water supplies, waste disposal and even an airport. If the project locality has very little previous infrastructure development, the costs of starting from 'scratch' may totally negate the returns on the single project. Clearly, the primary consideration for all participants would be to reconcile the infrastructure costs with the benefits likely to accrue, not only to the mining project, but to the region as a whole.

4.0 COUNTRY CRITERIA SIMULATION MODEL

4.1 Risks and Returns: Some Theory

The assessment thus far has shown the range of criteria to be considered when making international mining investment decisions. This would include an appreciation of the longer term repercussions from mega-political events, such as the collapse of the former USSR. Furthermore, the combinations and permutations of criteria associated with different mining projects would be endless.

Intuition and experience can provide an investor, engineer, manager or financier, a good "feel" for the probability of success, including the risks and the value attached to a mining project. Even so, the primary motivation underlying the decision-making process would be to achieve the greatest return on investment, suitably adjusted for the perceived or measured risks. Ultimately these returns would be supported by the future earnings (cash flows) generated by the project (Stern, 1977). The degree to which these earnings are assured would be a function of the stability of the operating environment, comprising the range of criteria under discussion in the executive survey and summarized in section 3.0.

In order to reconcile the concepts of risk and return, the issues raised in the surveys and the five

countries' investment codes, a calculating framework was developed to simulate the cash flow (investment) performance of a gold mining project in each country.

Before discussing the components of the simulation framework it would be appropriate to revise some theory on the risk and return relationship and, for this purpose, the Capital Asset Pricing Model (CAPM) has been used. Franks and Broyles (1979: 107), after the work of Sharpe (1964), Lintner (1965) and Mossin (1966), provide an overview of the CAPM, which can be written in the following form:

$$E(R) = R_f + (E(R_m) - R_f)B \quad \text{where:}$$

- E(R)** : the expected return on investment.
R_f : the risk-free rate of return (e.g. U.S. government stock).
E(R_m) : the expected return on a specific market portfolio or security (stock, share)
B : the beta coefficient which measures the risk attached to the investment relative to that of the market.

The important issue demonstrated by the CAPM is that the return on an investment comprises a risk-free return (say, 5 per cent) plus an expected excess return over the risk-free rate (say, 10 per cent), the latter being adjusted for risk as measured by the relative volatility (beta) of the investment. Assuming a beta

value of 1.10 for a particular investment then the total return would be 16 per cent.

The beta value can range above and below 1.0 and reflects the volatility of an investment's return relative to that of a comparative market portfolio of investments. If the beta is less than 1.0 the investment's excess return is less than the market portfolio and, if more than 1.0, then the expected return would be greater than the portfolio. In the numerical example above, if the beta value was 2.0 then the total return would be 25 per cent.

It is also important to appreciate that value and return on investment are relative concepts; there are always alternatives to consider when making any investment decision. A relevant situation to the research topic would be an investor's decision whether to invest in a "risk-free" U.S. government bond earning a safe, guaranteed return or whether to invest in a mining project in Chile or even in Zaire or Zambia.

Petrick (1985: 247), after the work of Lessard and Graham in 1976, breaks down the overall risk (the beta factor) in a mineral project into the broader underlying risks. A further classification has been made as to whether the individual risks are 'systematic', i.e. common factors to all risky investments, or 'unsystematic' which are unique to the project. Some examples are noted:

Mineral reserve risks: A function of the individual ore-bodies and would not be related to the economic or market behaviour; an unsystematic risk.

Development risks: Mostly specific to the project, such as timing of development and cost overruns which are largely unsystematic.

Operating risks: Parameters such as equipment failure, resulting in additional costs, would be unsystematic risks. On the other hand, labour disruptions (strikes) may be systematic risks because they could be related to general economic conditions.

Market (commodity) risks: Reflect the possibility of being unable to sell total output and unexpected changes in price. Generally considered systematic in nature because of the relationship to overall economic conditions.

Political (country) risk: The actions of the government would affect project earnings or cash flows to varying degrees (as per the theme of this research effort). It is arguably the most unpredictable of the risk elements described. This type of risk, although not clearly discernible as 'systematic' or 'unsystematic', would probably be considered unique to a (mineral) project.

Davis (1995) has added some useful perspective to the application of discount rates for net present value (NPV) determination, the treatment of risk and the (mis-)use of Monte Carlo (stochastic) simulation. Attention is drawn to the common application of arbitrary discount rates to account for risk, for example, the higher the discount rate, the higher the perceived risk and the lower would be the resultant NPV.

The issue that Davis highlights is that the same result could be achieved by reducing a parameter (e.g. milled tonnes throughput) because of, for example, persistent labour problems. Davis cautions against confusion of these concepts and, for purposes of demonstration, compares a hypothetical PNG gold mine with an identical mine situated in Nevada (USA).

In view of the above complexities, and in terms of the simulation framework, there are limits to the quantification of countries' mining investment codes and environments. Battman (1995) highlights this issue in an excerpt from an article written for the Mining Journal:

"There is, unfortunately, no simple methodology which will adequately assess risks and make forecasts. Assessing political and security risks is more of an art than a science. While quantitative approaches are useful, notably for economic analysis, the analyst must

be the final arbiter, not the computer. But some order must be introduced into the process." (PSA underline)

The simulation framework has been developed to achieve exactly this and take out as much of the 'guess-work' as possible. An additional objective has been to provide a means to think through the dimensions in decision making in international mining investment, which include some of the theory in mineral economics. Throughout any evaluation process, however, the concepts of stability and variability in earnings (or returns) should be kept in mind continuously by the investor or analyst.

4.2 Components of the Simulation Model

An important facility which has enabled the development of the simulation framework is the personal computer based technology and its flexibility and "user friendliness" (for the resource engineer). Microsoft Corporation's spreadsheet programme Excel 5.0 for Windows was used extensively. Essentially, these tools enable an aspiring professional in a particular field of endeavour to project his or her knowledge and experience into a fast calculating medium without also having to become a computer programming expert beforehand.

The three broad elements that would play an important role in the performance of any mining project or investment are:

- * the technical and operating characteristics of the particular project;
- * the host country's mining investment codes; and
- * the macro-economic environment (global and local), including the commodity markets.

In order to incorporate all these elements, a modular calculating structure has been developed and comprises the following:

- * Project module
- * Country criteria module
- * Simulation module

The details of the modules and their composition are described below.

4.2.1 The project module

The project module comprises the production, revenue, operating and capital expenditure parameters for the mining project which, for purposes of the analysis, have been based on a convenient, average-sized Wits

gold mining project (discussed below). In essence, the module represents a hypothetical or 'test' project which can be 'transported' into any country environment, the latter comprising the country criteria module and the simulation module.

Although the S.A. gold mining industry has provided a basis for the project parameters, the latter have been simplified so that analyzing the impact of changes to various criteria was made more manageable. The main focus has been to contemporaneously simulate the investment environment of the different countries and not the project technical details explicitly.

The components of the project module have been displayed in the printout Appendix H. For purposes of global standardization, the project module cash flows have been calculated in U.S. dollar terms, converted to the currency of the particular country in the simulation module, then back to U.S. dollars to compare and analyze the results.

The principal components of the project module and the assumptions made are presented below:

U.S. inflation rate

This has been based on U.S. price index data over the last few years (IMF, 1995) and forecast to average 3 per cent per annum over the life of the operation.

U.S. interest rates on loans

The interest rates applied to the loan financing have been based on the long term U.S. inflation rate plus an arbitrary variable premium. For example, a 10 per cent interest rate would comprise a 7 per cent real interest rate added to the 3 per cent inflation rate. In the project module the loan rates have been included as a variable input so that each lender's assessment of the risk profiles can be accommodated.

Commodity prices

A long term average gold price of U.S. \$ 380 per ounce (1995 money terms) has been assumed for the base case scenario.

Technical characteristics of the mining project

The technical attributes of the 'test' mining project have been based on a convenient sized Witwatersrand gold mine (COM, 1994), primarily because the public reporting of the operating results is adequately detailed and confidentiality problems reduced.

Consideration was given to basing the test project on a Chilean or Indonesian copper-gold producer, but was not pursued because the objective of the study was to focus on and compare country investment environments. The

simulation model would have become unnecessarily involved with the more complex technical attributes of such mining projects, such as smelting and refining logistics and transport economics for the higher bulk:low value commodities, i.e. copper concentrates.

Life-of-mine: The life of the operation has been assumed to be 20 years, inclusive of a 3-4 year period to self-financing status. The build-up and end-of-life production profiles have been displayed in Appendix H.

Ore grades: The recovered gold grade over the life of the operation was forecast at a convenient 10 grammes per tonne of ore. This would be considered a high grade operation in South Africa, being of similar order of magnitude as Driefontein Consolidated, and compared with a South African gold industry average of approximately 5.3 g/t (COM, op. cit.). Profitability would depend of course on the operating costs of mining and metallurgical extraction.

Milled tonnage and gold production: Milled throughput at full production capacity has been assumed at 100 000 tonnes per month (convenient size) which, at the assumed recovered grade of 10 g/t, equates to annual gold production of 12 tonnes.

Operating costs: In arriving at a working cost structure it was assumed that the project would generate approximately a 50 per cent operating margin,

equivalent to a long term cost of production of approximately US\$ 190 per ounce gold produced.

The cost structure was subdivided into four categories to make provision for the appropriate sensitivity analyses. The total costs were apportioned as follows: power, 11 per cent; services and stores, 31 per cent; human resources, 47 per cent; other, 11 per cent. The figures have been based on the average of the last four years for the Vaal Reefs complex (Annual Reports, 1992 and 1994).

Capital expenditure: Capital expenditure to the end of the first year of production was set at US\$225 million (1995 money terms) so that a real return of the order of 10 per cent per annum would be achieved over the 20 year life. The range was based on the returns indicated in the executive survey for North American and Australian mining projects. The bulk of this capital expenditure has been distributed over a pre-production period of three years, although this is considered extremely short in the light of the usual lead times required to develop the deeper reserves in the Witwatersrand gold basin (Eastvaal, 1993).

It has been assumed that maintenance (on-going) capital expenditure during the production period would be budgeted at 10 per cent of operating profits.

It was also necessary to categorize the capital expenditure to a sufficient level of detail to cater for the variable methods and rates of depreciation adopted by the countries under review (discussed previously in 3.4.7). Facility was included in the schedule to vary the amount spent on each capital category and the proportion of imported items.

Exploration expenditure: Expenditure on the exploration programme from initial discovery, to delineation, pre-feasibility and feasibility through to the commencement of production has been assumed at US\$35 million (1995 money terms). During the production period annual exploration expenditure has been budgeted at 2.5 per cent of operating profit.

Management fees: As is common with many mining operations, specialized technical and managerial skills are drawn from external consultancies or service groups, often administered by the controlling companies. In the South African mining industry these services are usually provided by the mining finance houses and are underwritten by management contracts which are renewed at various intervals during the life of the operation.

For purposes of the simulation it was assumed that management fees for these services were charged to the project at an annual rate of 4.0 per cent on 60 per

cent of working costs and at 6.0 per cent on 80 per cent of capital expenditures.

Funding structure: The capital required to develop the project has been assumed to be funded through both equity and interest bearing loan instruments. The exact amount of pre-production capital differed slightly, depending on the country hosting the project, mainly due to variations in criteria such as import duties. Nevertheless, it was assumed that the terms of the loans would be the same for all countries, that is, repayment periods and interest rate premiums above the U.S. inflation rate.

The debt:equity ratio was set as an input variable in the project module so that sensitivity analyses could be carried out on changes to financial gearing. A debt:equity ratio of 50:50 was assumed for the base scenario.

4.2.2 The country criteria module(s)

The country criteria module(s) comprises the mining investment code data, as discussed in section 3.0 and tabulated in Appendix G, and these have been integrated with the simulation module (see 4.2.3 below). The five countries whose data was collated were:

Chile; Indonesia; Papua New Guinea; South Africa and Zimbabwe.

As many as possible of the quantifiable criteria in the five mining investment codes were incorporated into the module. The objective was to remove as much 'guess-work' on the impact of such criteria in order that the more qualitative aspects, such as political and administrative issues, could be evaluated from a sound base.

4.2.3 The simulation module

An abbreviated printout of the simulation module has been provided in Appendix I; only that for Chile has been included because of the voluminous content. The following notes supplement the detail by explaining each component and all assumptions made.

Country inflation and currency exchange data

Each country's economic environment would be unique, with two of the most important elements being price or cost inflation and currency exchange rates. The inflation forecast has been displayed in tandem with the U.S. inflation assumptions so that the differential factor can be calculated over time by the relationship:

$$(1 + \text{country inflation \%}) / (1 + \text{U.S. inflation \%})$$

and then compounded annually. This factor has been applied to the depreciation (or appreciation)

calculation of the particular country's currency versus the U.S. dollar. The forecasts were based simply on the historic data in the IMF (1995) document on country financial statistics.

Input of the project module cash flow data

The U.S. dollar cash flow data from the project module was transferred through to the simulation module and converted to the particular country's currency using the exchange rate forecasts. It was essential that the calculations were carried out under the monetary conditions of the country so that the various fiscal and other mechanisms were treated more accurately. This was particularly relevant to tax loss carry forward calculations which would be sensitive to future taxable income and the impact of inflation thereon.

Input of the country criteria

The country criteria data, as discussed in section 3.0 and collated under Appendix G, were also transferred through to the simulation module.

Taxation

Taxation is one of the most important criteria monitored by investors. Besides the actual percentage of taxable income payable, there are usually a range of conditional clauses, modifications and incentives

attached to the final computation. Examples include deductible capital allowances, carry-forward of tax losses and additional profits (windfall) taxes.

Because of the numerous conditional clauses, a separate calculating schedule had to be developed to manage the more complex tax computations, and particularly to maintain a record of the carry-forward of tax losses. The components of this schedule have been displayed in Appendix I.

Depreciation

Another calculating schedule was developed to deal with depreciation of capital items for tax purposes (this schedule has not been included in Appendix I). The two most commonly used forms of depreciation in the five countries' fiscal codes were the straight line (SL) and declining balance (DB) methods. Facility was included to cater for the variable rates of depreciation applied, depending on the category or deemed useful life of the capital item.

In calculating the tax write-off amounts each year, care was taken to ensure that the sum of total depreciation for a particular item was equal to the actual capital expended over the life of the operation.

4.3 Balancing Checks for the Calculations

During development of the simulation module, by gradually integrating the respective countries' mining investment criteria, it was found that a progressively complex "web" of calculations and conditional arguments evolved. A checking structure had to be developed so that integrity of the calculations was maintained and that all cash outflows (operating costs, capital expenditure, duties, taxes, etc. and payments to investors) balanced exactly with all cash inflows (initial capital funds and all revenues generated). Two checking structures were designed in the simulation module:

4.3.1 Distribution of annual cash flow

An aspect often not given adequate attention in project evaluation work is an analysis of the distribution of funds (initial capital and revenues generated) to the main, if not all, participants. This concept has also been used to check the integrity of the annual cash flow calculations.

Each component of the simulation module, as displayed in Appendix I, has been allocated and distributed to each participant in the project, coded as follows:

> PROJECT: equity (share) investors
> LOAN: providers of loan finance

- > ROY.: royalties paid to non-resident (private) entities
- > MAN.: management and administration fees
- > EMP.: permanent employees
- > OMC: on-mine costs or suppliers of goods and services
- > HG: host government (or the fiscus)

The sum of the individual components distributed to each participant must equal all cash inflows, the latter comprising the initial capital expenditure and all the total revenues generated by the project. Appendix J displays each participant's annual accruals for the life of the project under the base scenario conditions, converted to U.S. dollars for country comparison purposes.

An analysis of each participant's financial accruals should also lend some light as to the relative levels of risk attached to their involvement, thereby justifying or refuting the reasons for disagreements that can arise during the life of the project. These issues have been explored further in the analysis of the results.

4.3.2 Totals for the life of project

Each component of the simulation module was summed over the 20 year life in real 1995 (or first year) money terms. Appendix K displays the life totals for the

project in each of the five countries, the amounts having been converted for country comparative purposes to U.S. dollars. Refer also to the columns at the end of the project cash flows in Appendix I and Appendix J.

The resultant 'life' summation (horizontally) for each component was then netted vertically to give the investors' after-tax distributable earnings over the life of the project. This grand total figure was checked against the annual horizontal summation of the net after-tax earnings.

The purpose of this checking structure was to ensure that all the cash flow calculations were applied consistently in every year and that no funds 'escaped' the system.

5.0 ANALYSIS OF THE SIMULATION RESULTS

For purposes of revision, the main reasons for developing the simulation model were to:

- * provide a calculating structure to evaluate the impact of quantifiable criteria underlying an international mining investment;
- * simultaneously compare the investment or operating performance of any mining project in any country and at any time during its life;
- * reconcile some of the responses in the executive survey, as discussed in section 2.0, particularly the rates of return and payback periods required to attract mining investment to various countries; and
- * present a framework to explain the current trends in international mining investment and touch on some philosophy.

The simulation structure, as described in section 4.0, has included as many of the quantifiable elements as possible. Other criteria such as political stability, security of tenure and administrative efficiency are not included in absolute terms, but the framework provides a more established base from which to assess their relative impact.

Schreiber and Kuestermeyer (1994) discuss a similar (a copper instead of a gold project) simulation exercise but they focused on mine operating costs in eleven selected countries. Of specific mention, however, was that the results should be interpreted with an appreciation of the inputs included in the calculations and on the relativity of the numbers. For example, if the level of taxes, new infrastructure and the costs of administration delays were to be factored in to the calculations, the relative attractiveness of an investment in a country may change drastically.

The basic difference between Schreiber and Kuestermeyer's costs analysis and this project's country criteria simulation was that the latter extends the concept to include mining investment codes. The issue of operating costs has been handled as a common denominator between countries so that the impact of the investment criteria would not be distorted. It will be recognized that, within the ambit of the sensitivity analyses discussed below, the different countries' costs profiles could be evaluated by further interpolation of the results. By inference then, the benefits of the investment code in one country may be totally negated by low productivity and/or labour strife.

Considering the scope and flexibility of the simulation model there are numerous results that could be designed, retrieved and compared. The results would be

a function of the objective, circumstances and background of the user. The following discussion of the results covers many of the applications but, in the interests of brevity, some have had to be excluded.

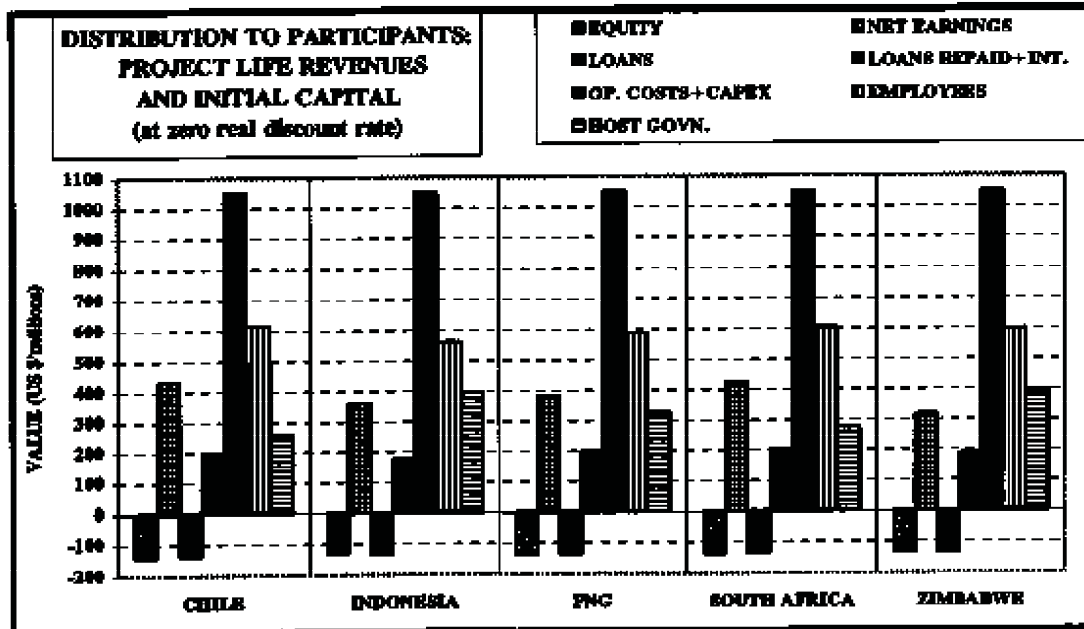
5.1 Distribution of Project Value Between Participants (life of project)

The distribution of the cash flow as a calculation checking structure has been discussed previously (see section 4.3). Figure 5.1 compares the present value in U.S. dollars of the amounts accruing to each participant over the life of the project in the five 'test' countries.⁷ The amounts have been displayed in Appendix K for reference, and also in Appendix J in the totals column. A zero real discount rate has been applied for purposes of neutrality because the selected participants, except for the investors, have not contributed risk capital in the same sense as the investor.

It should be pointed out that Figure 5.1 does not show the distributions to royalty holders and management service entities as these amounts are relatively small in the overall context. This need not be the case, however, and would depend on particular circumstances and agreements.

⁷ The amounts compared only reflect the actual cash flow generated by the project. No attempt has been made at estimating the multiplier effects in each country's economy.

Figure 5.1 **Distribution of project value by participant in each country**



The following notes clarify the legend headings:

- Equity:** The initial capital injected by the foreign investor(s) before the project achieves self-funding status.
- Net earnings:** The net after-tax earnings available for distribution to investors, net of with-holding taxes.
- Loans:** The amount of loan finance provided for the project before self-financing.
- Loans repaid:** Interest payments on loans including the principal repaid.
- Op. costs:** Comprises all other costs, operating + capex and capital in nature, over the life of the project (excludes employees' costs).

- Employees :** Payments to employees; comprising wages, social security payments, and profit share if applicable. Individuals' tax is not deducted.
- Host govn:** Total accruing to the host government; comprising all project taxes and sundry duties. Employees tax is not included.

The most striking aspect of the analysis was the average distribution of some 85 per cent of the total revenues accruing to the country, comprising government, 14 per cent; employees, 26 per cent; goods and services, 45 per cent. This compares with the 15 per cent to 'foreign' interests (equity earnings + interest and principal on loans + royalties + management fees). The latter figure is net of the original capital injected; total earnings of 27 per cent less the capital which amounts to 12 per cent of the total revenue plus capital figure. These calculations are shown at the base of the table in Appendix K.

By demonstrating clearly the distribution to participants of the project's value in each country, it may help to reduce misconceptions about the fairness of their 'takes' relative to their respective risks. Experience over decades has shown that conflict arising between the investor, labour (employees) and the host

government usually stems from disagreements on the equitable distribution of the monetary benefits.

The comparative magnitude of these amounts draws attention to the level of risk carried by the foreign investor in new mining development vis-à-vis the risk to the host country. It is submitted that the impact on the country of losing a portion of the value (cash flow) would be far less than the impact the same amount would have on the foreign investors and their returns, thereby improving the attractiveness of the country as a business destination.

It has not been explicitly mentioned but significant benefits can be generated from the development of mineral resources, particularly regarding skills training and ancillary business development. Although in the context of a poor outlook for developing country mineral development at the time, O'Faircheallaigh (1985) discusses these issues in some detail in the context of host governments' policies.

Based on the simulation results it is not surprising that foreign investors should be extremely sensitive to the amount of capital exposed for a given period, particularly if their own capital base is comparatively small. In relative terms it would appear that there is nowhere near the same degree of 'up-front' risk to the country as a whole. It also goes some way to explaining the comfort of foreign investors when multi-lateral

funding (IPC and World Bank) is involved, just in case the conditions on which the investment was originally based suddenly change for the worse. Otto and MacDougall (1994: A117-118) allude to these issues in the context of project financing, i.e. the raising of loan funding on the basis of anticipated earnings, but with limited-recourse to the equity investor.

5.2 Sensitivity of Host Governments' and Investors' Accruals to Changes in Selected Criteria

Figure 5.1 has displayed a simplified distribution of project value between the various participants. In terms of the theme of the research project it would be useful to consider the sensitivity of the participants' accruals to changes in various criteria, thereby providing a gauge on the relative impact of the latter. In the interests of brevity and to demonstrate the principles, the impact of selected criteria on only the host government and the equity investor have been analyzed.

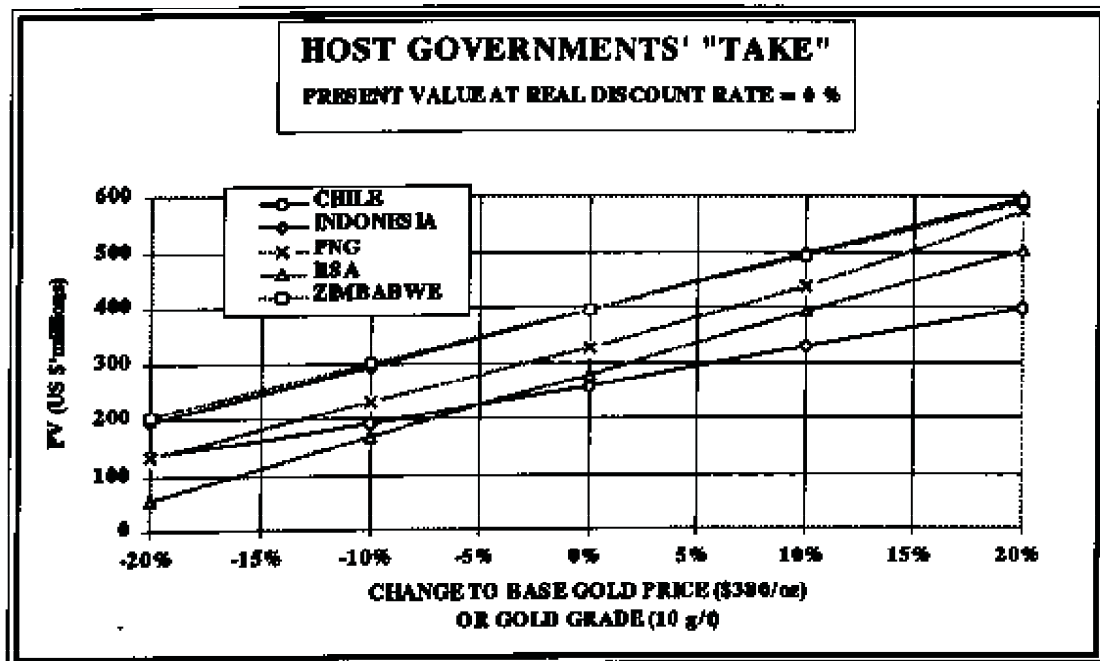
A concept which has been used extensively in the sensitivity analyses is equating changes to the gold price (base scenario: \$380 per ounce) with changes to the recovered gold grade (base scenario: 10 g/t). This concept has been introduced at the outset because most of the criteria influencing mining investment decisions can be measured in cost (or benefit) terms equivalent

to mineral grade. The principle extends to mineral economic theory where an investor would require a different 'class' or grade of ore deposit to achieve a minimum rate of return, depending on conditions in each country.

5.2.1 The host governments

Figure 5.2 compares the total accrual to government in each of the five countries over ranges of profitability, as simulated by changes to gold price (or gold grade).

Figure 5.2 Host governments' "take" per change in gold price (or gold grade)



The value accruing to the government in Chile is noticeably lower than the other countries. South

Africa's accruals are situated mostly between Chile and the other three countries'. The position would have been better for the S.A. government if the with-holding tax (15 per cent of remittances) had not been scrapped recently, but at the expense of the investor. This is a good example of changing codes to help attract foreign investors. The effect of PNG's additional profits tax can be seen at higher gold prices (or grades) where the gradient of the curve starts to increase.

Sensitivity analyses were carried out on other selected criteria. For purposes of summary presentation the change in host government total 'take' was measured per one per cent change in criteria. The comparative results for each country have been displayed in Figure 5.3. The equivalent amounts for the gold price (or gold grade) sensitivity are shown for reference purposes, that is, an abbreviated version of Figure 5.2.

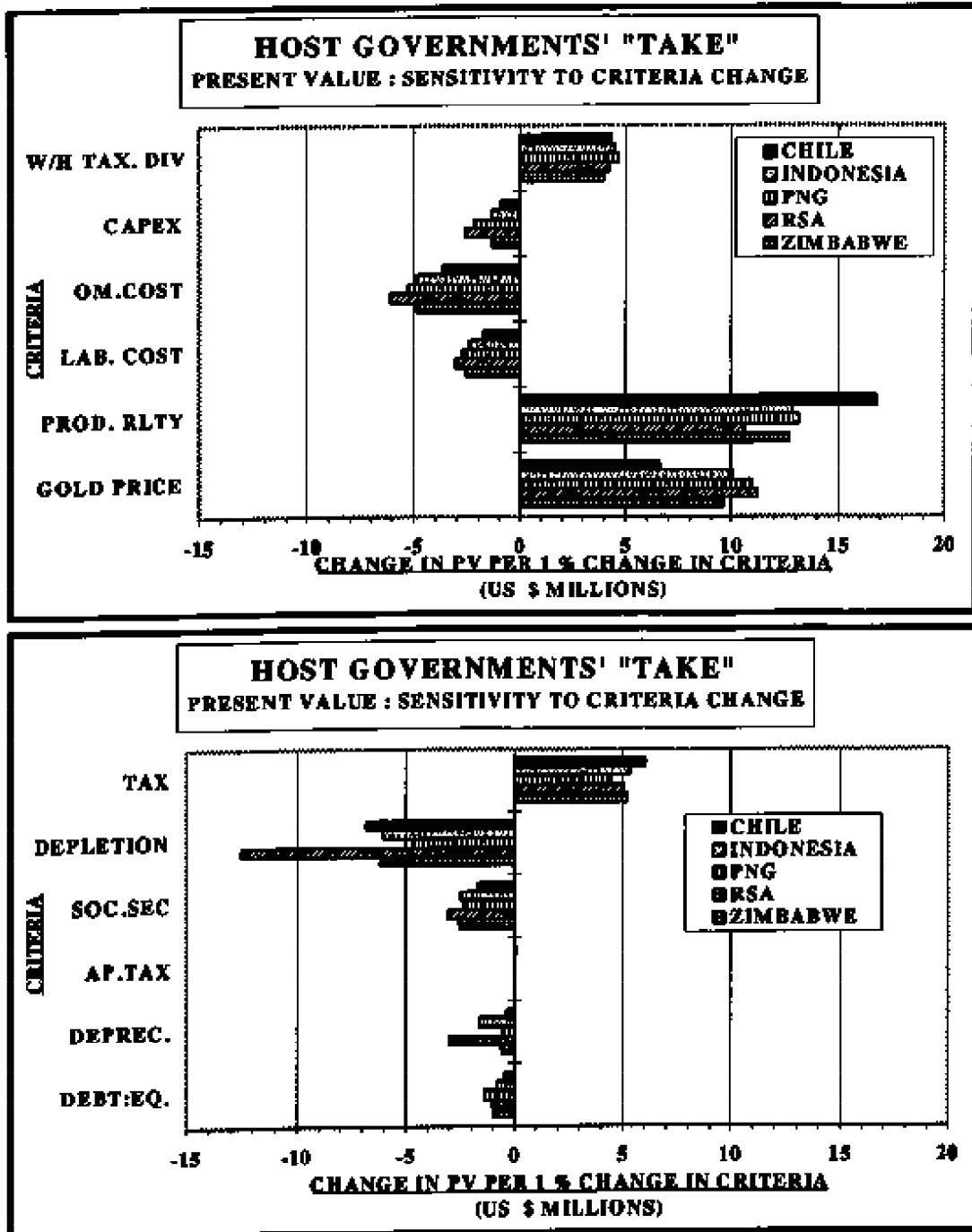
The charts in Figure 5.3 demonstrate a number of effects on the host governments' 'take':

- * Each criterion has a differing relative impact in each country.

- * The impact per change in one criterion can be equated in terms of another criteria. For example, the impact in PNG of changing the tax rate by 10 per cent would

be equivalent to changing the gold price (or grade) by approximately 5 per cent.

Figure 5.3 Change to host governments' "take" per change in selected criteria



- * The production royalty levied by some governments has the greatest impact on their total accruals (see below for the impact on the investors).
- * The change in labour costs can be equated to changes in productivity, for example, a 10 per cent change is equivalent to changing the gold price (or grade) by approximately 2.5 per cent.
- * With-holding taxes on foreign remittances can have a significant impact on the host governments' total take. In this case, a 10 per cent change would be equivalent to as much as a 5 per cent change in gold price (or grade).
- * The additional profit tax does not appear to have much impact under the base scenario conditions. It is questionable whether this type of tax is worth administering for the fiscal revenue likely to be generated. As commented previously (see section 3.4.3) investors view this tax as a major disincentive.

5.2.2 The investors

From the investors' perspective the net present value (NPV) at a real discount rate of 10 per cent in each country has been compared in Figure 5.4. The 10 per cent discount rate was chosen on the basis of the requirements of the executives for projects in North