

consideration given in recent years include:

- (1) cash payments to be made at specified intervals during and/or after the term of the option agreement,
- (2) commitments to spend specified amounts of money on exploration work with respect to the optioned property at defined intervals during the course of the agreement,
- (3) royalty payable to the optionor based on production from the property, if and when the property is placed into production, and
- (4) a proportion of the shares of a new company which the optionee may be required to form, to acquire the property, if and when the option is exercised.¹²⁹

The various forms of consideration defined above may be used individually, or in combination in any single agreement, although it would be unusual to have the same agreement grant share interest and royalty provisions.

6.1.1 Common Rights and Options Granted

An option agreement presents an optionee with certain rights which may be exercised under the terms and conditions established in the agreement. Typical rights which may be acquired by the optionee are:

- (1) Acquisition of all rights, title and interest in the property. The sum of all option payments paid by the optionee represent the full purchase price for the property and all mineral rights. However, the price paid will normally be higher than the case in which the optionor retains a participating royalty interest in the property.

(2) Acquisition of an undivided interest in a property. The final exercise of an option agreement, after payments have been made and work commitments completed, is for each of the parties involved to become registered or recorded owners of an undivided interest in the property. The undivided interest may, for example, be a 60% interest for the optionee and a 40% interest for the optionor. (The undivided interest may vary in relation to the amount of exploration work conducted by the optionor prior to the agreement.)

In the event that either party elects not to provide its pro-rata share (i.e., 60/40) of the budgeted expenditures, then the undivided interest of such party will be diluted in favour of the second party according to the following formula;

$$\begin{array}{lcl} \text{Party's} & \text{Deemed plus actual} & \\ \text{Percentage} & \text{expenditures of such party} & \\ \text{Interest} & \text{-----} & \text{X 100} \\ & \text{Total deemed plus actual} & \\ & \text{expenditures of both party's}^{130} & \end{array}$$

In many of the more recent agreements, there is a provision to convert a participating interest to a royalty interest if the participating interest is diluted to a pre-agreed level (i.e. 10-20%).¹³¹

In an agreement where both parties hold an undivided interest, the potential development and exploitation of the discovery may be undertaken through a joint venture organization.

(3) Acquisition of all rights and title to the optioned property, with the optionor retaining a royalty interest.

(4) Right, title and interest in the optioned mineral property

are transferred to a new company. Some major corporations may elect to form a new company if they have no immediate tax write-offs. However, in the case of a Canadian option agreement, a joint venture arrangement is usually more advantageous for a senior company from an income tax point of view. The Income Tax Act revisions of 1972 provided that the operation of a mine through a new company would be taxed at the value of the property at the date of transfer.¹³²

One advantage of operating a mine through a new company is that decisions are the responsibility of an elected board of directors. A joint venture, although beneficial from an income tax point of view, is plagued by the recurring problems of decision-making.

6.1.2 Terms of the Agreement

In the establishment of an exploration agreement, numerous factors must be considered. The potential value of the property is the most obvious consideration, such that the optionee would pay more for a good showing in a geologically favourable environment than for a claim holding in a remote, relatively unknown area.

Prior expenditures must also be taken into consideration in arriving at the terms of the agreement. The optionee will be required to accept a lower share if previous drilling and trenching by the optionor indicate that the prospect has potential. Correspondingly, the optionee should not be required to assume an equal share of the cost for previous work which was

of little value. Furthermore, a higher price would also be expected to enter an agreement to explore or acquire a property near a newly discovered orebody. Even though the geology of a property is unknown, the value of all claims in the region will have increased in value.

Time factors are also of significant consideration during the negotiation of an agreement. In planning for a long exploration option, the agreement should consider; (a) the length of the exploration season, (b) the past history of the area, (c) the availability of funds to undertake anticipated work, and (d) other technical exploration problems.¹³³

The political and economic climate also has a bearing on the type of deal which should be negotiated. An unstable political climate probably will not command a high price in the agreement. During periods of recession and/or poor metal prices, when little money is being invested into exploration, an optionor will be more likely to offer a property under more favourable terms. On the other hand, a rise in metal prices or a major discovery can offset the effects of recession.

There are no "standard terms" for an option agreement. Obviously, based upon the nature of exploration, the agreement should benefit both parties involved, and negotiations should ensure that the best results are established with respect to overall fairness.

6.1.3 Final Agreement

After the negotiating process is completed, the final agreement will be drafted. Nonetheless, as discussed in the previous section, it is very unlikely that any two agreements will be the same. For this reason, Walker (1984) summarizes the basic information which should appear in an agreement, with reference to standard clauses found in a typical option agreement between Noranda Exploration Ltd. (NOREX), and an unknown junior company.

Property -- The common objective of any exploration agreement is to specify the terms and conditions of the mineral rights which will be acquired by one party from another. The instructions must, therefore, contain a full description of the property, its location, and details of assessment work required.

Title -- The exploration agreement should contain a warranty of title by the optionor. For example,

...the optionor represents and warrants that it is the beneficial owner of all of the ... continuous mineral claims in those certain lands situated in the ... area of ... Township in the Province of ... and that the property is in good standing, free and clear of all encumbrances, and it has full undisputed rights to deal with the property.

This is a crucial clause, because it assures the optionee that he is not conducting an exploration program on claims owned by a third party.

Cash Payments -- Where an agreement involves the company in making cash payments, the timing of the payments and the conditions must be clearly stated. For example, an agreement dated December 1988 may state:

In order to earn a 50% Participating Interest in the Property, the Optionee must expend an aggregate of \$2,000,000 prior to December 31, 1991 for expenditure on the exploration and development of the Property.

Expenditures on Work -- Expenditures to be made in exploration work should be defined in negotiations. Normally work commitments following the first year of the agreement are optional (allowing the optionee to abandon future exploration requirements). For example, to maintain the option to earn a 50% interest in a given property, the optionee must expend the following amounts on or before the dates indicated on the exploration and development of the property:

- i) \$500,000 prior to December 31, 1989
- ii) an additional \$500,000 prior to December 31, 1990
- iii) an additional \$750,000 prior to December 31, 1991

Upon execution of the agreement, the optionee would have to expend the final \$250,000 for a total of \$2 million. Since work commitments are optional following the first year, the optionee's interest may be diluted from the potential 50%, if the aggregate amounts are not spent. For example,

- i) earn 10% if \$500,000 spent prior to December 31, 1989
- ii) earn 25% if additional \$500,000 spent prior to December 31, 1990.

Rights Earned -- If the company fulfils all of the terms in the exploration option by making cash payments (possible to pay cash to the optionor, who, in turn would conduct the necessary exploration) and/or undertaking work commitments, it earns the right:

- i) to acquire the property outright, or
- ii) to acquire the property outright, but subject to payment of royalty to the optionor, or
- iii) to enter into a joint venture for further exploration,

development and exploitation of the property, or
iv) to form a new company which will acquire the property.

Provision of Information -- The optionor shall receive reports of the optionee's operations on the property. This assures the optionor that specified exploration expenditures are being spent efficiently, as well as provides the optionor with the progress and potential of the prospect. There are also normally written provisions that any information provided by the optionee will be kept confidential during the term of the agreement. If the optionee decides to dilute his working interest prior to fulfilling all exploration obligations, then any exploration records, drill core logs etc., pertaining to the exploration property must be compiled and returned to the optionor without and undue delay.¹³⁴

6.2 Franchising in Mineral Exploration?

The brief analysis of franchise organizations identified three classifications of contractual arrangements: fixed-wage, fixed-rental and share contracts. The characteristics of sharecropping and fixed-rental tenancy resemble, for example, the revenue sharing and royalty charging franchise agreements. In the case of mineral exploration, the similarities with franchising occur in two types of options; (1) acquisition of an undivided working interest in a property where further exploration, development and exploitation is undertaken as a joint venture, or (2) acquisition of all rights and title to the optioned property, with the optionor retaining a royalty interest.

Fundamentally, the two types of options granted above resemble

neither of the franchise organizations (Tradename or Business-Format). Franchising's central features are the rental of an intangible asset and the operation of a decentralized production or distribution process. Although information and production processes may accompany the franchise, it differs from a mineral exploration agreement in the central role of the trademark. The franchisee cloaks himself in the identity of the franchiseable trademark, whereas in exploration, it does not play such a significant role. However, it is possible to identify the relationship with a senior firm's name or the value of the claim block as the trademark. In this sense, the junior company would gain the respect of being associated with a valued mining company and potentially prosperous exploration program. Regardless, in no way does this compare to the significance placed upon the franchisor's brand image.

There are no "standard terms" in an exploration agreement, and it is the responsibility of the person negotiating the contract to obtain the best terms possible. This is not what is observed in franchising, where an "average" share contract is specified for each franchisee. Franchisees in one system have identical contracts; in franchising this results from a single decision, while in exploration through many separate decisions. Nevertheless, as in franchising, both franchisors and mining firms tend to operate (explore) a certain number of stores (prospects) and franchise (option) others. One question that can be addressed here is what determines the number of prospects each firm chooses to option. In other words, what factors make them decide between a more or less fixed-wage and share contract?

There is no doubt that all senior companies would like their exploration prospects to perform. If a junior company is discovery-oriented and provides some type of absolute advantage (regional/specific), some senior companies would be willing to share their interest to spur development and reduce risk. Even if success is not the end result, the senior company will gain a better understanding of the regional geology at little cost to itself, and enable quick response to any future developments. Through the use of mineral exploration agreements, alternative methods of project financing and the ability to spread exploration risk increases the number of mineral properties being farmed-out and actively explored. In most senior companies, however, farm-out options are not of highest priority, the company's financial position will determine the number of prospects put up for option.

The level of exploration expenditures varies with the overall expected returns from exploration. Mineral prices strongly influence these returns through their effect on the availability of internal funds for financing exploration. This was especially true in the early 1980's, although the increased ability of juniors to raise dollars by means of flow-through shares increased the number of properties optioned by senior companies. This farming-out of properties (dilution of working interest) permits the seniors to pool their risk and explore several (possibly multimetallic) properties, rather than sink all internal funds into one or a few prospects. This concept of exposing themselves to opportunity, as well as becoming involved with successful juniors, increases the likelihood of finding new

mines. Just as the seniors use the junior mining firms' ability to raise capital by means of FTS issues, so franchisors franchise for its ability to raise capital. Hence, both franchising and option agreements are to a large extent exercised in order to gain access to capital when it is needed most.

Franchising was also found to increase with a rise in the cost of supervising downstream operators due to geographical dispersion. Owned-units entail more on-site monitoring because the managers are not residual claimants, which may result in a lower level of supervision and care. For this reason owned - units are located near regional headquarters, whereas franchised units are more widely dispersed. According to R.E. Harrison (personal communication) of Falconbridge Ltd., the increased cost of downstream supervision was not a direct reason for optioning a property. Even though lack of incentive and opportunism are problems within a large mining organization, it has been at least partially alleviated through corporate re-organization. Harrison claims that the company's "financial position," and "the potential of the deposit" are the main considerations in determining whether or not to option a prospect. Similarly, Burn (1984) adds that larger organizations are less likely to reduce their interest in something good. Even in times of recession or low metal prices, Burn finds that the really good prospects may well be the last offered for farm-out. The location of a potential deposit would only become a factor of consideration if a local exploration group provided regional or mineral specific specialization which would keep exploration costs to a minimum and increase the chances of discovery.

Both types of exploration agreements mentioned above differ from franchising in the sense that they do not require the need for monitoring or policing. The importance of the intangible trademark and the franchise package determines the proportion of franchised outlets and degree of monitoring. Conversely, in exploration there is no standard contract, providing no opportunity to free ride on the tradename. Thus, with both types of exploration agreements the optionee assumes all of the cost and risks involved in the exploration process, but both agents are residual claimants. Therefore, in the sense of Alchian and Demsetz (1972) the problem of moral hazard is eliminated.

Acquisition of an undivided working interest in a mineral property where further exploration, development and exploitation is undertaken as a joint venture is the most popular form of agreement. All relevant information pertaining to the prospect is granted to the optionee, since it is not in the best interest of either party to withhold any information. No monitoring of the exploration process is necessary (other than desired managerial assistance) because expenses to be incurred are specified in the terms of the agreement, and the optionee absorbs all costs and risks during the exploration phase. In this sense, the optionee functions as if he were risk neutral. If the contract is not fulfilled as specified, the working interest will be diluted in accordance with the terms of the agreement. For this reason, shirking is not recognized to be in the best interest of the optionee, and he is granted full power and authority to perform the required exploration at his own discretion. Self-motivation (incentive) will assure that the

exploration expenditures are not put to waste.

Once the option is granted, the two (or more) parties will become joint venture partners in accordance to their specified working interest. The joint venture is a typical share contract monitored by a management committee. At this point, any further decisions based upon exploration, development or exploitation of the property will be evaluated by the management committee since each partner now shares in all costs, risk and profits.

This type of share contract providing for a back-in provision is almost always encountered with the most promising exploration projects. Table 8 offers a comparison between the strict joint venture, and farm-out with back-in provisions, in terms of their benefit to the optionor.

TABLE 8
Share Contract Provisions

<u>NPV PROFITS ('000)</u>				
Possible Outcomes	100% Working Interest	Joint Venture 50%	Farm-Out, Back-In for 50% Working Interest	Don't Drill
Failure	-500	-250	0	0
Success	3000	1500	1500	0

Obviously, in this simple example a 100% working interest will

contribute the largest return if exploration is successful. However, it will also provide for the greatest loss in the case of failure. In this respect, the farm-out loses nothing if exploration is a failure, but receives 50% of the reward if exploration is a success.

John May, president of exploration for Teck Mining, points out in an interview with Northern Miner Magazine (May 1987), that most of Teck's mining operations started out as, or evolved into joint ventures. In both cases, the ideas of different people from different points of view all contribute to a common goal, and there is less chance of error, with little if any costs in exploration.

The second style of option agreement is the acquisition of full rights and title to the property in question, where the optionor retains an agreed royalty interest. This type of agreement is identical to the fixed-rental contract. Generally, this type of contract is negotiated when the optionor has lost confidence in his prospect, but bears no risk by maintaining a royalty interest. Once again, all relevant information is provided to the optionee with respect to previous exploration work, such that there is no asymmetry of information. The acquisition price of the option is similar to a franchise fee, although it may in all likelihood be higher than the above option (depending on previous exploration work conducted) since the optionee is now receiving a 100 percent working interest. Full discretion is also given to the optionee with respect to the conduct of exploration work, because he absorbs all of the risk. If and when the property does enter into production, the optionee

will be required to pay a specified royalty. There will be no direct monitoring during the exploration phase, and once production begins, monitoring will simply be in the form of quarterly statements on mining operations and gross value of minerals extracted.

Direct monitoring of labour can be foregone in mineral exploration under the sharing or fixed-rental contracts since the optionee in each are risk neutral and residual claimants. For this reason, the optionee in either case has a direct incentive to contribute effort. The choice between the two types of rent rests on weighing the superior incentive properties of one against the advantages of the other.¹³⁵ Because a fixed-rental optionee receives all of the benefits from extra effort, the incentives of a fixed-rental contract are superior to those of sharing. The disincentive effect of a share contract arises due to the fact that each of the two agents involved, receive only a fraction of their marginal product. However, the working interest of any party not providing their share of effort is diluted in accordance to the provision of a dilution clause. Hence, even though each agent in a share contract receives only a fraction of their marginal product, their incentive to self-monitor remains identical to that of a fixed-rental contract.

The fixed-rental contract receives very little, if any managerial assistance from the optionor. The value of the prospect is identified through the fixed-fee or acquisition price and, as in franchising, any uncertainties would call for royalty payments. Although the optionee is given full power and authority to perform the necessary exploration, it is in the best

interest of the optionor to provide any required assistance, since they do have some stake in the property. The share contract, on the other hand, is similar to the fixed-rental prior to the granting of the option. Once the option is granted, the optionee no longer acts in a risk-neutral fashion, and the opportunity for specialization results since each party provides their most efficient input and share in the return. Because needed supervision can be delivered simultaneously with managerial advice, Reid's (1977) discussion of share tenancy is also applicable to exploration and franchising. This implies that labourers wanting no advice rent, those wanting some advice share, and those wanting a great deal of advice work for wages.

The franchisor has a greater incentive to provide managerial assistance to maintain the trademark value. As mentioned above, in exploration the amount of assistance depends upon the type of option granted and needs of the optionee. Rubin's (1978) argument based upon the variation in managerial discretion in franchise agreements does not hold in exploration agreements. Nonetheless, his comparison between trademark value and royalty payments does hold for mineral exploration. For instance, if the trademark is defined as the value of the claim block, then the value of the claims will be represented in the acquisition price, and the amount of revenues received by the optionor in terms of royalty payments. This would establish the necessary incentive for the optionor to provide any required assistance.

Both option agreements and franchising increase with the amount of risk in their sector. This is consistent with the risk sharing argument for share contracts if we assume that the

optionor (franchisor) is more risk-averse than the optionee (franchisee). This does not seem to be compatible with the conception that risk-averse franchisors use franchising to provide insurance to their risk-averse franchisees, while at the same time offering them an incentive compatible contract. In mineral exploration, the optionor provides no insurance since there is no direct association with a trademark. Furthermore, the fact that exploration agreements are more popular during periods of depressed metal prices, in which the optionee absorbs all of the risks in exploration suggests that the optionor is more risk-averse than the optionee. Therefore, the share or fixed-rental contracts are optimal for the risk-averse optionor who bears little (if any) risk in exploration, but shares in the fruits of success.

6.3 Risk Sharing

The exploratory activities of large and small firms, and their co-operative arrangements are best understood in light of the large risk and uncertainties that they must face. An investment financed by one person might be quite risky from that individual's point of view, but might not be so risky if spread over a large group who have diversified portfolios of assets. Arrow and Lind (1977) argue that large firms, as the government, should ignore uncertainty and behave as if indifferent to risk. In this respect, the diversity of investments and ability to pool risks suggest that a risk-free rate of discount should be used in evaluating investment projects. However, if this is the case,

then why do large exploration firms act in a risk-averse nature when they farm-out their properties?

Lind (1982) in a discussion of his work with Arrow uses the results of the Capital asset pricing model (CAPM) to analyze the riskiness of a small public investment from a national point of view. Assuming that such a risk can be efficiently distributed, then from a national stand point, a public investment would involve some risk if it has positive covariance with national income; the required rate of return is greater than the risk-free rate. If, on the other hand, the covariance between the returns to investment and national income is zero, then from the stand point of the nation, risk is minimal. Alternatively, if the covariance between returns is negative, then from the national perspective the investment is similar to insurance; the required rate of return is less than the risk-free rate.¹³⁶

The Arrow-Lind (1977) theorem may therefore be interpreted in terms of the above CAPM analysis as an investment with a beta value of zero. Consequently, due to the independence of returns by the government and large firms, Arrow and Lind demonstrate that the risk associated with such an investment can be almost eliminated through diversification. This is based upon the assumption that the investment is a fairly small proportion of the total, since the costs and benefits are borne by the public and shareholders respectively.

Although the government is able to spread its investment risk over a large number of people, and the large firm over many shareholders, Lind (1982) contends that a risk-adjusted rate should be used. This is in view of the fact that neither

complete nor perfect markets for risk exist. Subsequently, the adjustment for risk should be similar in evaluating public investments from the individual standpoint as the evaluation of a similar risk in their own private investment decisions. Even though the earlier work by Arrow and Lind is correct in demonstrating that risky investments of the government and large private firms are spread over a large number of people, the cost of risk is not reduced to zero, and some degree of risk-aversion remains.

Senior companies are not apt to option high probability prospects, however, if a prospect lacks potential, or if poor metal prices are placing a strain upon retained earnings, the likelihood for a farm-in opportunity increases. The fine-tooth exploration methods of the junior company, as well as their recent ability to raise flow-through, permits the large firm to keep an interest in their property without facing the large costs and risk of exploration. Furthermore, large firms may behave as risk-aversers if some shareholders (who control the firm) hold a large block of the stock. Even though there remains a large number of smaller stockholders, the firm behaves in a risk-averse fashion because their investment behaviour is the same as a sole investor. One further reason for risk-averse behaviour may result when a manager's career and income are related to exploration performance. In this situation, firm managers may make investment decisions that exhibit more risk-aversion than is in the interest of stockholders. This is because stockholders view the risk of the company in relation to a portfolio of assets, whereas managers do not ignore risk because their careers

are correlated with the outcome of each particular venture.¹³⁷

Exploration, like R&D, is a venture into the unknown where the most profitable results are likely to come from projects whose degree of uncertainty is the greatest. If it is possible to shift this risk and uncertainty through the negotiation of exploration agreements, then why not simply transfer them to an insurance firm? The possibility of shifting risk to an insurance firm would also permit firms to engage in risky activities which they otherwise would not consider.

The problems with the use of the insurance market is that it is limited in its scope, such that many risks (i.e., exploration) are uninsurable, and if insurable, are frequently limited to their amount of coverage.¹³⁸ These two factors limiting the use of insurance, are based upon the characteristics of "adverse selection" and "moral hazard." The basic idea behind adverse selection is the asymmetry of information. Purchasers of insurance may have a better idea of the relevant risks than does the insurance company. This may require the insurer to carry higher subjective estimates of expected loss than the insured. Subsequently, in many cases the cost of insuring is so high that individuals choose to bear the risks rather than pay the transaction costs associated with insurance.¹³⁹ As noted by Doherty and Dionne (1987), the absence of information on which to base loss expectations can lead to a contraction of the insurance market with loss of the potential benefits of risk sharing. More importantly, is the existence of certain moral hazards. The fact that an individual has insurance may alter his/her behaviour so that the observed outcome is adverse to the

insurer. Standard examples of moral hazard include, (1) the incentive, when flood plain insurance is available, for individuals to move onto a flood plain and neglect precautionary measures; and, (2) the incentive, when medical insurance is available, for individuals to increase demands for medical services.¹⁴⁰

It is now much easier to see why insurance against business failure or mineral exploration has not arisen: the incentive to succeed by providing high levels of effort may be too greatly reduced. More fundamentally, if an insurance company were to bear the risk faced in mineral exploration, then one has simply redefined which firm specializes in exploration risk taking.¹⁴¹

If complete absence of risk shifting is bad because it inhibits the undertaking of risky projects and if risk shifting is bad because it reduces the incentive to succeed, then Arrow (1963) suggests that the Pareto optimal policy would be to involve some element of co-insurance (partial risk shifting). Clearly, most exploration option agreements permit part but not all of the risks on exploration projects to be borne by others. This reduces the obstacles involved in risk-taking without diluting the necessary motivation for efficiency.

The general structure of a risk sharing arrangement in mineral exploration is represented through Leland's (1978) model of optimal risk sharing. Leland's model assumes that the resource value (V) of a claim block is given by a consequence function $V(a, s)$,¹⁴² where $a = (a_1, \dots, a_n)$ is a vector of actions taken by the firm, and s is the states of nature. For example, a_1 could denote the number of holes drilled by the firm and s could

indicate the amount of ore deposited in the claim area. The optionor will delegate the claim block to a firm prior to the realization of the state of nature in exchange for an agreed-upon payment schedule $P = P(a, s)$. Leland assumes that the competitive nature of firms implies that the optionor can offer any option which leaves the firm with an expected utility level equal to the certainty-equivalent level of zero-economic profits.¹⁴³ Subject to this constraint, the optionor's problem is to choose a payment schedule such that the firm chooses the a_i 's which maximize the expected utility of $P(a, s)$.

Under the fixed-rent contract, the optionee bears most, if not all of the risk; under the wage contract, the optionor bears most, if not all of the risk. Share contracts may then be regarded as a device for risk sharing (or risk dispersion); that is, the variance of return is distributed among contracting parties. In Leland's examination of the optimal payments schedule $P(V)$, the derivative dP/dV was thought of as a measure of risk sharing at any given deposit value V . Two interesting cases are:

$$(1) \quad \frac{dP}{dV} = 0$$

$$(2) \quad \frac{dP}{dV} = 1$$

In case (1) payments are independent of deposit value, such that it depicts the acquisition of all rights, title and interest in the property. In this scenario, the optionee bears all costs and risk of exploration, and the only payment to the optionor is the acquisition price. In case (2) the optionor bears all of the risk, which is similar to a fixed-wage contract.¹⁴⁴

Clearly, as dP/dV shifts from 0 to 1, the optionor bears more and more risk. The outright sale (1), is optimal only if the firm (optionee) is risk neutral, similarly the fixed-wage contract is only optimal if the optionor is risk neutral.

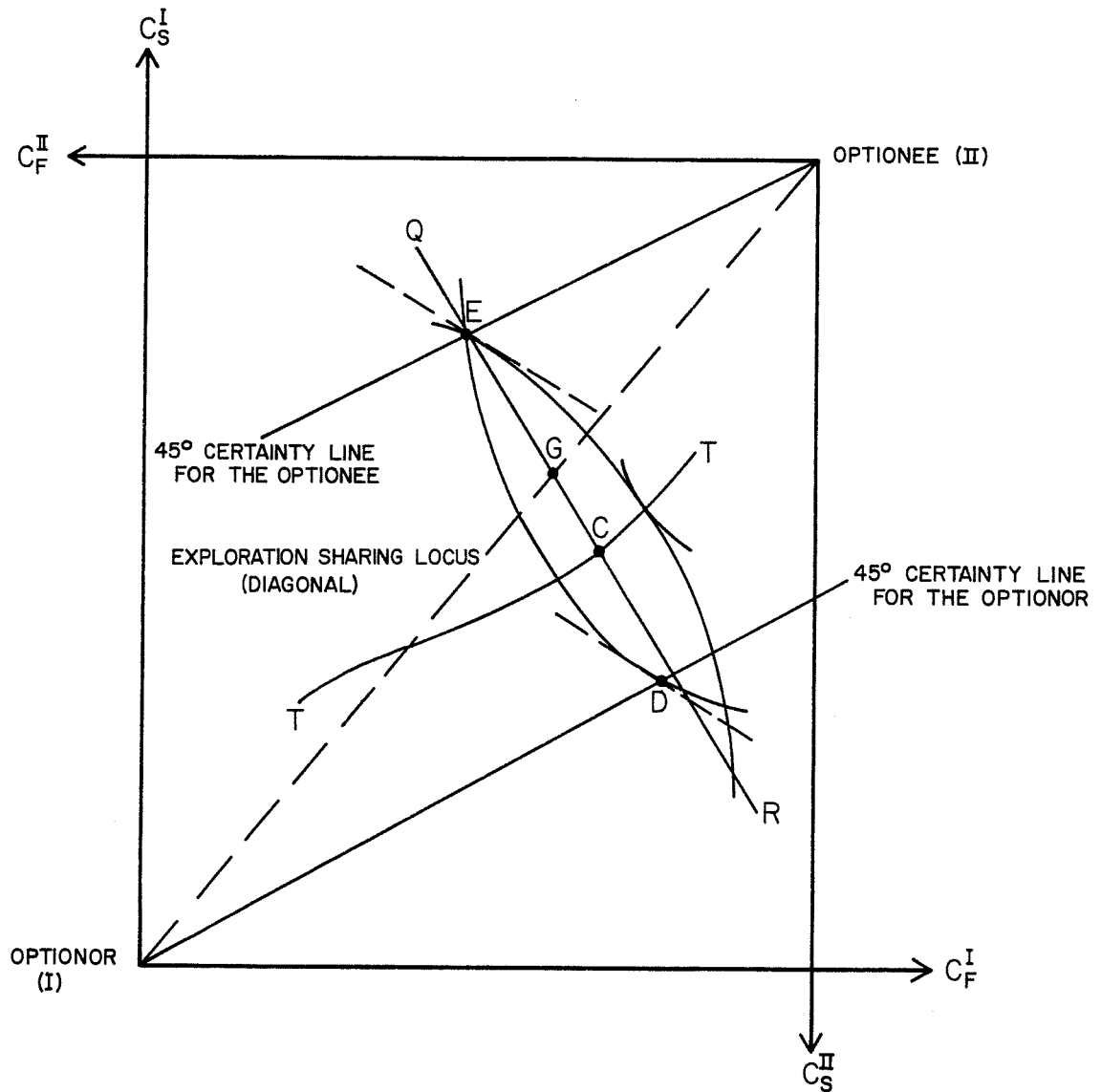
If both parties in the contract exhibit some degree of risk-aversion ($0 < dP/dV < 1$), they will generally contract to share in the total risks and returns. This can be illustrated by the Edgeworth Box in Figure 8.

The states of nature in Figure 8 are "success" (S) if an economic deposit is discovered and "failure" (F) if the opposite holds, with contingent claims C_s and C_f .

Given the subjective probabilities P_s and P_f ($P_f = 1 - P_s$) based upon available knowledge, the indifference curves for each agent have the same slope P_f/P_s along their respective 45° certainty lines. Consequently, each trader (optionor and optionee) cannot both attain certainty positions. At point E the optionor bears all of the risk (fixed-wage contract) and at point D the optionee bears all of the risk (fixed-rental contract). Beginning from a position like E, state claim trading or the negotiation of an exploration agreement would lead to an equilibrium like C on the contract curve TT which is a feasible location in the core, which is Pareto efficient. The contract curve lies between the two 45° certainty lines, so some of the risk is borne by each party.¹⁴⁵ If C were not Pareto efficient, then the coalition between the two agents could be improved upon.

If the two agents are constrained to a pure share contract, the equilibrium would lie along the main diagonal of the Edgeworth Box at point G. However, there is no reason to believe

FIGURE 8
Risk Sharing



Source: Hirshleifer, J., and J.G. Riley, "The Analytics of Uncertainty and Information," Journal of Economic Literature, Vol.17 (1979), Figure 3 p.1385.

Notes: Because of the difference in social totals of income in the two states, the box is vertically elongated.

that the economy would be at such a polar case. As pointed out by Stiglitz(1974), if one individual is more risk-averse than another, then the increase in mean income required to compensate him for an increase in risk (standard deviation of income) is greater. In this respect, the equilibrium contract in Figure 8 would be above the diagonal if the optionor is less risk-averse than the optionee; on the diagonal if the optionor is just as risk-averse as the optionee; and, below the diagonal if the optionor is more risk-averse than the optionee.¹⁴⁶ Hence, if both parties are risk-averse, we will never have a pure wage or rental system.

The difficult question is that of determining who is more risk-averse; it is therefore possible to derive the Arrow-Pratt proportional or relative measure of risk-aversion. To derive the relative measure of risk-aversion we must assume:

- (1) The firm has initial wealth (X) which is not random;
- (2) The firm faces a random loss $\bar{Z}$ which is proportional to X ;
- (3) $\bar{W} = X + X\bar{Z}$, where $\bar{W}$ is random wealth, and $U(\bar{W})$ = total utility of wealth.

If we assume that $U(\bar{W})$ is a differentiable function, then $U'(\bar{W})$ = marginal utility of wealth, which is always positive since we can assume wealth is desirable.

$U''(\bar{W})$ = rate of change of marginal utility with respect to wealth.

Thus, the firm should choose that policy which makes $E[U(\bar{W})]$ the larger.

The Arrow-Pratt relative risk premium $\pi(X, X\bar{Z}) = X\pi^*(X, \bar{Z})$ is defined by the following:

$$\pi^*(X, \widetilde{XZ}) = \frac{-XU''(X + \frac{XZ}{\widetilde{XZ}})}{2U'(X + \frac{XZ}{\widetilde{XZ}})} \sigma_z^2$$

From the Arrow-Pratt relative risk premium above, we can derive $r^*(X)$, which is the Arrow-Pratt relative measure of risk-aversion; where

$$r^*(X) = \frac{-XU''(X + \frac{XZ}{\widetilde{XZ}})}{U'(X + \frac{XZ}{\widetilde{XZ}})}$$

Hence, the measure of relative risk-aversion is the elasticity of the marginal utility of wealth; it is invariant not only with respect to changes in the units of utility but also with respect to changes in the units of wealth.¹⁴⁷

Stiglitz (1974) denotes $\beta = 0$ as the case of pure risk sharing, therefore $\beta > 0$ implies that the optionor is less risk-averse and $\beta < 0$ indicates that the optionor is more risk-averse than the optionee. Utilizing the Arrow-Pratt measure of relative risk-aversion, we can establish that;

$$\beta \geq 0 \quad \text{as} \quad r^{II}(X) \geq r^I(X)^{148}$$

where, $r^I(X)$ = optionor's measure of relative risk-aversion
 $r^{II}(X)$ = optionee's measure of relative risk-aversion

In other words, if $r^I(X)$ is small relative to $r^{II}(X)$ we approach a pure wage system and the optionee is more risk-averse than the optionor. Conversely, if $r^{II}(X)$ is small relative to $r^I(X)$ we approach a pure rental system where the optionor is more risk-averse than the optionee.

Consider the situation where the principal (Optionor, Franchisor) has no information about effort provided by the agent (Optionee, Franchisee), so the fee can depend only on the

outcome. If the agent is risk neutral, then Shavell (1979) finds that there is a Pareto optimal fee schedule under which the agent is paid the outcome minus a constant, where the constant is the principal's share. On the other hand, if the agent is risk-averse, then the fee depends to some extent on the outcome, but the agent never bears all of the risk.¹⁴⁹

If the principal knows the outcome and has information about the agent's effort, then the fee would depend on both the outcome and the level of effort. In this case, if the agent is risk-neutral, then there exists a Pareto optimal fee schedule under which the amount the agent is paid depends only upon the outcome. Thus, the information about the agent's effort is of no value. Because the agent is risk neutral, Shavell points out that he acts on behalf of the principal, who may be risk-averse, as a perfect insurer against risk. Therefore, from the share contract (sharecropping) point of view, which seems to apply to exploration but not necessarily to that of franchising (i.e., free-riding problem), it is optimal for the agent to maximize the expected net return. If the agent were risk-averse, then under a Pareto optimal fee schedule the agent is paid an amount which depends on information about his effort level. Since the agent is risk-averse, it is optimal for him to avoid risk whenever possible. This suggests that the actual level of effort maintained by the agent would provide for a first-best solution serving as an incentive in the fee schedule.¹⁵⁰ Thus, incentive schemes force the agent to bear a greater amount of risk than would otherwise be endured.

CONCLUSIONS

The major purpose for this paper has been to shed some light upon the important aspects of mineral exploration, and the role of the exploration organization in terms of a franchise relationship. Granted that a vast amount of literature is available in terms of the franchise organization, and contractual arrangements, little focus has been directed towards the analysis of the exploration organization. For this reason, the analysis of informational issues have been based upon the insights of geologists, geochemists, geophysicists and engineers to form a basis for economic analysis. Furthermore, there are few solid data on mineral exploration which shifted this study from an empirical to a theoretical assessment of mineral exploration option agreements in the context of the franchise phenomenon.

The organization of the first part of this paper may appear rather abstract, nevertheless the analysis of the exploration organization provides the framework for an interesting yet necessary introduction to exploration and contractual arrangements. The reason for this is that there has been much discussion about the effective size of an exploration company. Many people (Freyman (1978), Kalyon et al. (1978), Bailly (1979), Snow and Mackenzie (1981)) have stated that smallness is a desirable asset. This philosophy is based upon the fact that many of the major mining companies today owe their growth to the profits of their initial discovery that was made by a small group of exploration people. Over the years these companies have grown into large complex exploration departments, within which the

exploration process has often tended to become a managed business activity. Unfortunately, in many cases the organization of these exploration departments are rigid and complex with administrative structures which require recommendations from the field to go through numerous layers and channels of stratified authority before receiving final approval. As a result many productive exploration idea's in these large groups become lost in the administration.

Organizational theory lends support to the above problems found in the exploration organization. A brief study of the abundant literature on organizational design tied together with excerpts from relevant geologic publications found that the solution to the rigid structures was to avoid layering in the organization by breaking or decentralizing into small independent groups with the authority to make key decisions as close to the field as possible. While these groups are integrated into the overall structure of the larger exploration group, the philosophy is to remain small at the same time. The independent exploration group will retain the characteristics of the entrepreneur, while avoiding the weaknesses of bureaucracy and drawing upon the strengths of the organization.

Exploration is probably the riskiest form of investment in the mineral industry. The likelihood of profiting in the long run is only favourable if the steps are taken to minimize the grounds for these risks. Nonetheless, corporations are ultimately dependent on the exploration industry for their survival. The purpose of this section on exploration risk was to outline briefly the factors which should be considered in assessing the

economics of mineral exploration, and through an empirical analysis by Mackenzie (1981,1986) how such assessments can be made by considering experience. There is no doubt that historical values offer useful guides in the assessment of exploration, however, the fact that the proceeds of previous plays are not immediately available and the odds change over time, place a great deal of scepticism upon their relevance. Although the 'probability-of-ruin' approach has historically been identified as a case of true ruin, in exploration it is simply used as a tool to measure feasibility or degree of self-sufficiency. Thus, historical data can be of considerable importance in a corporations overall strategic plan to integrate prospective exploration programs of varying size and risk into their exploration portfolio of investment alternatives, while avoiding cash flow problems, managing risk, and maximizing return.

The probability-of-ruin theorem was also found to be of significant importance in strategic planning as a method of determining when risk should be shared. The more expensive it becomes on average to discover a mineral deposit, the lower the availability of exploration funds, or the chance of falling mineral prices will all direct exploration organizations to lower their participation risk by "diluting" their working interest. This is of interest when applied to the discussion of the exploration organization and participants in exploration, since the dilution of working interest is the basis for the delegation of exploration activity.

The senior companies' access to opportunities and the

willingness of small companies to prospect the speculative ventures are important elements in the structure of the mineral industry. The seniors enter into co-operative ventures with junior mining firms because of mutual interest, and not merely because the junior is a satellite or "exploration arm." If the senior firms decided against entering into these exploration agreements, they would be in no better position to evaluate their claim blocks than they were beforehand, and would not be any more motivated to further explore these uncertain prospects themselves; whereas if they abandoned some of their selective prospects, the junior firm would soon find the means of acquiring them, and conducting the necessary work to establish it's potential. As mentioned earlier, "better a small percentage of something than 100% of nothing."

Mineral price trends offer an explanation with respect to the similarities amongst company expenditure trends. Mineral prices influence the demand for exploration funds, however, they also influence a firms revenue position with respect to its availability of retained earnings. Consequently, mineral prices, as noted by Eggert (1987,1988), are found to influence the cost of capital if the cost of external funds is greater than the cost of internal funds. Hence, periods of low metal prices imply low levels of internal funding and periods of high metal prices are associated with high levels of retained earnings.

Prior to 1983, there had been a vast diversity in the tax positions between junior and senior companies. This occurred namely because only senior companies were able to deduct exploration expenses against taxable income. Junior companies,

without taxable income began to deteriorate in terms of their exploration significance since it was too difficult to maintain an efficient level of exploration with diminishing retained earnings. Clearly, the juniors were at a disadvantage. FTS's were therefore designed to address this imbalance in the tax positions of these two types of firms.

Section 4 offered an in depth analysis of FTS financing in terms of its significance as a tax shelter for potential investors. In understanding the tax implications of the FTS mechanism, it is possible to comprehend the importance of FTS's as a measure to sustain the importance of junior companies. One significant downstream benefit that flow-through financing created was the ability for a company to bring in new mines with reduced debt loads. This key factor provided new operations with the ability to withstand cyclical world metal prices and provided long-term stability to employees. The bottom line is that seniors have used flow-through financing through farm-outs to offset their costs, and juniors have looked to the larger companies for opportunity and management expertise.

The FTS mechanism was very successful in its heyday, contributing to the Canadian economy and regional economies (specifically northern economies) both directly through exploration and indirectly through its multiplier effects. Nonetheless, cost/benefit inefficiencies, senior companies abuse of FTS's by forming junior subsidiaries to make use of FTS's, government retrenchment, as well as an improved economic climate in the mineral industry have eliminated the use of MEDA in the FTS program. The Canadian government also realizes that FTS's

have financed over 70% of preliminary grassroots exploration in Canada since 1983. Subsequently, a Federal grant program (CEIP) has been introduced to assist the juniors, while eliminating any "arm's length" abuse of the system.

The backbone of this paper has been to determine whether franchising works as an explanation in exploration. The FTS program is the key link to the delegation of exploration activity, because FTS's became attractive to senior companies as a source of additional capital beyond that which was budgeted. For example, Westmin's exploration budget has averaged \$4 million annually, however, FTS financing increased their budget to \$12 million (1987) with approximately three-quarters coming from flow-through farm-out agreements using juniors.

A brief analysis of the franchise organization and exploration option agreements identified three classifications of contractual arrangements; fixed-wage, fixed-rental and share contracts. The characteristics of sharecropping and fixed-rental tenancy resemble, for example, the revenue sharing and royalty charging franchise agreements. In mineral exploration, the similarities with franchising occur in two types of options; (1) acquisition of an undivided working interest in a property where further exploration, development and exploitation is undertaken as a joint venture, or (2) acquisition of all rights and title to the optioned property, with the optionor retaining a royalty interest.

The most interesting concepts of franchising were outlined in the introduction, however, the general franchise relationship was not found to be an appropriate explanation for the delegation of

exploration activity. Franchisors' resort to franchising more often when monitoring downstream operators become costlier, and use it less when the value of the inputs it provides increases. This is consistent with the two-sided moral hazard described by Lafontaine (1987). In terms of exploration, however, direct monitoring and policing, geographical dispersion, and the trademark value are not key concepts in the decision to option exploration projects. Nonetheless, the junior's association with a senior company, the managerial assistance available, and the potential value of the claim block play a role similar to that of the franchisors tradename in achieving a higher and more efficient level of effort. Mineral exploration did identify with the following underlying characteristics, both of which influence the use of sharing in franchising and mineral exploration:

The ability to earn a reasonable profit without becoming involved in high capital risk or in the day-to-day details and problems support the theory that firms' propensity to option (franchise) increases during periods of rapid expansion. Each optioned property utilizes the financial resources of the individual optionee; it therefore follows that the senior mining firm, as the franchisor, can expand much more rapidly using a minimum of risk capital and management resources.

In addition to their ability to raise capital, both franchising and exploration agreements are greatly motivated by their ability to share risk. Because both franchising and exploration agreements entail variable payments, they are a type of share contract, similar to sharecropping and joint ventures. As pointed out beforehand, Shavell (1979) advocates that the

principal-agent problem combines two elements, risk sharing and differential information. Even if there is no problem of differential information, there would be some sharing since both parties are risk-averse to some extent. Indeed, if the agent (optionee, franchisee) were risk neutral, the principal-agent problem would have a simple solution: the agent would bear all of the risks and differential information would not matter. That is, the principal would retain a fixed amount and pay the remainder to the agent, who would have no dilution of incentives. This type of agreement is based upon the risk sharing or risk spreading property, where the principal's use franchise or exploration agreements as a source of insurance for themselves. Thus, as in franchising, optionors use the exploration agreement as a source of insurance for themselves, not for their optionee's.

Generally, the availability of the junior as a source of capital and risk sharing partner are the two basic characteristics which prompt the senior to option a prospect. Nonetheless, the company's financial position and the prospects overall potential are the main considerations in determining whether or not to option the property. Seniors will only option their more worthwhile properties if they feel they can gain from the junior in some way (i.e., regional/mineral specific specialization).

The delegation of authority through the exploration option agreement has seen its heyday following the introduction of FTS financing. With the recent phasing-out of the exploration deduction (MEDA), it is plausible that many junior companies will

farm-out some of their exploration properties in return for equity. Moreover, it is highly probable that once the juniors have farmed-out their prospects, they will use their newly acquired funds to search for farm-in opportunities. Provided that the junior firms offer specialized geologic knowledge, a sufficient source of capital, and optionors' are interested in pooling their risk, exploration option agreements may continue to be an instrumental tool in the discovery of new mineral resources.

The one problem which may dampen exploration activity is the uncertainty related to the introduction of CEIP. Although real figures will not be available until some time after exploration work begins in May (when the snow melts in northern regions), it is felt that the elimination of MEDA, changes in the area of taxation, and a more complex grant system will hurt exploration investment.

This paper has dealt specifically with the relationship between junior and senior mining firms and their potential franchise relationship. A future research consideration may be to analyze the conceivable franchise relationship within mining firms which divide the organization into semi-autonomous units. For example, Hemlo Gold Mines Inc. is a subsidiary of Noranda Ltd., which maintains a 50.1% working interest. The exploration arm was set up to make use of FTS financing, while exploring for gold in the Hemlo district. These semi-autonomous 'franchises' were provided with corporate guidelines and high quality managerial support to make certain decisions in the field. In this sense, during the period of FTS popularity, these

exploration arms affiliated to a senior organization, played a potentially analogous role to that of franchising.

Prior to writing this paper, I was of the opinion that "franchising in mineral exploration" could be covered in a short but informative fashion. I am now of the opinion that the subject is as elusive as the orebodies that the contractual relationship will hopefully help to find. Perhaps this is the reason why nothing as of yet has been published on the subject. Nonetheless, this paper does provide the groundwork to a very interesting topic, and as noted by Cairns (1987, p.28), "Even though our understanding is still incomplete, progress has been made."

APPENDIX 1

TOP MARGINAL TAX RATES

	Top Marginal Tax Rate	
	1987	1988
British Columbia	52.53%	44.81%
Alberta	53.09	45.43
Saskatchewan	54.44	47.23
Manitoba	58.05	49.53
Ontario	52.53	44.81
Quebec	56.57	52.25
New Brunswick	54.74	46.69
Nova Scotia	54.23	46.26
Prince Edward Island	53.72	45.82
Newfoundland	55.42	47.27

Source: First Exploration Fund 1988, Public Offering Prospectus
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FOOTNOTES

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131. In the case of a 50-50 interest scenario, if either party's undivided interest in the property is diluted to a 20% ratio, then such party's interest shall automatically be converted to the higher of a 15% Net Profit Interest in the property or to 1.5% of the Net Smelter Returns and such party shall no longer have any right to participate in the joint venture except to receive payment of its 15% Net Profit Interest or 1.5% of Net Smelter Returns.
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142. By consequence is meant a full definition of all relevant characteristics of the individuals environment resulting from the interaction of the specified act and state.
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