

Franchising in Mineral Exploration

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1.0 INTRODUCTION

The mineral industry is sustained by exploration, in that exploration is the means by which deposits are replenished. More fundamentally, it is the discovery of new sources of mineral supply. However, the analysis of this paper is limited to nonfuel minerals and thus excludes sources of energy such as petroleum, natural gas and coal.

Mineral exploration, and the mineral industry in general, are extremely complex because of the physical characteristics of mineral resources: minerals are a heterogeneous nonrenewable resource; their occurrence is uncertain and often in deep locations beneath the earth's crust; the sites of discovery are often found in remote areas; and once discovered many phases of development and processing are required prior to its final use. Mineral resources have to be discovered, and even after discovery, the true value of the deposit is unknown until the resource is depleted.

This paper examines the delegation of authority within mineral exploration and franchise organizations. The study focuses on the contractual arrangements of share contracts, under which, two or more parties share in the output of the production process. Examples of interest will be exploration option agreements (specifically the joint venture), franchising and the theory of sharecropping.

Most organizations are characterized by organizational arrangements where authority is distributed among several decision-making levels. This is of particular interest in

exploration organizations because responsibilities are usually shared over several decision levels. In this respect, the size of exploration firms has resulted in several recent studies attempting to determine whether the so called junior mining companies are more efficient and successful than their senior counterparts. Empirical results relating the discovery of economic deposits and exploration expenditures suggest that junior companies were at least as, if not more successful in discovering economic deposits at a lower cost than the larger firms.

This is of considerable interest when related to an annual survey conducted by the "Northern Miner" with respect to exploration work conducted by senior companies. The trend in exploration suggests that the character of the junior industry has changed dramatically since the discovery of Hemlo and the introduction of Flow-Through Share financing; now the juniors are playing a larger and certainly more influential role than the more established companies. Most of the major Canadian mining companies were represented in the Northern Miner's survey, yet their exploration plans totalled only about one third of the total exploration for Canada (1987), not including their programs that were being financed by junior companies. This leaves almost two-thirds of the exploration in Canada under the financial control of junior companies.

A sequence of decisions must precede any decision to conduct further exploration (i.e. reconnaissance drilling) or stop exploration, but each decision is directed towards the final payoff question: Should we invest money in the deposit? If so,

how much should we risk and how much should we share with others?¹

Several mineral properties have been farmed-out under this decision rule, and are now being actively explored or mined in keeping with many senior company strategies to seek alternative methods of project financing and spread exploration risk. Thus, co-operative ventures often involve the sharing of costs and/or benefits from an exploration program. The actual exploration is often performed by the small junior company, which enters into an exploration agreement with the senior company holding the prospect.

This relationship between junior and senior exploration firms is similar to that of franchising, in that both franchisors and mining firms tend to operate (explore) a certain number of stores (prospects) and franchise (option) others. Similarly, since franchising and exploration agreements both entail variable payments, both parties to the contract are residual claimants.

This paper will offer a better understanding of the principal-agent relationship involved in a franchise and exploration agreement, and analyze the factors that influence the agent's decision between a more or less fixed-wage or share contract. The key concepts of franchising which may provide for a franchise relationship in mineral exploration are: the franchisor's propensity to use franchising as risk increases in their sector; the franchisor's propensity to increase their use of franchising during periods of rapid expansion as a source of capital; franchisors tendency to use franchising more when the cost of supervision increases with geographical dispersion; and, the

right to use the franchisors' trademark, combined with managerial assistance, play a key role in the franchisees' provision of a higher and more efficient level of effort. Franchising, thus offers the opportunity to test the contractual decisions of the exploration firm.

This paper is organized as follows. In Section 2, I provide a description of the exploration organization, followed by an overview of the theory of organization found in the theoretical literature. The theory of organizational design is then applied to the exploration industry and discussed in terms of junior and senior companies role in mineral discoveries. In Section 3, I briefly provide an analysis of exploration risk, including Mackenzie's (1981,1986) empirical analysis of risk in the Canadian Shield. In Section 4 it is shown how the high degree of risk and large size of most mineral investments gives rise to several different patterns of financing exploration. Section 5, provides a brief overview of contractual arrangements in the context of franchising, with an explanation for the existence of share contracts. In Section 6, the characteristics of an exploration option agreement are defined, as well as its relationship to franchising. Finally, Section 7 contains some concluding remarks.

2.0 THE EXPLORATION ORGANIZATION

2.1 Corporate Exploration Techniques

As exploration corporations evolve, they continue to search for the most successful exploration philosophy. A precise definition of "exploration philosophy" is difficult to formulate since an exploration management manual explaining the "art" of exploration does not exist. Exploration management varies from one company to the next -- some companies operate on their own "secret philosophy," and yet others rely mainly on luck, by trial and error (hit and miss) methods. Everyone appears to have his or her own exploration philosophy, nevertheless, every exploration manager probably has a clear idea about what constitutes an effective exploration program.

The techniques of ore discovery for corporations lie at two extremes: (1) exploration (the raw discovery), and (2) the acquisition of (or interest in) an orebody. The raw discovery involves research leading to the identification of new or previously unrecognized ore environments and re-evaluation of the potential of known mining/mineral districts, and acquisition involves actively seeking out suitable opportunities for investment in the ongoing projects of others.²

Corporate objectives will influence the technique of investigation, based upon resource availability and overall levels of exploration expenditures. Management of mineral resource companies are faced with the question of whether funds can be better spent by purchasing existing ore reserves,

acquiring an operating mine or acquiring a participating interest in an established exploration program. To be effective, the project generation stage must be recognized by senior management as one of the most important decision-making stages in exploration.

To fulfil corporate objectives, mineral exploration firms are organized within three different frameworks: (1) territorial, (2) specialists, and (3) a mixture of the two.³

The territorial regime is most common, under which an exploration district is outlined, followed by the establishment of regional offices. The territorial group is then responsible for the exploration of all minerals that may occur within their given district.

Miller (1976) argues that the complex nature of ore deposit geology requires a high degree of specialization. Specialist groups within the corporate system have an advanced knowledge of specific deposit types (i.e., volcanogenic, porphyry), or specific minerals (i.e., gold, copper), and for this reason focus their attention upon the exploration of their particular specialty. Moreover, the future of exploration corporations depend to a large extent on the expertise specialist groups acquire in each class of deposit.

Finally, it is possible to mix both territorial and specialized exploration groups. For example, Noranda Exploration (NOREX) is established on a regional basis, but in order to maintain a high level of success it has organized inter-regional specialists from several divisions who assist in the exploration of particular deposit types.⁴

2.2 Corporate Goals

Profit, growth and survival are fundamental corporate goals. Profit is the basic investment incentive and the measure of success; growth is the driving force behind company development. In the long run, however, profit and growth are based upon survival -- a mining company cannot survive on the basis of their currently producing mines forever.⁵

Depletion of reserves is the driving force behind exploration, and exploration is employed to replace high-grade ore in order to offset the depletion effect. Devarajan and Fisher (1982) present a two-period model of optimal extraction and exploration under uncertainty. In their model, mineral resources occur in a continuum of grades, where the highest grade is depleted first. In this respect, with each ton of ore extracted, the next ton requires more effort. However, Devarajan-Fisher were not the first to find this relationship between depletion and the marginal cost of extraction. It was Pindyk (1978) who first established that exploration occurs in order to reduce extraction costs, which are negatively related to reserve holdings. The fact that current extraction can increase future costs by lowering reserves suggests a motivation for exploration.⁶ For this reason, Devarajan-Fisher remind us that while modelling exploration, we must not lose sight of the depletion effect in extraction, which is clearly linked to the depletion of exploration projects.

Consequently, profit and survival considerations play an important part in influencing a mining company's exploration

strategy. As Devarajan-Fisher contend, if a mining company is to survive beyond the life of its current operation, it must explore, discover, and develop mineral deposits.

The importance of exploration within a mining company, and the role which it plays can be determined by the level and percentage of resources delegated to exploration. Exploration success is possibly one of the most influential factors in determining the level of expenditures dedicated to exploration. A firm is likely to increase its expenditures after a period of successful exploration which increases its future expected returns from exploration. However, increased expenditures alone will not guarantee success. In order to become and remain successful, the management of an exploration team must be "discovery-oriented." The hope for a bonanza, a discovery bigger and better than most, is a major driving force in exploration. The more demanding goals become, the greater will be the risk of not achieving them. Unrealistic objectives may result in outcomes which could threaten corporate survival. Less ambitious objectives, such as:

- (1) individual prospectors look for signs of mineralization that might persuade some mining or exploration company to buy their claims;
- (2) poorly financed companies seek, through a promising find, to create demand for their company's shares;
- (3) major companies seek new deposits of marketable quality to ensure their long-term development; and
- (4) government bodies explore for materials where quality and proximity are the main criteria⁷,

will lower their risk, and while the rewards may be less spectacular, corporate survival may be secured.

Holmes (1977) indicates that an effective, "discovery-oriented" exploration philosophy should include the following elements indicative of an effective exploration group, which are: management, individual peoples, organization, technical excellence, size, flexibility and other related factors. If the exploration group is working within a favourable environment, all of the above factors will take part in achieving an effective exploration philosophy, with lower than average exploration expenditures. Hence, the discovery rate is essentially a function of constructive expenditures on exploration and of the over-all probability of achieving success.⁸

It should, however, be kept in mind that most exploration projects fail to discover any economic deposits, and for this reason lose their initial capital investment. Exploration success will primarily result from only a few prosperous discoveries. In this regard, mineral exploration is comparable to research and development (R&D) and the generation of new technology, rather than investment in new manufacturing facilities or highways.⁹

2.3 Exploration and Information

In the course of exploration, the definition of the target is improved through a number of sequential information gathering stages. These stages include obtaining data from geologic mapping, geochemical and geophysical studies, drilling and other technical procedures to decide whether to advance to the next, usually more expensive stage of exploration; to improve the

information set at the current stage; or to drop the program altogether.¹⁰ The sequential nature of exploration is often compared to that of R&D.

A descriptive characterization of R&D by Hirshleifer and Riley (1979: p.1403) pertains to exploration: "Since nature will not autonomously reveal her secret, it must be sought out by costly (generally private) search for the still unknown 'message'." Both require research with an acknowledged note of uncertainty, particularly in the value of the final outcome. In fact, both are sequential development (information-gathering) processes in the sense of Roberts and Weitzman (1981) and Mackie-Mason (1985). There are many steps in the sequential process, and as one proceeds through the steps, more costs must be paid out. Nevertheless, greater information is gathered as the outcomes of each particular step is realized. The decision to proceed with the next stage of exploration is made as the benefits of the outcome become more evident -- the realization of a stage removes more uncertainty and yields an improved decision.

Both Roberts and Weitzman (1981) and Mackie-Mason (1985) require a sequential decision rule, which indicates whether or not to continue at each stage as a function of the information then available. An optimal stopping rule is defined by Roberts and Weitzman, where at each stage the optimal stopping rule maximizes expected benefits minus costs based upon information available at that stage, and taking into account that the stopping rule will be exercised in future stages. The optimal stopping rule can be more clearly defined by pointing out that at any stage, the expected cost to complete the project is C and

the perceived benefits, distributed $N(\mu, \sigma^2)$. It is optimal to continue the sequential process if and only if expected terminal benefits exceed expected costs (to completion).¹¹ Thus,

$$C \leq E[Y | Y \geq \mu] \quad \text{where } Y \sim N(0, \sigma^2)$$

The easiest way to explain the above, is to determine when an individual would be indifferent between continuing and stopping exploration. Given C and σ^2 , what is the cutoff value of μ , (i.e. $\hat{\mu}$) which turns the inequality into an equality. Roberts and Weitzman define this as

$$C = E[Y | Y \geq \hat{\mu}]$$

At $\mu = \hat{\mu}$, the decision maker would be indifferent between continuing and stopping the project. Furthermore, when $\mu < \hat{\mu}$, it is best to stop, whereas if $\mu > \hat{\mu}$, continue exploration.¹²

The difference between R&D and exploration is that the sequential search in R&D is for the design of a new improved product as opposed to the discovery of a new supply of ore. Moreover, once a project is abandoned under R&D it is abandoned forever, however, the idiosyncrasies of exploration would permit the claim to be re-evaluated at a later date. Roberts and Weitzman add to this by establishing the distinction between the two types of sequential development processes; in R&D all stages of a process must be completed before any benefits can be secured, whereas in exploration, the process could in principle be terminated at an early stage and (uncertain) benefits could be received.

Information externalities in exploration are unlike R&D. There exists the depletion effect in the process of exploration since mineral resources are a non-renewable resource, whereas a

new innovation does not reduce the potential for future innovations. Exploration usually finds the largest and easiest deposits to locate first, however these discoveries are only temporary; once depletion occurs, extraction transpires from lower grade deposits or, increased exploration results to replenish the depleted reserves. Regardless, technological advance is cumulative. A less productive method is never maintained once a superior one is established. Thus, the conflict between R&D and exploration is that R&D tends to increase knowledge, while exploration attempts to avoid depletion.¹³

The information problem which arises in exploration is the tendency for deposits to cluster. The clustering of deposits suggests that the discovery of a deposit improves the probability of there being another deposit nearby.

Peterson (1975), Stiglitz (1975) as well as Dodds and Bishop (1984) have all pointed out the existence of two externalities in exploration; the first involves the external diseconomies in which firms treat undiscovered mineral deposits like common property. The open access aspect of exploration (similar to overfishing) eludes the firm from considering their effect on others when making their drilling decisions; thus, private benefits exceed social benefits, and excessive drilling is the consequence.¹⁴ Dodds and Bishop(1984) suggest that the open access problem of overinvestment in exploration can be internalized by assigning exclusionary mineral rights before exploration is conducted.

The second type of externality concerns the fact that one

prospect provides information about the promise of others. Success or failure of exploration on neighbouring properties provide valuable information about the probability of success on one's own plot of land. Peterson (1975) calls this the information spillover externality, and claims that this externality will result in inefficiency if information acquired through exploration becomes public. If such information does become public, the firm which conducted the exploration would be providing valuable and costly information for free. Stiglitz (1975) proposes that this externality can provoke inadequate exploration, because owners of prospects whose exploration would provide valuable information, may have the economic incentive to "wait and see" what the results are on neighbouring plots. Thus, both Peterson and Stiglitz find that exploration would be slower and impractical. However, once a discovery is made, rent-seekers would rush-and-drill the surrounding area (i.e., Hemlo gold rush) due to the common property of unclaimed land blocks.¹⁵

An important question is whether the information externality will encourage or discourage exploration at remote sites? Gilbert (1981) finds that exploration in remote areas will still be encouraged because there is much to gain from being "first" and less to gain by waiting, simply because the density of exploration is low.

2.4 The Participants in Exploration

Over the past several decades, research and technological change has found that the creation of new technology is stimulated by low entry barriers and a variety of enterprises.¹⁶ This trend also seems to be true for exploration. The success and effectiveness of different types of participants may vary from one stage to another in exploration. Universities may enjoy a comparative advantage in generating new geologic concepts and models of ore genesis; geologic surveys in collecting and providing general geologic information; small, specialized exploration companies in identifying specific targets; and, large mining companies in furnishing the funds and expertise required to appraise and develop the best of these targets.¹⁷

2.4.1 Junior Mining

Historically, the junior mining companies of Canada have been responsible for discovering many of the Canadian mineral deposits. The following definition of a junior mining company has been extracted in an essentially identical form from Freyman (1978, App.A, p.2) and Cranstone (1987, App.2):

- (1) Neither a producing company, nor the recipient of significant income from some other business venture,
- (2) Exploration funding does not mainly come from accumulated cash flow, nor from previous production or the investment income of such funds,
- (3) Exploration funds are not provided by a senior company

that controls more than half the issued shares of the subsidiary company in question,

- (4) The principal method of raising exploration funds is the issue of treasury shares,¹⁸
- (5) The company is not an oil and gas producer, nor is it the exploration arm of a senior company, and
- (6) It is not a government organization.

2.4.2 Senior Mining

A senior mining company can be defined as one which derives their income from mining or some other business portfolio, as opposed to the issue of treasury shares. Senior companies include all exploration firms operated by Canadian or foreign governments.

2.4.3 Junior vs Senior Mining Organizations

There are few solid data on the mineral exploration expenditures of different types of organizations. The reason for this being, is that until recently the statistics compiled in Canada, and the rest of the world for that matter, have been crude and in many respects inadequate when measuring effort. For instance, exploration statistics tend to lose significance with aggregation since aggregate statistics are removed from the measure of organizational effort (i.e., how much money was spent by whom, on what, and where?). Nonetheless, several efforts are provided within the Canadian mining literature to analyze the

role of the Canadian junior mining industry. Two of the best efforts to date based upon relative exploration success (discoveries regardless of size and value) have been (Kalymon et al., 1978, and Freyman, 1978). These studies indicate that the juniors have made several discoveries, some of which have resulted into major producers. Freyman's study of metallic mineral exploration in Ontario during the period 1951-1974, for instance, indicates that the juniors discovered 62 percent of the economic deposits at only 28 percent of the exploration costs.

A reason for the juniors success is that the smaller company is much more effective with respect to the needs of the explorationist. Similarly, the junior company encourages geologic experimentation, such that more government reports are re-read and more prospects are re-examined. As suggested by Freyman, a finer combing process takes place, resulting in more discoveries at a lower cost. The level of expenditure must be that which is necessary to achieve the objective of exploration, i.e., success at a desired rate, and not just those funds which a company decides it can afford to risk on exploration.¹⁹

In terms of a world perspective, junior companies are mainly confined to Australia and Canada, with some limited status in the United States and some Latin American countries.

Small exploration companies in Australia and Canada have done, and still do much of the grassroots exploration. These junior companies in many cases either dilute their interests significantly or sell out to a larger more advanced mining company when they find a viable deposit. In any case, the discovery remains the success of the junior, even though the

participants in exploration tend to change as exploration moves closer to the development stage.

Smaller companies play a less significant role in the United States than Canada and Australia since securities laws make it much more difficult to raise venture capital in the stock market.²⁰ Consequently, even though sufficient data is not available, it is unlikely that U.S. junior companies account for a large share of discoveries.

In less developed countries, the pattern of small companies succeeded by larger companies also ensues. However, in many of the less developed countries the government is more inclined to fulfil the role of the larger mining company. In some instances, reserving all of the rights to exploration itself. Nonetheless, in Latin America and Asia, junior and medium-sized companies continue to operate, although they co-exist with state-owned companies.²¹

Thus, the number and type of participants in mineral exploration have grown in the past years, but insufficient data do not permit reliable estimates to study the exploration success of various size companies. Even the data for Australia and Canada (which are available in far more detail than any other country) are unfortunately far too sparse to permit reliable estimates of aggregate spending by each of the main actors, even in the 1980's let alone a decade earlier.²²

The traditional method of exploration by senior mining companies has been to perform all functions "in house." However, as a company grows its exploration department and budget also tend to grow, losing its flexibility within the managerial

structure of the organization. Freyman (1978) suggests that with growth the mining company becomes more bureaucratic and attempts to minimize this by simulating the "hunger" and autonomy of smaller enterprises. Regardless, in such an environment the corporate philosophy remains directed towards bigness.²³ The objective of the senior exploration group is to discover and delineate economic mineral deposits within the constraints of corporate criteria. However, minimum profitability is also related to the size of economic mineral deposits. A company may place minimum size restrictions for orebodies which it might consider worth developing. But, there may also be a maximum size of orebody above which it might feel incapable of, or too financially exposed in evaluating and developing.²⁴ The maximum size restriction is usually applicable to smaller mining companies, whereas the majority of large firms apply minimum size cutoffs in exploration planning.

For Noranda, a mine life span of seven to ten years is a minimum in an area removed from company experience and infrastructure. Discoveries in remote areas deficient in infrastructure may involve higher exploration costs demanding higher than average ore grades to incur average returns. The rationale behind minimum size requirements is that a senior company cannot afford to waste time worrying about a deposit which does not provide a considerable contribution to overall company performance.²⁵ Teck Mining Corp. found that with growth (from junior to senior status) they shifted away from short-lived mines to develop or acquire long-life operations. Long-life, low-cost deposits are more inclined to consistently return a

profit regardless of the commodity or its cycle.²⁶

As noted beforehand, mineralization of particular deposits tend to cluster. Consequently, there are likely to be many smaller deposits associated with a large discovery. Although these smaller deposits are partially the reason for the juniors' success, the fact that size cutoffs ignore small (otherwise economic) deposits remains a symptom of overcentralization in large mining companies.

Junior mining companies gain a great deal of their strength from their survival instincts. Constraints on investment income lead to improved exploration knowledge since survival considerations play a dominant role. The restriction on exploration dollars indicates that the selection of exploration environments combined with improved geologic concepts, provides for a higher percentage of junior exploration expenditures invested in property re-evaluations. This was also argued by Ramsey (1980,1981) who suggests that smaller firms specialize in relatively low-risk, low-return areas.

The larger mining firms are much more diversified. For example, many of the larger companies are vertically integrated into milling, smelting and refining. Therefore, survival through exploration is not the only corporate goal; profit and growth also play a key role in other investment alternatives. Subsequently, the exploration department of a large mining company has the tendency to lose itself within the layering of the corporate hierarchy. This rigid structure specifies the size and type deposit of interest, which obviously restricts the explorationists' experimentation and conceptual growth in the

modelling of ore genesis. The junior organization, on the other hand, remains in close contact with their geologists, encouraging exploration and listening to new ideas.

Stuart (1980) points out that senior companies tend to concentrate on the larger and more remote prospects. Owing to the significant drilling investment required in such locations, several levels of management scrutinize drilling proposals very cautiously, and it normally takes a long period of time to get the approval to drill. The juniors generally examine better known territory, where a geologist can prospect his own project with a two- or three-person team. Decisions are usually made much more quickly in this type of organization, where the geologists frequently take their proposals straight to the company president (normally a "shirt sleeves" type) for consideration.

2.5 ORGANIZATIONAL DESIGN

2.5.1 Division of Labour

Organizational structure is not the easiest concept to define precisely because the concept covers such a wide domain. The basic consideration of organizational design deals with the interdependence which exists within organizations because of the division of labour between various positions. The organizational division of decisions is broken up into small components, and the co-ordination of these interdependent decisions are achieved through the organization's structural arrangement.

The nature of the division of labour within organizations, both between individuals and departments is undoubtedly of great importance. Senior management is likely to face three problems with respect to organizational design: (Mansfield 1986: pp.63-64) the first such problem relates to finding a way to carry out senior management's organizational strategy to meet chosen targets. The second problem that senior managers face when designing structures is that of control to ensure task accomplishment. Finally, the third problem which senior management encounter in their decision-making process regarding organizational design is that of cost. Since no organization has infinite resources, there is no doubt costs are a relevant issue. For instance, the co-ordination of activities alone will incur certain costs, if only in time and effort spent in co-ordination.

Williamson (1979,1981) and Thompson (1967: Ch.5) agree with Mansfield in that organizational structure should be designed to minimize co-ordination costs; which involves placing the most interdependent positions as close together as possible in the organization. One of the advantages of this type of organizational design is the possibility of coordinating the efforts of a large number of individuals, while avoiding the problem of bounded rationality. Due to the limited information processing capabilities of all individuals, Simon (1957: p.198) coined the term bounded rationality which infers that economic actors are rational, but they experience limits in formulating and solving complex problems and in processing (receiving, storing, retrieving, transmitting) information. The result of

this uncertainty is that approximation must replace precision in reaching a decision.²⁷ As long as uncertainty and/or complexity are present to some degree, the bounded rationality problem will arise.

The division of labour makes specialization possible, which enables the organization to overcome the problem of bounded rationality which limits individual actors. Nevertheless, specialization leads to internal opportunism or subgoal formation (Simon and March (1958); Tirole (1985)). Opportunism or subgoal pursuit results as a consequence of the division of labour, when different subunits identify with their own activities and base decisions upon local goals unrelated to the total organization. These types of effort generally involve communication distortion, which may be the result of individual managers, or more often, as noted by Tirole(1985), through collusive behaviour.

Although monitoring may serve to check distortions, it is simply too expensive for management to review every level of the organization. Moreover, these problems become more severe as the firms grow in size.

Williamson's (1981) hierarchial decomposition principle suggests that the internal organization should be designed in such a way as to effect the quasi-independence between the operating and strategic planning of activities. According to Williamson, this division should be clearly distinguished and incentives provided within and between parts so as to promote both local and global effectiveness. Thus, the hierarchial decomposition principle recognizes the need to divide problems into manageable units and at the same time prevent agents from

pursuing local goals which reflect bounded rationality and opportunism respectively.²⁸

2.5.2 Size and Communication Considerations

The size of an organization can be analyzed in several different ways (i.e., annual income), but in organizational theory the number of employees is the best indicator of size. Organizational size is one of the most important factors considered in making decisions regarding organizational design, since organizations differ according to the number of levels in the hierarchy. The hierarchy involves a division of labour between management and subordinates, the various versions of which are often referred to as the flatness or tallness of the organizational structure.

The relation between efficiency and size is a serious problem in organization theory. The problem for management is to arrange the organization in such a manner that the effort of the employees at all levels of the hierarchy provide the maximum benefits to the organization. Clearly, if the organization's strategic objectives and the goals of individuals comply, then not only will the individual provide maximum effort, but will require little in the form of supervision.²⁹

Meyer (1971) defined a mathematical relationship between the number of hierarchical levels and the span of control in the organization. The concept span of control refers to the number of subordinates supervised by one superior. The relationship between size, the number of levels and span of control, assuming

the hierarchy is symmetrical is:

$$X = \sqrt[n]{S}$$

where X is the span of control, n is the number of levels in the hierarchy, and S is the number of positions in the organization.

According to this relationship, as an organization expands vertically, there is a smaller span of control and closer supervision. The dilemma which results from attempting to select an optimal span of control is that in a large organization a restricted span of control produces excessive red tape, whereas increasing the span of control weakens supervision.³⁰

The flow of information through an organization may result in the problem of communication distortion. Communication distortion can take either assertive or defensive styles. Defensively, subordinates may tell their supervisor what he wants to hear; assertively, they will report those things they want him to know.³¹ As Kahn and Katz (1966) observe, the upward communication transmission usually terminates with the immediate supervisor. He or she may transmit some of the information to the next higher level, although generally in a modified form.

Downs (1966: p.109) argues that the larger any organization becomes, the weaker is the control over its actions exercised by those at the top. This results from the cumulative loss of control as instructions and information are passed across various hierarchial levels. By adding another hierarchial level, additional information can only be acquired by sacrificing some of the detail previously collected.³² As observed in Tirole's (1985: p.57) theory of coalition, the direct control of one level of supervision's transmitted information -- or, equivalently, its

proper use of discretion -- becomes harder and harder when the (vertical and horizontal) span of control rises. The degree of communication distortion in a growing corporation is most prevalent depending on the type of organizational structure (centralized or decentralized). The concepts of centralization and decentralization refer to the degree of authority delegation to lower levels (decentralization) or retained at the top (centralization).

2.5.3 Centralization

Centralization refers to the tightest means of coordinating decision-making in a particular part of the organization. All decisions are made by one person at the top of the organizational structure, and then implemented throughout, either by direct or various levels of supervision. The problem with centralization is that one or a few people have only a limited amount of information processing capabilities. Chandler summarizes the defects of the large centralized firm in the following way (1966: pp.382-383):

The inherent weakness in the centralized, functionally departmentalized operating company ... became critical only when the administrative load on the senior executives increased to such an extent that they were unable to handle their entrepreneurial responsibilities efficiently. This situation arose when the operation of the enterprise became too complex and the problems of coordination, appraisal, and policy formulation too intricate for a small number of top officers to handle both long-run, entrepreneurial, and short-run operational administrative activities.

A state of "information-overload" is often defined to describe the limit in efficiency which one can bear in attempting to coordinate various different projects. People at the bottom of the hierarchy with the relevant knowledge must transmit their information through the hierarchy up to the manager who is often out of touch with the situation. The inability of upper management to handle the complexity of information and demands placed upon them will often lead to the managers of functional parts to pursue subgoals instead.³³

These are the consequences of bounded rationality and opportunism. Bounded rationality gives rise to finite spans of control, requiring additional levels be added to the hierarchy, and eventually a loss of control through opportunism and communication distortion.

In small organizations, personal forms of contact are possible, therefore many small organizations are characterized by centralized decision-making with little bureaucracy. On the other hand, growing corporations continually decentralize their decision-making procedures to assure that decisions involving uncertainty are made by those with adequate information.³⁴

2.5.4 Decentralization

Decentralization removes the responsibility from the executives at the top of the hierarchy in dealing with complex problems of coordination and administrative activities. This decentralization process results in a continual downward shifting of authority, with the key decisions involving information

gathering and evaluation being made by lower ranking managers.³⁵ Decentralization offers the stimulus for motivation, because it delegates the power of authority down to lower levels of the hierarchy. Chandler (1966: pp.382-383) portrays the reasons for success of the decentralized structure as:

The basic reason for its success was simply that it clearly removed the executives responsible for the destiny of the entire enterprise from the more routine operational activities and so gave them time, information and even psychological commitment for long-term planning and appraisal ...

The new structure left the broad strategic decisions as to the allocation of existing resources and the acquisition of new ones in the hands of a top team of generalists. Relieved of operating duties and tactical decisions, a general executive was less likely to reflect the position of just one part of the whole.

In comparison to the centralized type organization; decentralization provided the large, complex firm with the ability to economize on the degree of both bounded rationality and opportunism. Decisions were no longer transmitted to the top but resolved at the divisional level, which relieved the problems of communication and information-overload.

Divisionalization operates in a semi-autonomous manner, free of the need to co-ordinate with others; each division is delegated the power to make decisions concerning their own operations. However, Mintzberg(1985) suggests that the decentralization called for in divisionalization may turn out to be rather centralized -- delegation of authority from headquarters to the managers who run the divisions.

Effective divisionalization requires management to maintain

an appropriate distance, although some form of control and coordination is required between headquarters and the divisions, such that the overall level of control in the organization is not undermined. In general, headquarters grants each division close to full autonomy to make their own decisions, and then monitors their outcome.³⁶

2.6 Exploration and Organizational Design

The most successful organization will be decentralized because this places the decision-making ability at the lowest possible level. Simplicity and flexibility are two important and necessary characteristics influencing the efficiency of an exploration organization. A flat structure with a narrow span of control will ensure that wherever possible communications are face to face. Snow and Mackenzie (1981: p.889) characterize this type of organization as one which will achieve positive results by having the greatest and most directly applicable knowledge, on the greatest number of decisions.

Although the organizational structure of a small firm will maintain a centralized form, the above summary of an effective exploration organization is preserved. Due to the small number of individuals involved in the exploration and decision process, and their nearness to one another, informal relationships for processing information are usually sufficient. Within the characteristic structure of small firms, there exists little need for formal communication or delegation of authority. In most cases, members of the firm are in daily verbal contact with one

another; information is transferred directly by the geologist to the exploration manager, and final decision-making authority is usually concentrated in the exploration manager himself.³⁷ Thus, the junior organization is informal and, compared to the seniors, uncomplicated.

In the large (senior) mining companies many exploration programs co-exist, but decision-making power remains at head-office. The centralized structure of a growing senior company does not permit the informal decision-making process which is typical of most juniors. The majority of senior companies have three levels of organization -- districts, which act as listening posts, searchers and evaluators; divisions, which coordinate districts and evaluate proposals; and head-office, which screens proposals, adds in other economic and financial considerations, and reaches the final decision.³⁸

This type of centralized structure has serious shortcomings, based upon the problem of communication. As mentioned earlier, the communication of facts between individuals in a complex structure is not only difficult, but there is a danger that the information will be lost or misinterpreted by the recipient. A common technical language between the geologist and each level of the hierarchy rarely exists in a large mining firm. As Dickerson (1978) points out, each level in the organization has a communication interface which is likely to create considerable distortion. A simple message; for example, "discovery or bust," started at the bottom, stands an excellent chance of reaching higher levels as: "maximum success or a reasonable alternative."³⁹

There is no substitute for confidence and delegation of authority. Head-office management cannot do the thinking for the field staff thousands of kilometres away. The problem of "information-overload" is inherent in large centralized companies; more success is available to those companies which have the freedom to act.

A practical solution to this problem is to divide the organization into semi-autonomous units, or "franchises," that are able to maintain the favourable organizational characteristics with efficient budget and staff size.⁴⁰ These franchises or smaller exploration arms are organized under partially decentralized or divisionalized structures, which have enabled senior management to more closely simulate junior companies. Head-office provides these independent groups with guidelines, as well as specialized, high quality support and financial ability to make certain decisions in the field. Most major expenditures will remain under the authorization of head office, to assure that current company economic and financial considerations are complied with.

This type of vertical decentralization must always be selective, since some decision-making power will always be retained at the top. If head-office were to delegate all of its power to division managers, it would cease to exist, and each division would, in effect, grow as an independent organization.

Organizational structure thus plays a key role in the decision-making process of mineral exploration firms, and for this reason, junior companies have been classified as more efficient and successful in exploration. Juniors by reason of

their smaller size and less bureaucratic procedures, have a distinct advantage in communication, and speed in decision-making over that of the seniors.

2.6.1 The Cranstone Study

Prior to 1987, all relevant mineral exploration literature agreed with the preceding frame of thought, implying that the juniors are more successful and efficient than their senior counterparts in exploration. Nonetheless, a recent study conducted by Dr. Cranstone (an exploration specialist with the Mineral Policy Sector of Energy, Mines and Resources (EMR)) refutes the widely believed contention that juniors; (1) have found more mineral deposits than the seniors, and (2) have done so at a lower cost.

Cranstone (1987) was not convinced by the evidence produced by previous efforts.⁴¹ For this reason, a more conclusive representative sample was employed, with the compilation of a much larger record of discoveries and access to major sources of information within EMR and Statistics Canada.

In order to rationalize Cranstone's conclusions, it is necessary to interpret his assumptions. A slightly different definition of discovery was established; defined as a mineral deposit attractive enough to establish its tonnage and grade.⁴²

The discovery was given credit to the company which drilled the first hole intersecting the deposit, provided that reasonably continuous exploration was conducted. This definition of

TABLE 1

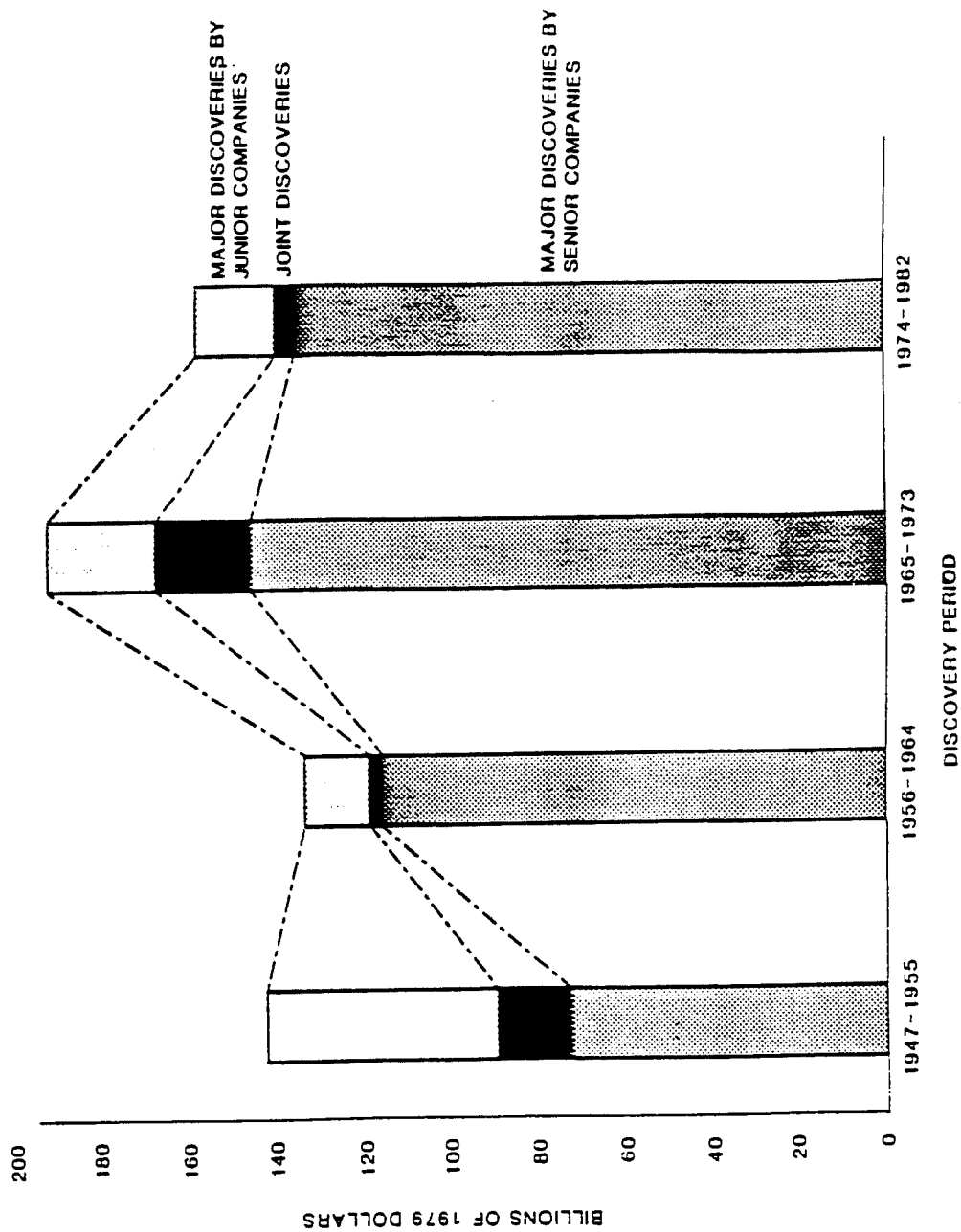
MAJOR DISCOVERIES* BY SENIOR
JUNIOR COMPANIES IN CANADA, 1947-1982

Value of contained metal in \$ billions

Discovery Period	DISCOVERIES BY SENIOR COMPANIES		JOINT DISCOVERIES BY JUNIOR AND SENIOR COMPANIES		DISCOVERIES BY JUNIOR COMPANIES		TOTALS	
	Value \$	No. of Discoveries	Value \$	No. of Discoveries	Value \$	No. of Discoveries	Value \$	No. of Discoveries
1947-55	73.0(51%)	12	16.3(12%)	2	53.3(37%)	11	142.6	25
1956-64	116.0(87%)	19	2.5(2%)	1	15.1(11%)	5	133.6	25
1965-73	145.5(76%)	28	21.7(11%)	5	24.3(13%)	7	191.5	40
1974-82	135.7(86%)	26	3.9(3%)	2	17.8(11%)	5	157.4	33
1947-82	470.2(75%)	85	44.4(7%)	10	110.5(18%)	28	625.1	123

Source: D.A. Cranstone, 1987., "The Role of Junior and Senior Companies in Mineral Discoveries," Mineral Policy Branch, Dept. of Energy, Mines and Resources, p.5.
*Those with a metal content of at least \$1 billion (1979 dollars). The value of the metal content in these 123 major deposits is 84% of that in all 1000 or so deposits discovered between 1947-1982.

FIGURE 1
VALUE OF MAJOR DISCOVERIES BY JUNIOR
AND SENIOR COMPANIES



discovery was adapted to provide evidence that the initial find was recognized.⁴³

The survey included nearly 1000 metallic mineral deposits found in Canada during the 1947-1982 time frame. Of these discoveries, the study analyzed the "major" deposits -- those containing more than \$1 billion worth of metal (1979 metal prices). Of these nearly 1000 deposits, 123 were classified as "major deposits," representing 84% of the total gross metal value.

With respect to the 123 discoveries, senior companies were responsible for 85, juniors 28; and 10 were made jointly. Given that the seniors are allotted half of the joint discoveries -- then the seniors discovered three-quarters of the "major" discoveries -- the value of metal contained in these discoveries account for four-fifths of the total (see Table 1 and Figure 1). This signifies that the gross value of senior discoveries overwhelm that of the juniors.

Although Cranstone does not provide evidence for the remaining smaller deposits representing 16% of total gross metal value, he does acknowledge them. In his check of two dozen of the largest remaining deposits, it was found that the same general conclusions result in favour of the seniors.

Exploration expenditures of the 123 "major" deposits reveal that senior companies were as effective as the juniors when applied to the value of discoveries per unit dollar throughout the 1947-1982 period (see Table 2).

During this period, the seniors accounted for 79% of all exploration expenditures and found 79% of the value representing

all major discoveries (70% of the value of those that were developed into mines).

TABLE 2

DISCOVERY PERIOD	PERCENTAGE OF DISCOVERY VALUE* BY**		PERCENTAGE OF EXPLORATION EXPENDITURES BY***	
	SENIOR COMPANIES	JUNIOR COMPANIES	SENIOR COMPANIES	JUNIOR COMPANIES
1947-55	57.0%	43.1%	62.0%	38.0%
1956-64	87.8%	12.2%	76.0%	24.0%
1965-73	81.6%	18.4%	75.0%	25.0%
1974-82	87.5%	12.5%	87.5%	12.5%
36 YEARS				
1947-1982	78.8%	21.2%	79.0%	21.0%
	(70%)****	(30%)****		

* Of the 123 major discoveries with metal content of at least \$1 billion (1979 dollars)

** For any discovery made jointly by junior and senior companies, half of the value was assigned to each.

*** For all metals

**** Figure in parentheses refers to value of discoveries that have become mines.

Source: Donald A. Cranstone, The Roles of Junior and Senior Companies in Mineral Discoveries, 1947-1955, (1987) p.7.

The juniors, on the other hand, accounted for 21% of all exploration expenditures and found 21% of the value representing all major discoveries (30% of the value of those that were developed into mines). This suggests that the juniors were

slightly ahead discovering 30% of the value at 21% of the cost.

Even though these values indicate that the juniors were as successful and efficient, Cranstone submits that the values are influenced by the Elliot Lake uranium deposits discovered and developed in the 1947-1955 interim. Juniors deserve credit for 8 of the 9 deposits discovered at Elliot Lake. Cranstone stresses that these deposits influenced the success and effectiveness of the juniors in the study, since post 1955 the seniors dominated.

Cranstone further contends that Table 2 contains a bias in favour of the juniors for three reasons:

- (1) Juniors do not have the funds to delineate all major deposits, therefore many projects are financed by senior companies;
- (2) Junior exploration expenditures at Statistics Canada are less complete than those for senior companies. This incompleteness would lower junior exploration expenditures per discovery value; and,
- (3) Some juniors are less reluctant than seniors to publicize large tonnage discoveries on the basis of simple initial drillings without further follow-up.⁴⁴

The data base and thirty-five year period of study used by Cranstone is much more extensive than any previous study to date. All earlier studies were of a shorter time frame and restricted to specific regions (i.e., Ontario). For this reason, the fraction used for analysis was not a representative sample for the Canadian context as a whole. Furthermore, the exact dimensions of a mineral deposit are not known until it is nearly mined-out. The initial drill hole data will likely underestimate

the true deposit size. To overcome this problem, Cranstone derived multipliers based upon four historical generalized deposit types.⁴⁵ The multipliers were applied to those discoveries yet to be mined, to ascertain a better estimate of the true deposit size.

Exploration productivity is assessed by Cranstone by comparing the gross value of metal discovered with exploration expenditures. However, this procedure ignores the fact that production costs vary extensively from one deposit to the next, and the time value of money varies from one period to the next. Although deposit size, type and grade are included in the multiplier analysis, it does not permit for an evaluation of production costs, and their effects upon exploration.

Of the 123 deposits defined as "major" discoveries, Cranstone admits (although does not provide for in his survey) that 41 will never be defined as "ore" (mineable at a profit at foreseeable prices). The elimination of these 41 subeconomic deposits should alter the conclusions, although it is argued (without evidence) that these subeconomic deposits were discovered by senior and junior companies in the same ratio as mineable deposits, which would not influence the conclusions.⁴⁶

Most of the world's outcropping orebodies and other easy-to-find deposits have already been discovered, forcing exploration to rely on more costly techniques to locate deposits buried deep beneath the earth's crust.⁴⁷ Insufficient funds have therefore placed the juniors at a distinct disadvantage in comparison to the financial positions of most senior companies. For instance, if exploration is being conducted in the Canadian Arctic, the

minimum acceptable size would have to be extremely large; an orebody containing several million tons of high grade ore, or several hundred million tons of lower grade ore. Any smaller (or deeper) deposit would not be acceptable in such a remote area due to production and transportation costs.⁴⁸ Although the Arctic offers a higher probability of discovery owing to better bedrock exposure, it also offers a high time value cost of exploration. Exploration dollars are tied up for a long period of time before the first ton of ore is extracted. Therefore, the Arctic is not a financially viable environment for junior companies.

Several of the seniors "major" discoveries in the study were the outcome of exploration in the Arctic, or were properties optioned from juniors in remote areas of northern Canada. A total of 18 "major" discoveries were optioned from junior companies, yet Cranstone does not directly account for this in his conclusion.

It should be kept in mind that junior companies deserve some of the glory if they optioned their property to a senior company. Once again, the juniors may have determined the location of the potential orebody through grassroots exploration, but their inability to finance a drilling program would have diminished their importance under Cranstone's definition of discovery.

Elliot Lake discoveries are debated by Cranstone to bias his final conclusion in favour of the juniors, since after 1955 the juniors' contribution to major discoveries had taken a sharp decline. This is an unfair rationalization if we consider that during the 1955-1960 period a similar result was encountered in the Thompson Manitoba district in favour of the seniors. Deposits

have the tendency to cluster, therefore the identification of a new deposit type (i.e., Hemlo's stratiform gold discovery) or a discovery in a region previously considered to lack resources is usually followed by a rush of exploration. Expenditures in the exploration for specific minerals, deposit types and, in particular, geographic regions tend to be cyclical and should not be considered a bias in exploration success.

The period of study placed the juniors at a disadvantage since their activities were to a large extent curtailed in 1964 by stock exchange rulings to protect small investors. Scott (1988) defends the juniors superiority in exploration by drawing attention to the "Windfall Affair" of 1964.⁴⁹

Although juniors' were able to raise some exploration financing through the TSE following the Windfall scandal, the amount was reduced substantially. The lack of confidence following the Windfall affair witnessed 10 "major" discoveries optioned to senior companies during the 1964-1978 period, furthering the seniors level of success and efficiency in mineral exploration. In 1978, the growth of the Vancouver Stock Exchange (VSE) provided investors with the opportunity to participate at an early stage of a company's development. Even though the principal role of the VSE has been as a venture capital marketplace since 1907, its growth has made it unique in one respect; it is the largest venture capital market in North America organized specifically to enable start-up or 'junior' companies to raise the public financing they need to grow and develop.

Of more immediate importance for policy decisions affecting

junior versus senior mining is flow-through share financing. During the entire period of study, junior mining companies were at a disadvantage since they could not deduct any of their exploration expenses against taxable income. The reason for this being that the juniors' had no taxable income to speak of, since they had no producing mines. This is one of the main reasons for the decline in the juniors exploration success, and only in 1983 has the junior mining industry returned with a resurgence due to the more favourable financial climate.

There is no clear cut definition of discovery; although Cranstone attempts to compare junior and senior companies through his definition of a "major" discovery, it is clearly insufficient. Junior companies have limited resources, therefore a large proportion of their exploration budget must be allocated to low risk projects. Ramsey (1980,1981) presents a model where probability-of-ruin considerations influence the decisions made by exploration firms. A trade-off is derived between (a) probability of a discovery, and (b) expected value of a discovery, given that a discovery is made. Ramsey concluded that large companies tend to prefer the low-probability high-value prospects since they are geared towards profit and growth, whereas smaller firms specialize in exploration which is low in cost with a high probability of success to promote survival.

An analysis of mineral discoveries by Cook (1986), finds a criterion of \$1 billion too high, and defines a significant discovery as one whose size and grade would yield at least \$500 million. The fact that exploration may lead to a billion dollar discovery is a great motivator, although unlikely. For this

reason, such large targets are not usually found within the exploration environment nor the corporate strategy of most junior companies.

If the definition of a "major" discovery were altered to one whose size and grade would yield at least \$500 million of gross metal value, a more conclusive result would be realized. Nevertheless, maintaining Cranstone's definition and period of study, his end result does not conclude that senior companies are better prospectors than junior companies, just that the seniors were as effective as their junior counterparts in mineral exploration.

3.0 EXPLORATION RISK

Three basic types of risk influence the decision to begin, continue or terminate an exploration program -- political, economic and geologic. Political risks include government actions such as changes in environmental control, changes in taxation etc., which affect variability in returns. Economic risks reflect the variability in returns due to changing commodity prices and, costs of extraction and processing. Geologic risks reflect uncertainties associated with various orebodies i.e., variability associated with the probability of any exploration target becoming an ore deposit. Thus, the basic problem encountered by those in exploration is the uncertainty in making deductions from the interpretation of basic exploration data.⁵⁰

3.1 Probability of Discovery

Explorationists do not drill entirely at random. For any individual trial, the outcome of any given stage will lead to either success or failure. Consequently, if exploration were purely random, the probability of success would be very low. Through the application of sound scientific judgement, it is possible to estimate the reserves that a prospect may contain, should the prospect prove successful. Mineral exploration would only prove to be a pure gamble (pure risk), like a lottery, if the distribution of mineral deposits were entirely random so that nothing but chance determined success.⁵¹ Grid drilling (Griffiths 1966) and random drilling (Menard and Sharman 1975) are two possible exploration strategies which view exploration as a form of gambling. Although exploration may approach some form of randomness, Harbaugh (1977) observes that random drilling has probably never been employed deliberately. The application of grid drilling has been used in the exploration for mineral deposits over large areas, but explorationists are usually reluctant to adopt grid-drilling reflecting their unwillingness to ignore geologic data. Most explorationists believe that knowledge of the area's geology will improve their success ratio. Subsequently, the comparison between exploration and gambling serves only the purpose of quantifying the organizational risk.

The smallest lottery prize has a probability of $P_r = 0.0008$, equivalent to odds of 1:1200. Similarly, the other prizes have astronomical values, with odds greater than 1:120,000 for top prizes.⁵² Whereas, Boldy (1977) finds that empirical odds for exploration discovery occur in the range between $P_r = 0.01$ and

$P_r = 0.002$, within which several exploration discoveries have been made. Peters (1978) points out that of several hundred favourable anomalies examined by geologists, only one is likely to become an orebody. If it is decided to proceed with a detailed surface exploration program, one in 100 will likely be an orebody; if attractive enough to drill, one in 50; after ore grade has been identified, only one in 10.

The above comparison with a lottery brings a sense of reality into exploration discovery. It exhibits the low probability of obtaining any winning ticket, whereas exploration always provides a slight chance that a discovery with high probability can result, and yet have a high deposit value. Consequently, exploration should not be viewed as an expensive form of gambling, but as a competent process of decision-making. Risk should be considered and assessed as the result of any decision. If failure results as the consequence of certain actions, then not only will financial loss follow, but also the loss of time, effort and possibly credibility.⁵³

The "Expected Value" and "Expected Rate of Return" concepts of Mackenzie (1981,1986) and Snow and Mackenzie (1981) are useful methods of estimating the potential profitability of investment in mineral exploration. These articles apply cost, risk and return parameters to measure the productivity of exploration investment. The long term attractiveness of exploration is evaluated using measures of expected value, where expected value measures the average value that exploration yields in the long term when the successes and failures associated with a very large

number of discoveries are considered.⁵⁴ The expected value of exploration may be assessed from an average time distribution of cash flows for all economic discoveries in the environment of interest. Thus:

$$EV = R - E$$

and, $E = K/p$

where, EV = expected value of exploration per economic discovery,

R = average return associated with an economic deposit,

E = average exploration cost required to find and delineate an economic deposit,

K = average exploration cost associated with the discovery of a mineral occurrence, and

p = probability of an economic deposit given the discovery of a mineral occurrence.⁵⁵

The rate of return is the discount rate which equates the present value of the positive cash flows (production) with the present value of the investment (negative cash flows based upon exploration expenditures and development costs). Hence, the expected rate of return yields the average percentage annual return that exploration is expected to offer or, in other words, the minimum acceptable conditions for investment.⁵⁶

The short term problems associated with realizing expectations are assessed by risk criteria. Snow and Mackenzie (1981) as well as Mackenzie (1986) both identify three fundamental types of risk associated with exploration expectations:

- (1) the sensitivity of the productivity of exploration to metal price uncertainties,
- (2) the uncertainty of the return given an economic discovery arising from geologic variability among economic deposits, and
- (3) the risk associated with the discovery of economic mineral

deposits.

The first type of risk is purely economic, and involves the high level of uncertainty associated in forecasting the short-term fluctuations and long-term trends in mineral prices. A method employed in many exploration strategies to lower this risk is, "not to place all eggs into one basket." In other words, to explore for several types of minerals. Eggert (1988) notes that after 1973, future metal prices and demand became increasingly difficult to forecast. Faced with these uncertainties, many mining firms have turned to multimetallic massive sulphide deposits which promise a safer return on investment by reducing fluctuations in earnings caused by price instabilities.

The second type of risk involves the variability of returns from an economic deposit. The chance that a bonanza or multibillion dollar discovery may occur, although unlikely, is a definite motivator in mineral exploration.

The third and perhaps most important risk faced in exploration is the low probability of discovery given the high cost of exploration. That is, each time exploration efforts result in the discovery of a mineral occurrence, there is only a small chance that the discovery will prove to be an economic deposit. Consequently, the attractiveness of the expected value criteria associated with mineral exploration does not ensure success if the exploration organization has a limited budget.⁵⁷

The increasing exploration risk, (e.i., money spent per discovery) necessitates that criteria be determined to evaluate exploration projects on the basis of their profitability potential. A yardstick for decision-making, or the number of

trials which may permit the successful evaluation of a prospect is a function of:

- (1) P_1 , the average probability of an economic occurrence or mineable deposit within the prospect area;
- (2) P_2 , the probability of an economic mineral deposit given the discovery of a mineral occurrence;
- (3) P_3 , the probability of the deposit being of sufficient value to repay exploration and development costs, and satisfy the minimum profitability criterion.⁵⁸

It should be recognized, however, that each of these probabilities may be negatively influenced by poor target selection, high return requirements, inefficient search techniques, and incompetent interpretation of results.⁵⁹

The above evaluation of a prospect by Brant (1967) and Burn (1984) are applications based upon Allais (1957) who performed the first study in which a philosophy of exploration was formulated into a probability framework. Allais also considered the search activity to consist of three probabilities, such that the overall probability of success in each trial (P_s) is,

$$P_s = P_1 \times P_2 \times P_3$$

Subsequently, all exploration stages will be multiplied by $(P_1 P_2 P_3)^{-1}$ since any stage requires having passed through the previous, as well as succeeding stages. For instance, if $P_1=0$ then obviously P_2 and P_3 must also equal zero. Alternatively, if a prospect contains an economic deposit which will meet the profitability requirements, then $P_3 = 1$ which implies that P_1 must also equal one. The possible outcomes are given in Table 3. Although the use of this form of probability analysis has some value in the planning and budgeting of exploration programs, it

has not seen wider use, because it is difficult to determine relevant values of P_s . Historical results can be empirically derived, but they reflect past success and may not be applicable for future exploration. For example, within a particular geologic province, the higher grade or outcropping deposits, may have already been discovered, thereby decreasing future values of P_1 , P_2 , and P_3 , and consequently P_s .⁶⁰

Conversely, it is possible to increase the value of P_2 by a better understanding of ore genesis and new exploration techniques. While P_3 may also be increased if minimum profitability criterion are lowered.

TABLE 3
Probabilities of Success in One Trial

P_1	1	1	1	1	0
P_2	0	0	1	1	0
P_3	0	1	0	1	0
P_s	0	0	0	1	0

Source: R.G. Burn (1984), "Exploration Risk" in F.J. Anderson ed., Selected Readings in Mineral Economics. Pergamon Press 1987, Table 1, p.67.

Mackenzie (1981,1986) estimated discovery risk for the Canadian Shield region between the period 1951-1974 by analyzing the number of economic discoveries divided by the total number of occurrences discovered. Assuming an average exploration cost to locate a mineral occurrence of \$450,000, Mackenzie found that the discovery risk (probability of an economic mineral deposit,

given the discovery of a mineral occurrence) was $p = 0.02$.

TABLE 4

Organizational Risk Considerations: Canadian Shield Region

Exploration Funds Available (C) (\$million)	Probability of Making At Least One Economic Discovery (P_s)
5.0	0.20
10.0	0.36
22.5	0.64
50.0	0.89
67.0	0.95
100.0	0.99

Source: B.W. Mackenzie, "Looking for the Improbable needle in a haystack: The Economics of Base Metal Exploration in Canada," CIM Bulletin, Vol.74, no.829 (May 1981), Table 7, p.120.

Notes: K = average cost of discovering a mineral occurrence is \$450,000
 p = probability of an economic deposit given the discovery of a mineral occurrence = 0.02
 C = the exploration budget available to the organization concerned over a relevant planning horizon (say 5-10 years)
 $P_s = 1 - (1 - p)^X$; where $X = C/K$

Furthermore, since the average cost of \$450,000 is associated with each discovery, then the average exploration cost for an economic deposit is; $E = K/p = \$450,000/0.02 = \$22.5 \text{ million.}^{61}$
 However, the expenditure of this amount does not ensure success.

In fact, the expenditure of \$22.5 million would only secure a 64% chance of making at least one economic discovery (see Table 4).

The second type of risk, given the discovery of an economic deposit is the variability in return. Differences in tonnage, grade and other geologic characteristics of economic deposits all influence the average return. For example, there is a very low probability that an economic discovery will yield a higher than average return. Nonetheless, the possibility of a discovery bigger and better than most influences exploration. For instance, the effect of the Kidd Creek deposit on the economics of base metal exploration in Canada during the 1951-1974 period caused the expected rate of return to increase from 14 to 16 percent (13 to 21 percent in Ontario).⁶² Similarly, the effect of the Hemlo gold discovery on the economics of gold exploration in Canada during 1946-1984 accounted for the time adjusted exploration cost (\$ per ounce) falling from \$166 to \$119 (\$281 to \$82 in Ontario)⁶³

Although these are only two examples, they were both followed by an influx of exploration expenditures, changing the overall discovery risk or probability of success in their regions of discovery.

Historical values offer useful guides in the assessment of exploration, even though their odds change over time (i.e. average cost to find and delineate an economic deposit, the time cost of exploration, discovery risk and the variability of returns among economic discoveries). Therefore, the decision-making process continues to be the most influential factor in the possibility of securing exploration success.

3.2 Viability Analysis (Probability-of-Ruin)

The evaluation of an exploration program calls for the assessment and setting of risk levels. As mentioned above, the most obvious goal of any exploration strategy is program survival. Accordingly, a program that has had too many failures loses its viability either because it has depleted its resources, or management has lost confidence in the overall program. If the program must be discontinued because of an unfavourable chance of outcome, it may have disastrous results on the exploration firm, and in the case of smaller companies even bankruptcy. Since all firms, large and small, have equal access to exploration, the major company would have only one advantage over the smaller firm: its better chance of avoiding ruin. The probability of not meeting a minimum goal is known as "gambler's ruin."⁶⁴ The concept of gambler's ruin is applied to the organizational risk associated with mineral exploration.

Gambler's ruin does not necessarily suggest bankruptcy and ruin of the company, it is more often applied to exploration to analyze the possibility of a particular objective. For example, exploration management may have stated as a corporate objective, to find a \$1 billion deposit over the course of a five year exploration program. The gambler's ruin approach can be adapted, where "ruin" implies no such deposit was found. A further example could be the case where management would like an expensive exploration program to maintain a degree of self-sufficiency so as not to draw upon production for a few years, so that growth

is not jeopardized. In this case, "ruin" would imply that the objective was not fulfilled over the short term.⁶⁵ Although the phrase "probability-of-ruin," or "gambler's ruin" has historically been identified as a case of true ruin, this is overly dramatic, and in exploration is simply used as a measure of feasibility or degree of self-sufficiency.

Maintaining the nomenclature previously utilized in the study of Mackenzie (1981) in Table 4, the gambler's ruin equation can be written as:

$$P_f = (1 - P_s)^X$$

where, P_f = probability of failure to discover at least one economic deposit.

$X = C/K$, the number of projects the firm could unsuccessfully explore before exhausting capital.⁶⁶

This equation presents the probability, P_f , that the initial capital devoted to the discovery of an economic deposit will be exhausted by failure.

In many ways the concept of gambler's ruin is said to maintain only historical precedence, since in exploration the proceeds of the previous plays of the game are not immediately available and the odds change over time so that the theory of gambler's ruin is not directly applicable.⁶⁷ Although historical values offer useful guides, the choice of an exploration strategy must be based upon an understanding of the area in question, from experience, current information, and new geologic concepts. Information must be current and not merely historical data which offers an indication, in mature regions, of previous exploration results. Reliable forecasts of future discoveries are of more use in mineral exploration than a compilation of historical

statistics.⁶⁸

The viability measure, or probability of program failure, may be restricted with respect to its historical pertinence, but it may also offer some value in determining whether to proceed with an exploration program in a given area. If a local division can provide head-office with the probability of goal achievement, then corporate management is better able to set local goals which comply with the corporate portfolio in maintaining the overall viability of the firm. In this respect, Quick and Buck (1984) suggest that a corporation's overall strategic plan can integrate prospective programs of varying size and risk into their exploration portfolio of investment alternatives, while avoiding cash flow problems, maximizing return and managing risk.

Viability analysis can further be utilized in strategic planning and portfolio analysis as a method of determining when risk should be shared. If the probability of program failure is extremely high, a "dilution" factor can be calculated with which the desired working interest can be identified and the probability of program failure minimized.⁶⁹ If the decision-maker has some idea of how low the maximum acceptable likelihood of program failure should be, then the maximum working interest can be calculated to decrease risk exposure and permit involvement in a greater number of programs.

It is possible to multiply (K), the average cost to discover a mineral occurrence by the working interest (i) to determine the drain on available capital. This can be expressed by re-writing the gambler's ruin equation;⁷⁰

$$P_f = (1 - P_s)^{C/iK}$$

where, (i) is the working interest expressed as a fraction, or

$$i = \frac{C \log(1 - P_s)}{K \log P_f}$$

Now the desired working interest can be directly evaluated for a chosen value of (P_f), probability of program failure.

Table 5
Maximum Allowable Working Interest*

C (\$million)	P_s	Probability of Program Failure (%)	Maximum W.I. (%)	Number of Programs (C/iK)**
2.5	0.106	53.6	100	6
		43.6	75	7
		28.8	50	11
		8.0	25	22
		5.0	21	26
5.0	0.20	8.0	100	11
		5.0	83	13
10.0	0.36	0.0	100	22
22.5	0.64	0.0	100	50
50.0	0.89	0.0	100	111
67.0	0.95	0.0	100	149
100.0	0.99	0.0	100	222

Note: * Probability of program failure reduced to 5 percent.

** Number of exploration targets being taken from first to second stage exploratory drilling, at a cost of K = \$450,000.

$$P_s = 1 - (1 - p)^x \quad \text{or} \quad P_s = 1 - (P_f)^{1/x}$$

Organizational risk considerations of the Canadian Shield Region (Mackenzie 1981) were previously analyzed in Table 4, it is therefore possible to expand this data in Table 5, to determine the necessary working interest which would reduce the probability of ruin to, let's say 5 percent.

Note how the probability of program failure is reduced by dilution. For example, it was possible to reduce the probability of program failure from approximately 54% to 5% by participating with a 21% working interest on 26 targets rather than 100% on 6 targets. Clearly, it can be seen that dilution is much less likely when large exploration budgets are available. Therefore, the more expensive it becomes to discover a mineral deposit (on average), 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 interests (i.e., spreading their risk). In other words, if we have a capital constraint, we lower our chances of program failure (ruin) by "placing a few eggs in many baskets rather than all of our eggs in a few baskets."⁷¹ Hence, the element of gambling enters into exploration investments when a company is underfunded relative to the cost of discovery. That is, since risk is a factor of life in mineral exploration and because higher returns are associated with higher risk, the desired risk position of the firms exploration strategy will be determined by their current position for withstanding risk.⁷²

4.0 EXPLORATION FUNDING

The high degree of risk and large size of most mineral investments have resulted in the development of several different financing patterns for mineral exploration. The two most basic forms, other than internal financing, being debt and equity financing.

In the case of debt financing, the company borrows money from financial sources such as banks, finance companies, insurance companies etc. Exploration offers only an average probability of success, therefore debt financing is similar to an insurance market which is based upon expected loss criteria. Notwithstanding, debt financing is not a likely source of funding in exploration due to the risky nature of the investment. Debt financing is more likely to occur in the mine development stage, once the deposit has reached the preproduction phase. Equity financing, on the other hand, is the most basic form of financing in which companies or individuals put up capital at their own risk. In any case, the use of these two financial vehicles will depend upon economic conditions and the timing of financial needs.

Differences in the degree of exploration expenditures among firms are usually accounted for by mineral price trends, exploration success and corporate goals. The latter two were briefly referred to beforehand, such that mineral price trends tend to be a relevant issue in the discussion of exploration funding.

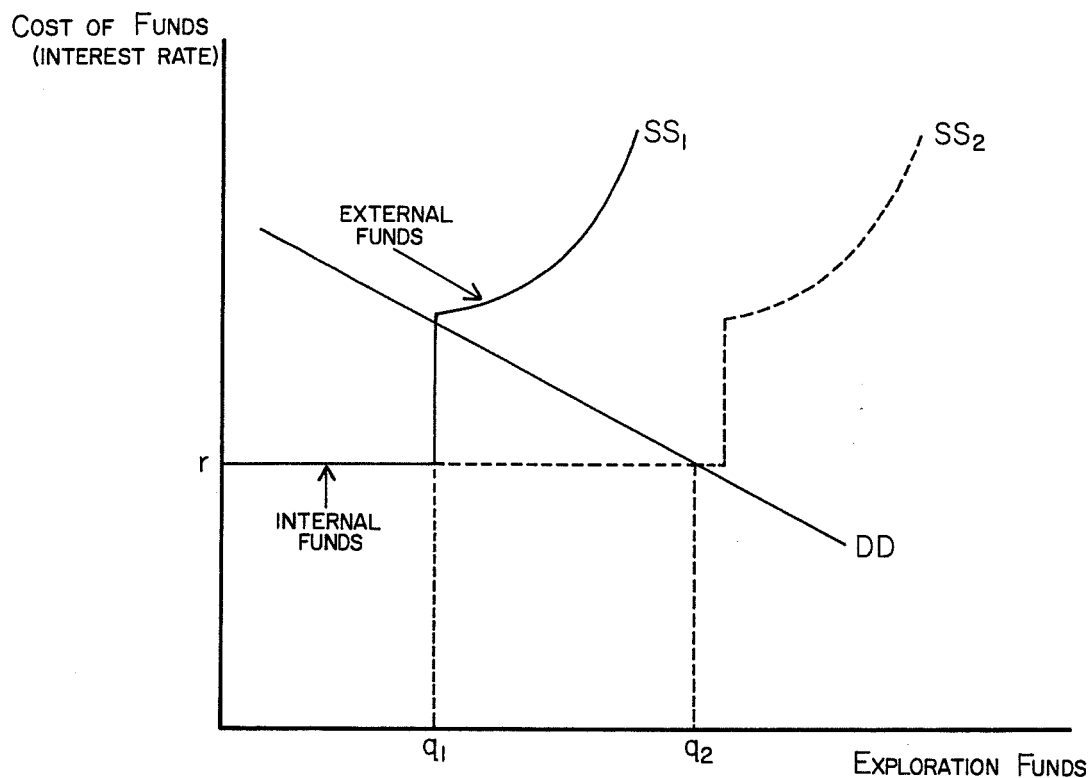
Mineral price trends offer an explanation with respect to the

similarities amongst company expenditure trends. Mineral prices affect exploration expenditures in two ways, the first being that prices alter the expectations of future prices and revenues from mining, and subsequently influence the net returns from exploration. Although other factors influence the expected returns (i.e., development and mining costs, mineral demand), it is mineral prices which influence the demand for exploration funds.⁷³ A second reason for the relationship between exploration expenditures and recent mineral prices is that of exploration funds for financing exploration. Mineral price trends influence a firm's revenue position and hence the availability of retained earnings or internal funds for exploration.⁷⁴ Rising prices lead to increased profits and larger accumulations of internal funds, whereas falling prices have the opposite effect. Eggert (1987,1988) argues that mineral prices influence the cost of capital if the cost of external funds (debt or equity) is greater than the cost of internal funds (retained earnings). Figure 2 attempts to explain this through supply and demand relationships for exploration funds.

SS₁ in Figure 2 is the supply curve for investment funds, and the cost for using the limited amount of internal funds is roughly constant. For example, firm's tend to assign a lower interest rate to funds which are available from retained earnings. As a firm calls upon external sources of debt and equity, higher interest rates (higher cost of capital) are imputed because external sources increase the firms debt/equity ratio. This occurs because external sources represent a fixed liability regardless of the firms financial position, or because

additional stocks dilute the managements degree of control over the firm⁷⁵, which must be weighted against the opportunity cost of the investment.

FIGURE 2
Supply and Demand Schedules for Exploration Funds



Source: R.G. Eggert, Metallic Mineral Exploration: An Economic Analysis. Resources for the Future, Washington, D.C. (1987), Figure 2-3, p.21.

DD is the demand curve for exploration funds. During periods of low metal prices, which implies low levels of internal funding, the equilibrium level of exploration expenditure will correspond

to q_1 . To the left of q_1 , all projects will have positive present values because the demand curve represents the interest rate at which each additional project could just break even.⁷⁶ During periods of higher metal prices and correspondingly higher levels of internal funding, the supply curve will shift to the right, illustrated by SS_2 . As profits increase, the amount of internal funds which are available for investment increases, as shown by the dashed flat part of the internal funds curve. In this case expenditures increase to q_2 , although demand remains constant. It was mentioned earlier that mineral price changes cause a shift in the demand curve for exploration funds by altering expected revenues from exploration, however, changes in exploration expenditures are likely to follow price changes with a short lag. Consequently, the demand curve would not shift immediately because budget allocations reflect price expectations of the previous year.⁷⁷ Furthermore, competition amongst exploration firms may make them reluctant to call upon external funding if it means disclosing exploration information.⁷⁸

Eggert (1988) analyzed the above proposition by testing seven mining companies, of which five (Cominco, Falconbridge, Inco, Noranda, and Phelps Dodge) had their exploration expenditures correspond closely with net income, which is a measure of internal funding availability. Therefore, the positive and significant regression results of the above firms' strengthen the reality that mineral prices influence exploration expenditures and help explain company trends in terms of exploration funding.⁷⁹

It is important to mention once again that mineral exploration

is rarely, if ever debt financed. Banks and other institutions simply do not lend on exploration and drilling programs with indeterminate returns due to the risky nature of the expenditures. As far as exploration is concerned, two categories of companies are involved; junior and senior mining firms.

Junior mining firms' are those which have no producing mines and do not receive income from mineral production or other business ventures. Normally such companies take on risky grassroots exploration programs, nonetheless, their principal means of raising exploration funds is through the issue of shares since they have no cash flow and generally have a problem borrowing money.

Seniors, on the other hand, derive their income from producing mines and other business ventures. This permits them to fund exploration through retained earnings rather than a dependence on equity financing.

In undertaking past exploration, there has been a vast diversity between the two players (junior and senior companies). For a senior company with taxable income, exploration is a deductible expense. In contrast, junior companies without taxable income, were at a distinct disadvantage, and slowly began to deteriorate in their exploration significance. The implementation of Flow-Through Shares, was able to overcome this imbalance in the tax positions of both types of firms.

4.1 Flow-Through Share Financing

4.1.1 What are Flow-Through Shares?

A flow-through share (FTS) is a share issued by a corporation that flows through to the subscriber (investor) the income tax benefits relating to the expenditures funded by the subscription. The tax benefits which are flowed-through, such as mining exploration expenses, are specifically provided for in the Income Tax Act. Mining exploration expenses are a category of Canadian Exploration Expenses (CEE).⁸⁰

A FTS is defined to be a treasury share of the capital stock of a principal business corporation,⁸¹ issued to a taxpayer with respect to a written agreement with the corporation, under which the taxpayer will incur exploration expenses for shares of the business. Most issues are ordinary common or convertible shares, however, a FTS is not purchased -- it is "earned" by fulfilling exploration expenses that are flowed through to the investor. Therefore the FTS has the advantage of increasing the equity base of the company without the risk and dilution of a normal public offering. The problem of having the investors' carry out exploration programs is resolved by appointing the issuing company as the investor's agent in conducting any necessary field work.

In order to qualify to renounce the exploration expenses, the investor must receive a share that is not a prescribed share. A FTS cannot be a prescribed share which is generally a share that the issuing corporation is or may be required to redeem,

acquire, or cancel within five years from the date of issue.⁸²

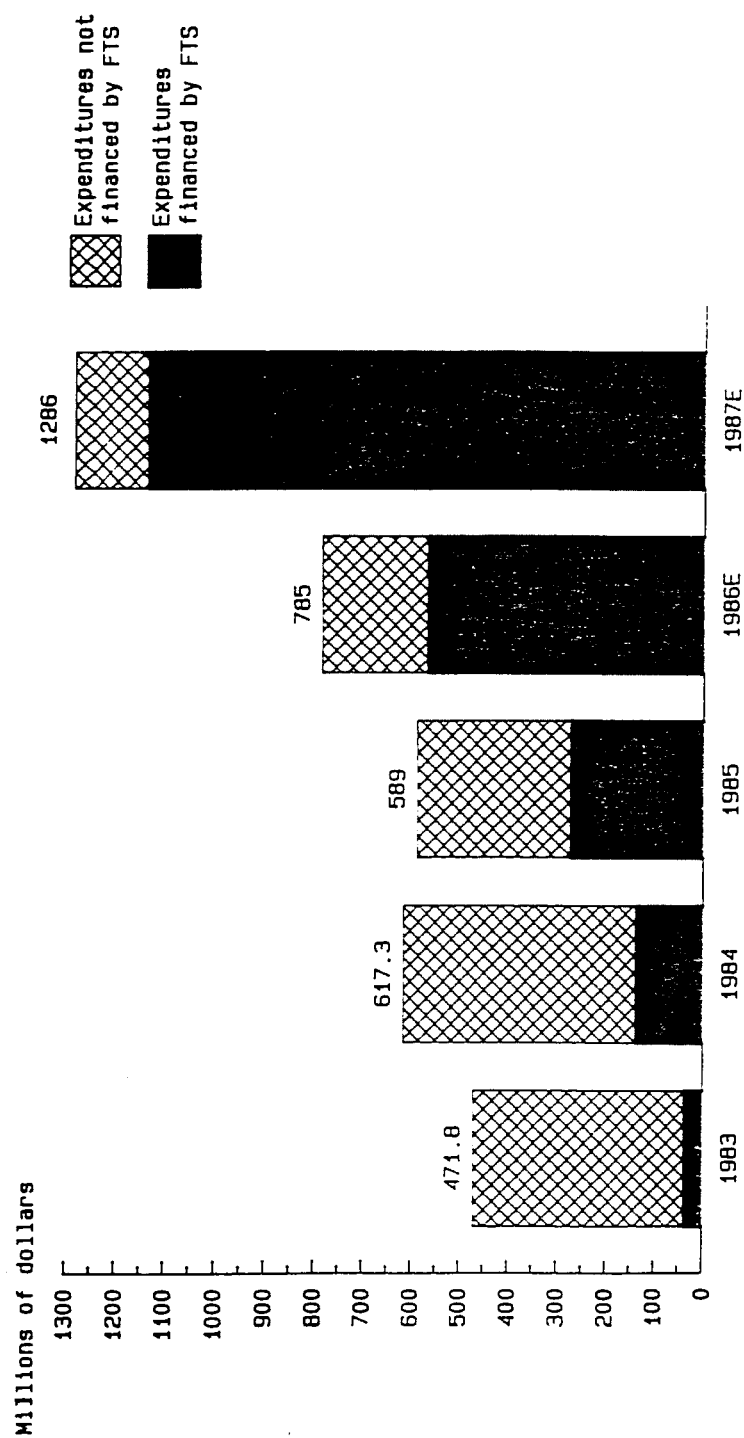
4.1.2 The Flow-Through Deductions

FTS financing has been available to senior mining companies for the past three decades (1954). Nonetheless, it was not readily used because senior companies were not eager to dilute their shareholders share value through the issue of new shares. FTS's lacked popularity because senior firms were not willing to share the value of any new discoveries with new shareholders.

Since the introduction of the Mineral Exploration Depletion Allowance (MEDA) in the Budget of April 19, 1983 the financing of mineral exploration has shifted dramatically from traditional sources to financing by FTS's. The earned depletion is provided under the Income Tax Act as an incentive for those engaged in the high risk activity of mineral exploration. This incentive provides for $33\frac{1}{3}\%$ of grassroots exploration to be deducted from taxable income, but limited to 25% of net income. Subsequently, a taxpayer who incurs mining CEE in a given taxation year was now entitled to a 100% deduction for exploration expenses incurred (CEE), in addition to a $33\frac{1}{3}\%$ bonus deduction, for a total of $133\frac{1}{3}\%$.

This reform, united with the \$500,000 lifetime capital gains exemption introduced in 1985 provided the stimulus for the popular growth in FTS issues. Figure 3 illustrates the growth in FTS's with respect to exploration expenditures between 1983 and 1987.

FIGURE 3
TOTAL EXPLORATION EXPENDITURES *
AND AMOUNT FINANCED
BY FLOW-THROUGH SHARES (FTS)



Sources: Statistics Canada Catalogue 61-216,
 Energy, Mines & Resources Canada, EFPAB
 * Includes overhead; E-EMR internal estimate.

The following example (see Table 6) reveals the tax benefits offered by the introduction of MEDA to an investor in FTS's. In this example, the investor is in an average top marginal tax bracket for 1988 of approximately 46.5% (excluding Quebec). (see Appendix 1 for the Top Marginal Tax Rates of each province)

TABLE 6
Purchase of a Flow-Through Share

Investment		\$1000.00
Administrative Cost	<u>\$100.00</u>	
CEE Investment	900.00	
<u>Tax Deductions</u>		
CEE (100%)	900.00	
MEDA (33.33%)	<u>300.00</u>	
Total Deductions	\$1200.00	
	=====	
<u>Tax Savings @ 46.5%</u>		
CEE + MEDA: \$1200 x 0.465	558.00	
Admin. Cost: \$100 x 0.465	46.50	
Total Savings		<u>604.50</u>
After - Tax Cost		<u>\$395.50</u>
		=====

For a \$1000 investment in FTS's, Table 6 illustrates that the after-tax cost will only be \$395.50. The after-tax cost of the same investment in Quebec would be \$169.75, because the top marginal tax rate is higher, and there exists a 66^{2/3}% depletion

on grassroots exploration conducted by juniors within the province. Nevertheless, the transfer of $133\frac{1}{3}\%$ tax deductions to the investor makes the FTS investment very attractive.

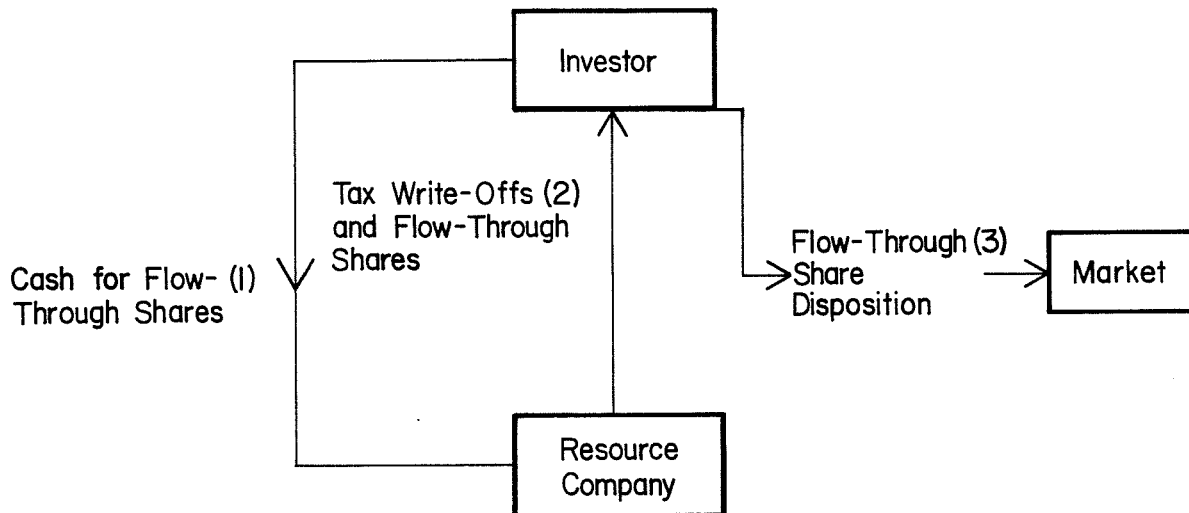
4.1.3 Investment in Flow-Through Shares

The two most popular types of FTS arrangements are; the one-on-one deal and the limited partnership.

A one-on-one deal is a simple agency agreement which results when a resource company offers, and then issues shares directly to the investor for CEE work completed. Depending upon the exploration program's success and the value of the issuing company's shares, the one-on-one investor will hopefully receive shares which will reduce the amount at risk (his after-tax cost), and provide some profit when the FTS is sold.⁸³

Both the investor and the company are interested in the success of the exploration program. If the drilling results show no value, the value of the shares will depreciate since there are now more shares (additional FTS's) against the original asset base. Hence, the company would like good drilling results, not only to increase the value of their mineral properties, but also to claim success, and more easily sell future FTS's.⁸⁴ Figure 4 shows the structure of a one-on-one deal.

FIGURE 4
The One-on-One Deal



The second, and less risky type of FTS deal is the limited partnership. By subscribing for FTS's of several resource companies, a limited partnership reduces some of the risks related to the direct one-on-one investment. This arrangement involves a holding company or mutual fund which establishes a limited partnership between several hundred investors who buy units of the limited partnership.⁸⁵ Under this type arrangement the FTS's are issued to the limited partnership, but the tax deductions are only deductible by the investors.

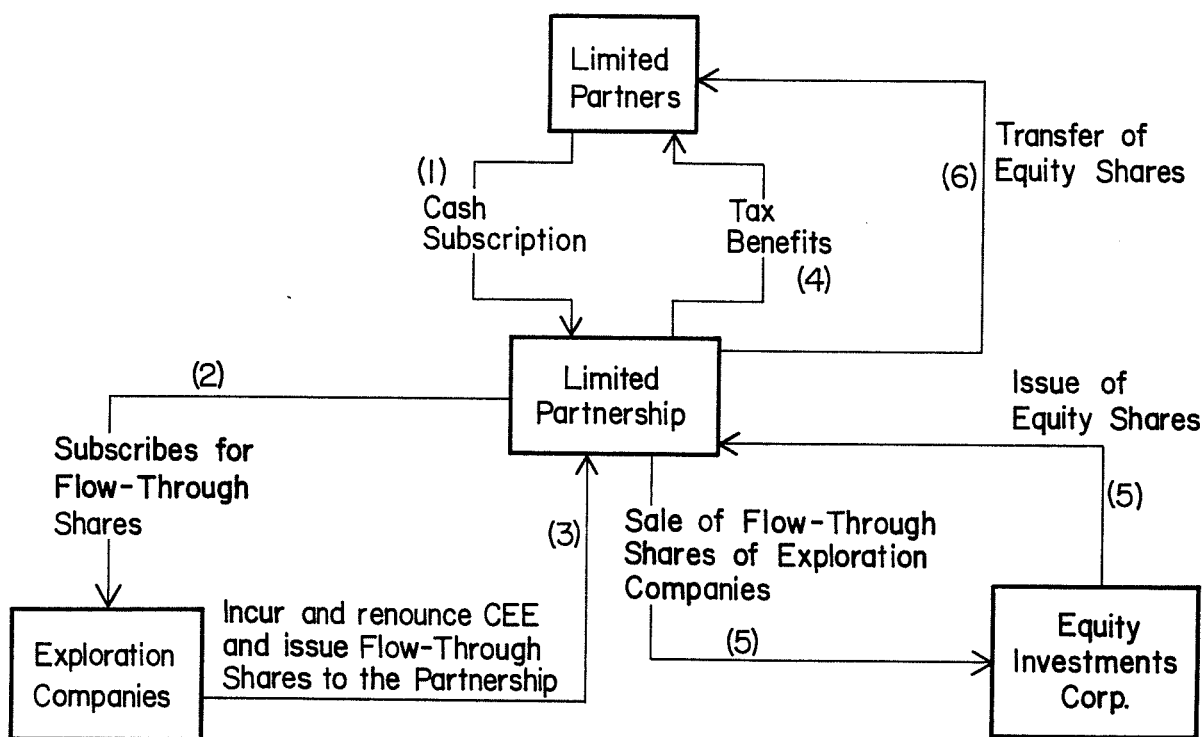
The investment strategy of the limited partnership is that it gives the investor a diversified portfolio of resource companies. Hence, the investor is protected against downside losses from

poor drilling results, but at the same time foregoes a part of upside gains if exploration is a success. Figure 5 offers a summary of transactions of the limited partnership arrangement for the First Exploration Fund 1988. However, CMP and NIM arrangements are almost identical.

FIGURE 5

Limited Partnership Arrangement

SUMMARY OF THE TRANSACTIONS



Source: Merrill Lynch Canada Inc., First Exploration Fund 1988: Public Offering Prospectus, September 14, 1987, p.9.

Investors in ordinary mining stocks would receive equity

shares at the prevailing market price. These investors would hope that the value of their shares increase with a successful exploration program. Similarly, a FTS is a good investment only if the investor can recover his investment and earn a profit. Valuing the shares, particularly those of a junior company, is a difficult task since the investor does not actually receive the shares until the work is completed, which may take up to a year. Meanwhile, a price change of 50% in one day is not unusual for a junior mining stock. Thus, in purchasing a speculative asset, the investor does incur some real risk. Nevertheless, the investment in FTS's differ from the purchase of common stock because the investor in FTS's recovers his investment from two sources; (1) the reduction in income tax expense resulting from tax deductions, and (2) the after-tax revenue realized upon selling the share. The investor is therefore at no more risk than his out-of-pocket after-tax cost.

The available reduction applicable to income tax to lower the after-tax cost depends upon the investor's marginal tax rate and the provincial tax rates which will apply. The top marginal tax rates for 1988 range from 52.52% in Quebec to 44.81% in B.C. and Ontario. The investor will seek to shelter income which would otherwise be subject to tax at the top marginal tax rate in order to maximize the tax deductions flowing from the investment.⁸⁶ When FTS's are issued, they are issued at a premium to the market price (the premium is the amount by which the price of the FTS exceeds the price of the common share). For this reason, only high income earners who are able to take full advantage of the tax deductions are most likely to invest in FTS's.

FTS's allow a company to issue shares at a premium to market price because of the value of tax benefits attached to the issues. Thus, for a given amount of money required for an exploration program, fewer shares need to be issued. This is of interest to the issuing company because higher premiums imply fewer shares issued for a given amount of CEE undertaken. This makes it easier for the manager to maintain control of his company.⁸⁷ The issuing company will also take into consideration the present value of the tax savings foregone when CEE is renounced to the investor, as a further reason for the preference of high premiums.

The investor, on the other hand, will desire a low premium so that he will obtain more shares and more value for his investment. The maximum the investor would be willing to pay for a FTS according to Jenkins (1987), is the market value of the share after it is free of all its tax features plus the present value of these features. The minimum value the company would be willing to accept is the value of the share if it were sold on the market without the tax features, plus the present value of the tax benefits he gives up by flowing them through to the investor.⁸⁸

Since the adjusted cost base of a FTS is zero⁸⁹, Jenkins finds that the expression relating the market price of an ordinary share to the maximum price of a FTS is;

$$X = S + X[CEE(t_p) + MEDA(t_p)] - St_c$$

or simplified,

$$X = \frac{S(1 - t_c)}{1 - t_p(CEE + MEDA)}$$

where, S = market value of a company's ordinary share
 X = maximum price an investor would pay for a FTS
 t_p = personal marginal tax rate (in present value terms)
 t_c = corporate marginal tax rate (in present value terms)
 CEE = Canadian Exploration Expense (100%)
 MEDA = Mineral Exploration Depletion Allowance ($33\frac{1}{3}\%$)

In summary, Jenkins finds that the price the investor is willing to pay for a FTS is larger (higher premium), the higher is the individual's marginal tax rate, the greater the proportion of expenditures spent on CEE, the longer he expects to hold the share (which determines the effective capital gains tax), and some discount rate which Henin and Ryan (1987) attribute to the risk provoked by the time lapse between pricing and issue of the shares.

What happens in the financial market is that there exists a market determined premium that varies with the asset value of the issuing company, and the expectations of the investors and promoters. Consequently, juniors may be able to charge a premium of no more than 115%, medium-valued firms may charge premiums of 140-150% and seniors may obtain 170-180% premiums.⁹⁰

4.1.4 Flow-Through Shares: Past and Present

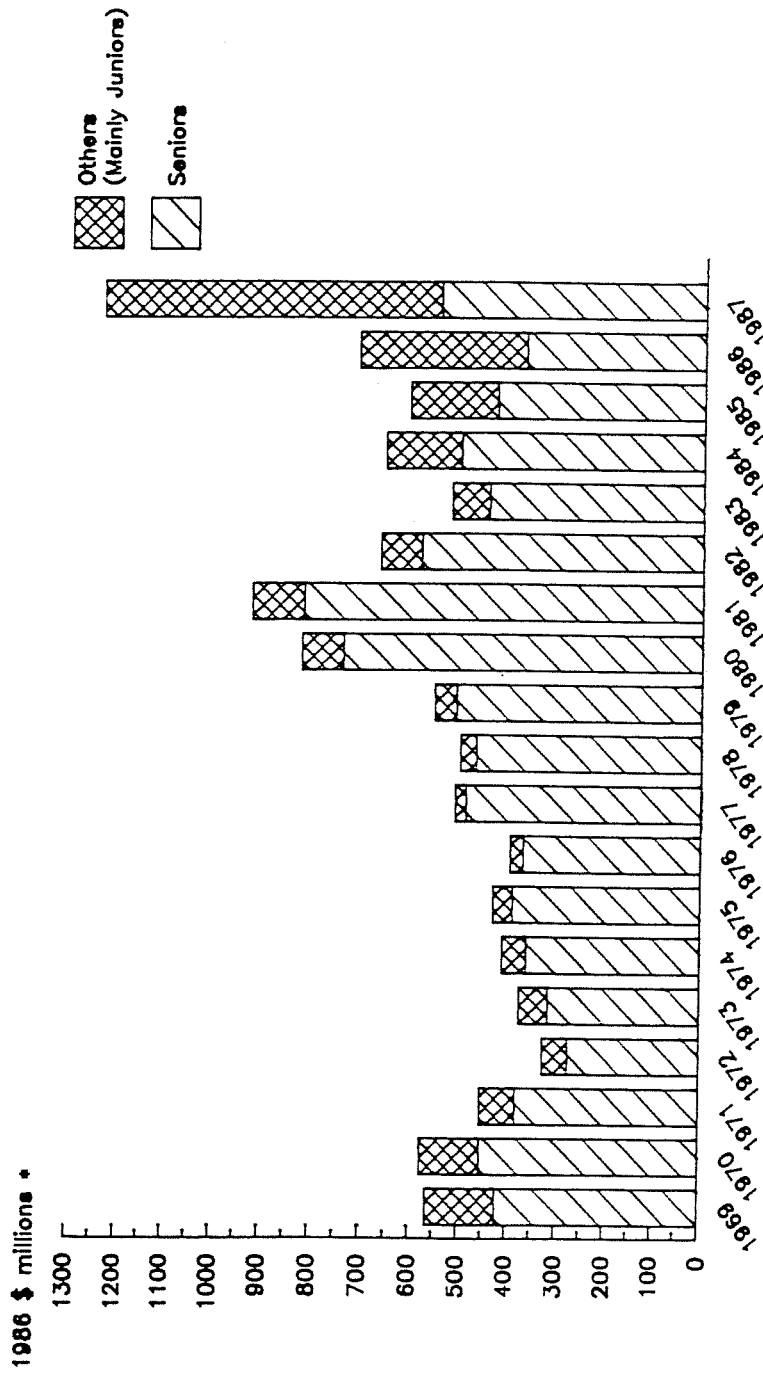
Flow-through financing has provided both junior and senior companies with a substantial boost during a period when the Canadian mineral industry was faced with the pressures of the 1982 recession. The prices of some base metals had plummeted to levels as low, in relative terms, as prices during the Great Depression of the thirties. In particular, flow-through financing assisted the viability of the "Junior" firms and their contribution to Canada's economy and regional economies. Two substantial benefits provided by flow-through financing have been its availability to bring forth new mines, and permitting the juniors to become known for their exploration skills and flow-through fund raising abilities, while the seniors provided them with management expertise and opportunity.

Preliminary data covering FTS investments confirm that the junior mining sector have increased their importance in mineral exploration. In 1983, juniors accounted for only 15% of total exploration (approx. \$78 million). By 1987, junior firms had conducted over two-thirds of all grassroots exploration in Canada (approx. \$700 - \$800 million)⁹¹ (see Figure 6). As was shown in Figure 3, FTS-raised capital increased from \$38 million in 1983 to over \$1.2 billion in 1987 (56% by the junior sector), an increase of approximately 3000 percent.⁹²

Every region in the country has benefited from the recovery. Since 1983, three new mines have been opened in the Atlantic

FIGURE 6

ANNUAL CANADIAN MINERAL EXPLORATION EXPENDITURES
FIELD EXPENDITURES PLUS OVERHEAD
JUNIOR/SENIOR SPLIT



Sources: EMR estimates based on Statistics Canada 61-007, 61-216,
and other sources.
• Values were adjusted using GDP Deflator rebased to 1986.

Provinces, five in British Columbia, one in the Northwest Territories, 16 in Ontario, three in the Prairie Provinces, six in Quebec and one in the Yukon. These 35 new mines represent an investment of \$663.7 million and could create 3500 new jobs in mining. This does not account for the multiplier effect or considerable gains attributed to exploration related companies (i.e., laboratories, equipment rentals etc.) and non-mining businesses.⁹³ However, we must remember to measure efficiencies in terms of costs.

The investor in FTS's receives three benefits: (1) the tax deductions for CEE and related MEDA; (2) capital gains exemption on the full proceeds of the sale of FTS's; and, (3) the value of the share that is received from the company (or mutual fund share) which is realized at the time of sale. These benefits are provided by two sources; the first two are rendered by the government and the last by the company.

The first two benefits provided by the government are examined by Jenkins (1987) to estimate the efficiency of the flow-through mechanism. Jenkins illustrates the amount of tax revenues that must be foregone by the government in order to provide a non-taxable corporation with an additional dollar of tax benefits through the use of FTS's.

Given a fifty-one percent premium over the normal market share, the total deductions given up by the company are $151(1.333) = \$201.28$. These deductions have a present value of \$39 if the company was not to be taxable for ten years and present value of taxes saved equal to \$19.50 (assuming a discount rate of 20%).

The investor receives the total (CEE + MEDA) deductions of \$201.28, which have a tax value of \$100.64 (assuming a marginal corporate tax rate of 50%). In this case, if no capital gains tax applies, the revenue costs to the government would be $(\$100.64 - \$19.50) = \$81.14$, and the gain to the company in present value terms is $(\$51.00 - \$19.50) = \$31.50$. Therefore, the cost/benefit ratio for this scenario of a FTS issue is $\$81.14/\31.50 or \$2.58 of costs per dollar of tax benefits transferred.⁹⁴

The Federal Government realizes that the economic conditions are no longer what they were in 1983. The mineral industry as a whole was remarkably prosperous in 1987. In January 1988 EMR estimated that the total value of Canadian mineral production had increased by 11 percent in 1987 to \$36 billion. In the metals sector alone, this production which had a total value of \$8.8 billion in 1986, was estimated at \$11 billion in 1987. The value of gold, copper, zinc and nickel production also increased significantly in 1987. Although cycles do change, the recent resurgence of the mining industry itself, has increased internally generated capital from \$419 million in 1982 to \$1.26 billion in 1986.⁹⁵ Therefore, although there is no doubt that the tax benefits of the FTS program were certainly one of the factors which contributed to the recovery of the mineral industry, it was not the only factor.

The cost/benefit inefficiencies mentioned beforehand, as well as the changing economic climate in the mineral industry have moderated a tax reform which will definitely influence the future of FTS investments. The following changes will have a

discouraging impact upon the investors in FTS's;

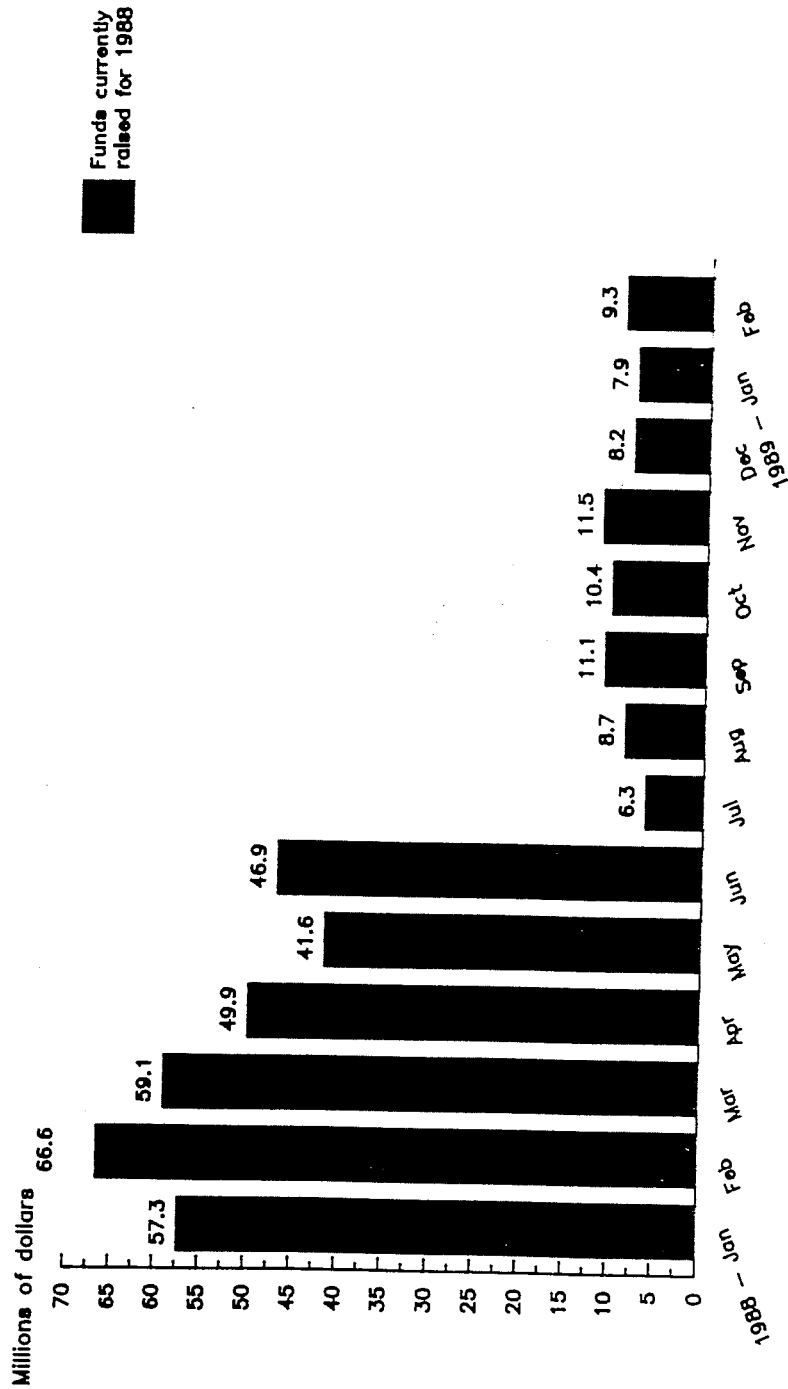
- (1) Phasing out of MEDA by February 28, 1989;
- (2) The Capital Gains portion to be included in taxable income is to be increased from the present 50% to 75% by 1990;
- (3) Capital gains exemption capped at a lifetime limit of \$100,000;
- (4) Reduction in personal taxes, which will decrease investors tax deductions (i.e. higher after-tax cost)⁹⁶
- (5) Cumulative Net Investment Loss (CNIL), will include deductions transferred to the investor of FTS's, but restrict the investors ability to utilize the capital gains exemption.⁹⁷

The above tax reform, as well as the market crash of October 19, 1987 have had a dramatic impact on junior exploration funding via FTS's. As can be seen in Figure 7, exploration funding for the second half of 1988 has dropped significantly, with the majority of the brunt being felt by the juniors.

Given the high level of risk in grassroots exploration, the Government recognized that some form of additional incentive was necessary, if junior exploration were to be maintained at healthy levels. Consequently, on May 3, 1988 the Federal Government announced a possible solution to maintain the meaningful contribution of the junior mining sector. The plausible solution to the generous FTS program was the introduction of the Canadian Exploration Incentive Program.

FIGURE 7

JUNIOR EXPLORATION EXPENDITURES FINANCED BY FLOW-THROUGH SHARES 1988 TAXATION YEAR



Note: Figures exclude issuance fees and commissions.

4.2 Canadian Exploration Incentive Program

The new Canadian Exploration Incentive Program (CEIP) is accessible to all grassroots mineral exploration through the use of FTS's. However, since we are now facing improved metal prices (in general), the senior mining sector will most likely finance exploration from retained earnings -- the juniors were therefore expected to make the most use of CEIP at its inception January 1, 1989.

4.2.1 How The Program Works

Companies will enter into FTS arrangements whereby the investor will finance exploration in return for FTS's. After the exploration work is executed, the company or limited partnership will apply for CEIP, which will then renounce to investors exploration expenses less the value of the grant. The company will benefit from the incentive by being able to sell its FTS's for a premium over market value.⁹⁸

Exploration expenses which currently qualify for MEDA will also qualify for CEIP. However, only exploration expenses incurred under a FTS arrangement where the corporation and the investors are at "arms length," are eligible for CEIP. The sale of FTS's to related companies or persons will not be acceptable for CEIP.

Expenses eligible for CEIP will also be subject to an annual expense limit for a company, or a group of associated companies of \$10 million annually. The program will permit companies to

claim up to 30% of the exploration expenses, making for an annual limit of \$3 million. For instance, a grant of \$0.30 will be returned for every dollar the company expends on grassroots exploration. This \$0.30 will be taxable since it is considered income to the company.⁹⁹

The annual expense limit will apply to all companies using CEIP, and is deemed to cover over 98% of all junior exploration programs (based on 1987 data). The \$10 million limit was selected as the maximum, since in 1987, of the 530 junior companies which were financed by FTS issues -- only 8 had programs in excess of \$10 million.¹⁰⁰ The \$10 million annual expense limit will also be applicable to all companies deemed associated with one another. This rule was implemented so that the grant is not taken advantage of by companies forming new subsidiaries (i.e., exploration arms).

The definition of associated companies according to CEIP are;

(1) Companies active prior to May 3, 1988:

- a) two companies are considered associated if one controls the other, or if they are both controlled by the same associated persons;
- b) control is more than 50% ownership;
- c) individuals related by blood, marriage or adoption are deemed to be associated.

(2) Companies entering the sector after May 3, 1988:

- a) same as (a) in (1) above;
- b) control is deemed to be more than 10% ownership.¹⁰¹

The following simple example (Table 7) illustrates recent

developments in the mining tax shelter area, comparing CEIP to MEDA.

The higher deduction value of CEIP in most provinces has the effect of reducing the after-tax cost of FTS's in comparison to MEDA at 33^{1/3}%. Furthermore, those investors who still have unused capital gains exemption also benefit in the sale of shares under the new CNIL rules. Since CEIP incentives reduce the CEE that the investor is entitled to claim, the investor includes less CEE in the CNIL pool. As a result, a lower proportion of the proceeds are taxed when the investor sells the share.¹⁰²

TABLE 7

Investing in Resource Funds

	<u>1988</u>	<u>1989</u>
Investment	\$1000.00	\$1000.00
Administration Cost	<u>100.00</u>	<u>100.00</u>
Price Paid for FTS	900.00	900.00
Premium	<u>20%</u>	<u>20%</u>
Implicit Mkt Price of Share	<u>750.00</u>	<u>750.00</u>

Resource Tax Deductions:

CEE	900.00	900.00
MEDA @ 33 ^{1/3} %	300.00	N/A
CEIP payment @ 30%	N/A	(270.00)
Admin. Cost	<u>100.00</u>	<u>100.00</u>
Total Deductions	\$1300.00	\$730.00
Tax Rate	<u>46.5%</u>	<u>46.5%</u>
Tax Savings	604.50	339.45
CEIP Incentive	<u>N/A</u>	<u>270.00</u>
Total Incentive	604.50	609.45
After - Tax Cost	\$395.50	\$390.55
	=====	=====

Although the new CEIP program appears to be rather attractive as a tax shelter, the near future will reveal how investors will react to the new arrangement with respect to their investment decisions. The mining industry does not seem to have such a positive outlook on the new changes. The recent Prospectors and Developers Association of Canada (PDAC) annual meeting brought forth a negative response to CEIP; expecting a negative impact on the amount of dollars raised, based upon tax reform and the issues of eligible expenses, associated company rules, and the annual expense limit.

Due to the lengthy nature of an exploration program, and the high degree of risk involved, several mining companies are willing to "dilute" the size of their investment in an exploration program by entering into sharing arrangements. This has been particularly true with the introduction of FTS's, which provided the junior companies with the financial powers to enter into joint venture and farm-out agreements with senior companies who wanted to preserve their exploration dollars during a period of dwindling retained earnings created by poor metal prices. Senior firms realized, and made use of the benefits that could be secured by entering exploration agreements with junior companies, who in effect had no internal financing, but the instinctive ability to raise dollars by means of flow-through.

Although a sharing arrangement may be a less risky form of exploration, it does not offer the highest reward. Consequently, low risk opportunities such as the purchase of an interest in an exploration program, or the delegation of exploration may include

sharing the profits of success, but in some instances also the costs of failure. In this respect, they are a mechanism utilized to maintain corporate survival. Two main types of exploration investment opportunities which enable firms to spread their risk are, as previously mentioned, the joint venture and farm-out agreements.

4.3 Joint Venture

Mining companies today have made a number of adjustments in their investment philosophy to compensate for the increasing risk of new projects. In the last ten to fifteen years, these changes have seen joint venture exploration become increasingly popular; both by having several partners in any single project and by distributing limited investment capital among several projects.

A joint venture exploration agreement specifies the terms, conditions and operating procedures ruling an exploration program undertaken by two or more parties; where one of the parties will be designated to control and supervise operations. As a legal contract, a joint venture exploration agreement sets the rights, duties and obligations of the parties involved. Thus, from the date of the agreement, the joint venture partners will both share in all costs and risk associated with the exploration project.

Joint ventures are most often undertaken by smaller companies¹⁰³ with a lack of adequate funds to finance their own exploration programs, although large companies will also undertake joint venture participation in very expensive, high risk projects. The usual argument is "better a small percentage

of something than 100% of nothing."¹⁰⁴ On the other hand, joint ventures may not be an efficient contractual arrangement if a company has sufficient staying power and adequate funds to continue their exploration program alone with a reasonable probability of success.

To illustrate this point (borrowed from Burn (1984)), let us reconsider the relationship derived by Mackenzie (1981) to calculate the probability of successfully discovering at least one economic deposit given an exploration budget of $C = \$5$ million; probability $p = 0.02$ of discovering an economic deposit given the discovery of a mineral occurrence and, an average cost $K = \$450,000$ of discovering a mineral occurrence.

$$P_s = 1 - (1 - p)^X \quad \text{where } X = C/K$$

For instance if $X = 11$ (number of projects allocated to the budget), then $P_s = 0.2$. Doubling the firm's exposure from $X = 11$ to $X = 22$ by participating in twice as many projects will only increase P_s to 0.36, a ratio of 1:1.8 not 1:2. Thus, spreading expenditures by taking a half interest in twice as many projects does not quite double the chances of overall success.¹⁰⁵ It should be noted that the smaller a firm's exploration budget, the higher is the probability of doubling success.

Consequently, unless the firm has a very small exploration budget, the joint venture must offer more than just the opportunity of sharing risk to make it worthwhile. In other words, it is to the advantage of both partners that each bring something to the joint venture which will reduce risk rather than just spreading it.¹⁰⁶

Reasons for joint venturing may involve:

Tax advantages, such that participants in an exploration joint venture can each claim their exploration and development expenditures as tax deductions against income from other mining related projects. However, if a new corporation is formed, the tax deductions will accumulate to the account of the new company to be claimed against future income.¹⁰⁷

A company which has significant funds for basic mineral exploration may choose to increase its financial exposure to high risk projects by allocating its high risk funds to joint venture programs. However, as mentioned earlier, by spreading financial risk, the ultimate return is reduced if exploration is successful. Gordon Walker's (1984) counterargument to the above is that "frontier" type or remote site exploration is usually directed towards very large targets which will ultimately require development financing, therefore it makes sense to share the risk at the high risk end of the project.

Geographical exposure is a further reason for joint venturing, because potential mineral deposits may be located in regions not normally covered by a corporate exploration program. Joint ventures therefore allow for geographic diversification that would not otherwise be possible, and in addition gain technical representation with locally based and technically competent exploration companies.

One other reason for a joint venture arrangement may be an interest in a specific mineral (geologic diversification). In some instances a corporation may opt to joint venture with a company which has exploration experience and specializes in a particular deposit type. The objective of this type of joint

venture would be to acquire an interest in discovering a source of specific or critical mineral.

If there is good faith and trust between the participants, then the joint venture may be undertaken, conversely, if there is no mutual trust, the parties should not engage in a joint venture. The interests of the two parties involved in a joint venture should not follow the "fair," 50-50 approach. This can create serious problems and deadlocks when decisions have to be made. Therefore, the only division which will not create problems would be one in which one party holds a smaller interest, and is willing to accept the decisions of the major interest holder in the partnership.

4.4 Farm-Out Agreement

Senior companies have a vast number of claims which have only been partially explored. The uncertainty of the true value of these claims results in a decision problem; to drop the claim is to risk an opportunity loss; however, drilling is to risk an out-of-pocket loss. A farm-out offers a compromise between the two and is a device used by many senior companies.¹⁰⁸ Juniors are always keeping an eye open for farm-in opportunities, which are treated as the purchase of an interest in an established exploration program.

Senior companies are not the only group which take advantage of farm-out opportunities. It is not uncommon for small exploration enterprises who are often successful in mineral exploration to consider farming a project out if insufficient

funding is available to finance a proper exploration program.

Although many reasons are provided by companies wishing to farm-out a prospect, they can usually be considered as:

(1) Potentially worthwhile prospects --

- (a) The size of the investment is larger than the firm's available funds at any particular point in time, or perhaps at any time, and additional funding is necessary,
- (b) The potential of the prospect is too large to handle alone,
- (c) The risk is too great for the firm to handle alone, and the firm wishes to reduce its investment,
- (d) Someone else possesses an ingredient which the firm needs; acreage, experience, information,
- (e) The exploration group is discouraged, but the farmee believes that the owner does not recognize the full potential of the prospect, and

(2) Possibly poor prospects --

- (a) discouraging results after a considerable amount of work and the farmee is not prepared to invest further into the project,
- (b) political risk, if unacceptable to the owner is unlikely to be any more attractive to the farmee.¹⁰⁹

Other than for reasons such as; funds are not available, or the risk of drilling is too high, why else would the optionor agree to farm-out after spending a specified amount of exploration dollars on the claim? -- It is possible that the optionor may be facing loss of the claim, since exploration work (i.e., trenching, drilling) is encouraged by the Canadian methods

of calculating the assessment work necessary to keep claims in good standing. In this situation the optionor may simply want the claim tested to identify whether an economic deposit exists in which profits may be obtained from a retained interest in the farm-out. It is also possible that the farm-out may prove up near-by properties. If the claims are found to be uneconomic, then it remains conceivable that other than economic profit, valuable geologic information may be obtained at no cost to the optionor.

The words "farm-out" signify that the mineral claims have been assigned to the farmee. In this sense, the company that farms-in assumes the obligation (in most cases) of carrying out exploration in exchange for a predetermined working interest in the property to be acquired only after certain obligations have been fulfilled.

5.0 THE STRUCTURE OF FRANCHISING

A franchise agreement is a contractual relationship between two independent firms, the franchisor and franchisee. The agreement will last for a definite or indefinite period of time, whereby the franchisor and owner of a protected trademark will grant the franchisee the right to operate under the trademark in question for the purpose of producing and/or distributing a product or service.¹¹⁰ The franchisee will pay a certain amount of money in order to earn the right to market the product or service in a designated location.

Two basic types of franchising arrangements prevail, the first

is referred to as "Product or Tradename" franchising, characterized by franchise dealers who concentrate on one specific product line which identifies with a particular franchisor. Examples of this type of franchising are car dealerships and gasoline service stations. The second, and more popular type of franchise arrangement is known as "Business-Format" franchising, in which the relationship between the franchisor and franchisee includes not only the product, service, and trademark, but also the entire business format itself -- a marketing strategy and plan, operating manuals and standards, quality control, and two-way communication.¹¹ Restaurant chains are probably the most popular form of business-format franchising.

In the majority of business-format franchises, the payment made by the franchisee is in the form of a fixed-fee up front (franchise fee) plus royalties that are proportional to sales or profit. Tradename franchises, on the other hand, do not pay royalties; but require the franchisee to purchase their inputs directly from the franchisor.

5.1 Franchise Organization

Most units within a franchise organization produce the same product or service. The difference which appears amongst most franchise companies, is that a certain number of units are operated by the central organization, while others are franchised. For example, McDonald's will decide on a particular location for a new unit and then decide whether to franchise it,

or maintain ownership by operating the unit through a corporate subsidiary.¹¹²

Lafontaine (1987) formulates a franchise model based upon a manufacturer with some monopoly power in its tradename. This firm has the option to maintain a company owned outlet (fixed-wage contract) or it can franchise the right to sell its product or service, and provide its tradename to an independent franchisee. For a given price level p , it is assumed that demand at the retail level can be written as

$$X_i = f(T, I_i) + U_i$$

for each franchisee. Where f is increasing and concave ($f' > 0$, $f'' < 0$) in its two arguments, T represents the value of the tradename, and I_i denotes local inputs provided by the franchisee. U_i is a random variable with mean 0 and variance σ_u^2 for all franchisees. Since the random variable is independent of the inputs, it becomes impossible for the franchisor to infer the level of I_i given T and the ex post level of demand. Similarly, the franchisee cannot infer T from his knowledge of X_i and I_i , which results in a potential two-sided moral hazard problem.¹¹³

The franchise contract is identical for all franchisees of a given franchise (which is typical in reality), with respect to the payment of a fixed fee (F) and royalties on sales (r), where $0 \leq r \leq 1$. If we assume an unlimited supply of potential franchisees, the franchisor can choose F and r in such a way as to maximize the value of the contract to himself.

There is no doubt that direct ownership will provide a definite advantage for extracting maximum rents, however, if the

central organization franchises then the franchised outlet under a linear contract with royalty r , and franchise fee F will pay

$$r \cdot p \cdot X_i + F = r \cdot p \cdot [f(T, I_i) + U_i] + F$$

to the franchisor.¹¹⁴

The trade-off between agency problems associated with each type of organization is significant in determining the proportion of outlets to franchise. In other words, how do firms decide between the two organizational forms?

One common explanation often connected with franchising is its ability to raise capital. This argument provides the franchisor with the opportunity to expand much more rapidly by franchising independent outlets rather than maintaining wholly owned subsidiaries. Rubin (1978) argues against the capital expansion argument, indicating that if it were a standard explanation, then no financially solid firm would be involved in franchising. Generally, a franchisor will be much more diversified, owning several outlets in many different regions whereas a franchisee will only own one or a few outlets in the same area. For this reason, the investment of the franchisee is subject to greater risk, and would demand a higher rate of return on investment if he were to invest in one outlet rather than a portfolio of outlets. Subsequently, the franchisor would earn a lower rate of return by subjecting the franchisee to a high level of risk.¹¹⁵ According to Rubin, this argument for raising capital would only result if the franchisor were more risk-averse than the franchisee. This tends to disregard the possibility of moral hazard on the part of managers of the company owned outlets. If the franchisee can supervise and get the benefits from their

outlets as an incentive payment, they may make their capital available at a lower price. Hence, the value of franchising may increase when franchisors face a binding capital constraint if it permits them to get access to cheaper capital.¹¹⁶ Furthermore, an empirical study conducted by Lafontaine (1987) finds that a firm's propensity to franchise does increase during periods of rapid expansion, lending support to the initial concept that franchisors use franchising in order to obtain capital when they need it most.

The Alchian and Demsetz (1972) paper on monitoring and control provides a further explanation for franchising. Specifically, franchising is generally undertaken when the franchisee is geographically removed from the franchisor. Unfortunately this creates the problem of not being able to observe all inputs of the production process, which incurs an increased cost of supervision. When individually beneficial shirking, carelessness, and on the job consumption can take place, we must assume it will. To encourage honesty and attain efficient cooperation, rewards must be tied to performance to penalize shirking or free-riding. Alchian and Demsetz suggest that an incentive mechanism in the form of sharing franchise profits would eliminate the problem of moral hazard. This method of motivation would avoid any undesirable behaviour, because any leisure would become a true cost.

The Eswaran and Kotwal (1985) paper on sharecropping and contractual structure provides both an incentive to cooperate and self-monitor in the production process by offering both principal (landlord) and agent (tenant) a share of the output. The

principal possesses three options regarding the manner with which to cultivate his land; under the fixed-wage contract, the landlord would provide both supervision and management. Similarly, if the land were leased, the tenant would provide both supervision and management. However, the share arrangement offers the opportunity for specialization -- each agent performs the task in which he/she has an absolute advantage (tenant is more efficient in supervision, and the landlord in management).

The use of fixed-wage or -rental contracts remain burdened with the problem of moral-hazard; the franchisor cannot observe the level of inputs (I_i) provided by franchisees, and the franchisees can observe neither the trademark value (T) nor the value of any managerial assistance provided.¹¹⁶ Thus, share contracts as provided by Eswaran and Kotwal may be chosen by franchisors over fixed-wage or -rental contracts, depending on the importance placed upon I_i , T and the level of managerial assistance provided by the franchisors, as well as the cost of monitoring these inputs.¹¹⁷

Just as the franchisor desires the franchisee to run the operation efficiently, so too would the franchisee desire the franchisor's ongoing assistance. The main item purchased by the franchisee is the franchise trademark, and the franchisor's role is to assure the continued value of the trademark. The franchisor is often responsible for monitoring the franchised units for quality, providing advertising and, providing training and managerial assistance to franchisees'. Since these responsibilities can prove to be very expensive, the franchisor has the incentive to free-ride upon the trademark by defaulting

on his duties of maintaining the trademark value. Nevertheless, an incentive remains for the franchisor to provide these services if he (1) intends to franchise future units, (2) receives continuing revenues from franchise operations, or (3) owns units.¹¹⁸

Each franchisee has an interest in franchisor policing, since any uncertainty (lack of experience, quality deterioration) will create an externality problem. All parties stand to lose something as the result of an externality, therefore the franchisor must maintain controls.

Caves and Murphy (1976) indicate that with perfect information, the fixed fee would be used alone. In this situation, the successful bidder would be the franchisee who is most efficient in using the tradename. Any uncertainties involved would call for royalty payments on the part of the franchisee. This is attributed to risk-aversion and/or the need for some assurance that the franchisor will provide the (costly) policing service necessary to maintain the value of the franchise.

Franchise arrangements can vary in two different ways: the amount of discretion available to the managers, and the value of the trademark to the business. According to Rubin (1978), in those businesses with a great deal of manager discretion, a higher percentage of the franchisor's revenue will come from the initial fee and a substantially lower percentage to come from royalties; where few managerial decisions are necessary, it is expected that more of the franchisor's income would come from royalties. Second, when a greater value is placed upon the

trademark, it is expected that more of the franchisor's revenue would come from royalties. This would establish the necessary incentive for the franchisor to be efficient in policing and maintaining quality in each franchised unit.

Risk remains an intrinsic problem in business behaviour, such that franchisors' propensity to use franchising increases with the amount of risk in their sector. This is similar to the risk sharing argument if we assume that the franchisor is more risk-averse than the franchisee.¹¹⁹ On the other hand, Lafontaine (1987) points out that this is not consistent with the belief that risk-averse franchisors use franchising to provide insurance to their franchisees, while giving them an incentive compatible contract.

If franchisors and franchisees are perfectly able to observe each other's behaviour, then the random term in the demand equation (U_i) would result in the need for risk sharing; where franchisors utilize the franchise arrangement as a source of insurance for themselves.¹²⁰ Stiglitz (1974) argues that if both parties are risk-averse, and are not able to spread their risk by mixing a fixed-wage and -rental agreement, they would both benefit from the insurance which arises from the use of a share contract.

Three polar cases prevail; pure sharecropping, fixed-wage and fixed-rental contracts. Although it is not possible to mix the latter two if both agents are risk-averse, it remains possible to mix sharecropping with either a fixed-wage or fixed-rent contract. If the landlord is more risk-averse than the worker, the worker will pay the landlord a fixed fee for the use of the

land plus a certain percentage of the crop. Conversely, if the landlord is less risk-averse than the worker, the worker will receive a fixed-wage plus a share of the crop as incentive pay.¹²¹

If both groups are risk-averse, we will never have a purely fixed-wage or fixed-rental system. These types of contracts would appear if, and only if the landlord or worker were risk-neutral. Rees (1985) also derives the optimal risk sharing argument for share contracts in his discussion of Principal and Agent Theory. Rees points out that with principal (P) risk neutral and agent (A) risk-averse, then P "fully insures" A with payment of a certain income (Fixed Wage) and, P bears all of the risk. Alternatively, if A is risk neutral and P risk-averse, then P will receive a "Guaranteed income" (Fixed Rent) with A bearing all of the risk. Therefore, the risk neutral group absorbs all of the risk, and the whole economy acts as if there were no uncertainty.

Given a franchise contract, increases in risk have an indeterminate effect on the franchisor's propensity to use franchising under the strict risk sharing argument. This is because an increase in risk implies that the franchisor has a greater need for insurance. However, risk will also increase for the franchisees who demand a greater incentive, which makes franchising less attractive in the eyes of the franchisor.¹²² As was mentioned beforehand, for franchising to be worth more to the franchisor as risk increases, it is necessary that he be more risk-averse than the franchisee. Considering that franchisors are generally larger and better established, in addition to being

more diversified through various outlets, it is difficult to perceive the franchisor as being more risk-averse.

Franchising may also be used by risk-neutral franchisors as a means of providing insurance and incentives to franchisees. In this case, however, Lafontaine (1987) contends that increased risk, given the costs of supervision, favour more company ownership. Stiglitz' (1974) optimal share contract is a function of each individuals risk-aversion characteristics. Stiglitz therefore demonstrates that under the pure risk sharing argument the share of output paid to the landlord should increase (decrease) as a result of an increase in risk if the landlord is less (more) risk-averse than the tenant.¹²³ Eswaran and Kotwal (1985) avoid the risk sharing aspect of share contracts, and suggest that the landlord first determine the inputs provided by both tenant and landlord with respect to their absolute advantages. The franchisor in this scenario would identify the inputs of the most effective individuals by comparing the outcome of the optimal share contract with the outcome of the fixed-rent and fixed-wage contracts. The equilibrium contractual structure to emerge will be the one which maximizes his expected income.

Both Stiglitz (1974) and Eswaran and Kotwal (1985) realize that a different optimal share contract is obtained whenever the individuals under consideration differ with respect to their risk preferences and/or individual abilities. This is not what is observed in franchising. In a franchise arrangement, each franchisor chooses an "average" optimal share contract for all of its franchisees and a fixed-wage contract for its company owned units.¹²⁴

The complementary importance of franchised and owned outlets should reflect the balance of factors favouring direct ownership and franchise arrangements for maximizing the franchisor's profit.

Although it is possible to earn a higher level of profit through direct ownership, numerous advantages of reducing costs or increasing net revenues prevail from the division of activities to independent enterprises. Independent franchisees may perform better than company-owned outlets because of simple managerial diseconomies of scale. As layers of supervision grow, the cost of information and communication often grow more in proportion. Internal control and supervision costs can be reduced by the use of a franchisee to supervise local production. In this respect, the franchisor can earn reasonable profits without becoming too involved in the high capital risk or day-to-day detail which arise in the management of small scattered outlets. Thus, it is found that franchisors' tend to use franchising more when the cost of supervising downstream operators increase, due to increased geographical dispersion.

The franchisees' motivation and effort may exceed those of hired employees. Managers of units owned by the central franchisor, although conceivably having some incentive compensation, receive fixed salaries. Owner-managers of franchised units, on the other hand, are compensated by residual claims from their particular units. Subsequently, the costs and benefits of franchisees actions which affect the value of their individual units are placed upon their own shoulders. The compensation of the franchisee is similar to that of the sole

proprietor or entrepreneur, except that the franchisee generally puts up a portion of their sales revenue in payment for the trademark.

Since managers of franchisor-owned units do not bear the full cost of shirking, they will have more incentive to engage in this type behaviour than franchisees. Hence, the local management of each franchised unit will be motivated and alert to cost minimizing and sales maximizing techniques.

During periods of rapid expansion, there may also be advantages in minimizing the supply price of capital. This suggests that franchisors contemplate optimal proportions of company-owned or-operated outlets, the proportion depending upon the environment and franchisors' shadow price of funds.¹²⁵ Through the use of franchising there is no need to invest vast amounts of capital to achieve rapid growth. Such an organization may expand more rapidly on a national or international level using minimal risk capital and management resources. Furthermore, franchisees' with local interests and knowledge will support rapid expansion by exploiting areas not in the scope of the organization. Thus, the franchise agreement provides an efficient sharing of risk between the franchisor and franchisee.¹²⁶ Moreover, as the franchise organization matures, the risk faced by the franchisor may decline as it is spread over an increasing number of franchisees.

6.0 FRANCHISING AND MINERAL EXPLORATION

As previously noted, a decision to fund an exploration program which, if successful, promises to produce a major discovery must be made by someone fairly up in the corporate structure. The top level executive is often too far removed from the field to judge the geologic merits of the proposal and, given the great risk involved and inadequate financial incentives, is likely to reject it. The problem of communication and incentives is much simpler in the small firm. Managers are only once removed from the field (as in R&D) and may reap a large portion of the benefits that a major discovery produces. In the large corporation, managers once removed from the exploration environment rarely have the authority or personal incentives to initiate an exploration program based upon a good showing or new geologic concept.

It is the large capital requirements mixed with substantial uncertainties that frequently keep large companies from initiating exploration programs. The decision to go ahead with a major exploration program is made at the top of the company because of the large capital outlays required. The chief initiators of the exploration effort, usually the exploration manager and his geologists, are people further down the corporate hierarchy who may not have the incentive or the ability to convey to top management the enthusiasm that they have over the potential of a prospect.

The manager of a small firm knows that if his firm can successfully establish a place for itself in the mineral industry, the rewards will be substantial. These small firms are

likely to have managers with geologic backgrounds, who may even participate in some of the exploratory work. Thus, they keep in close contact with developments in the field, participate heavily in major decisions connected with the exploration program, and are rewarded in direct proportion to the success of the company.

Exploration ventures can take many various forms, but they all reflect a complex allocation of sharing in risk and potential benefits. The senior company gets information about the value of its claims with a much smaller outlay than if it were to conduct the exploration itself. It will choose to do so if its estimates of the (uncertain) probable productivity of its claim options plus cash investment is less than the estimated cost of making its own test.¹²⁷ This type of contractual arrangement (exploration option agreement) is similar, in some ways, to the organizational characteristics of franchising.

6.1 Exploration Option Agreements

Exploration option agreements have two principal objectives: (1) to allow a potential buyer (optionee) adequate time to explore a property and establish a prospect of value, before being faced with large cash outlays and other commitments, and (2) to allow a potential seller (optionor) to participate in the project if exploration leads to the development of a profitable mining operation.¹²⁸

Under the terms of the agreement, the optionee captures certain negotiated rights from the optionor in consideration of objectives defined in the agreement. The most common forms of