

PRICING AND MARKETING OF MINERALS FROM SMALL-SCALE
MINING OPERATIONS (THE CASE OF GEMSTONES)

BY

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Thesis
(M. Min. Sci.)
Aug
1988
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A dissertation submitted to the University of Zambia
in partial fulfilment of the requirements for the
degree of Master of Mineral Sciences in
Mining Engineering.

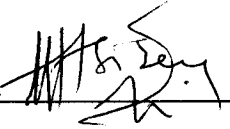
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DECLARATION

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DEDICATED TO:

MY Lord and Saviour Jesus Christ, my Parents -
Kwame Asenso Mensah and Ama Konadu(Kate Mensah),
my brothers and sisters and Ms. Joyce Adusei.

"GLORY TO GOD IN THE HIGHEST"

ABSTRACT

This study analyses the factors which are involved in the determination of prices and marketing of mineral commodities. Its emphasis is on gemstones. The experience of Zambia, Zimbabwe and Tanzania have been used to illustrate problems facing less developed countries trying to use small-scale mining for development.

The study shows that it is not easy to regulate supply in times of low prices and it is primarily demand which quickly responds to changes in business cycle in industrialized countries which dictate price fluctuations. The study also establishes that high quality gemstones are luxury goods and are mainly demanded by wealthy countries for jewellery and speculative purposes. From an examination of the three African countries studied it is clear that most less developed countries lack expertise to value and establish realistic prices. The problem is compounded by the fact that these less developed countries sell their gemstones in monopolistic markets. De Beers and other coloured stones dealers are clear examples. The organization of the gemstone industries in Zambia and Tanzania has not been satisfactory. Zimbabwe though may be a country on the threshold of developing appropriate structures for running a viable gemstone industry.

ACKNOWLEDGEMENTS

I wish to express my deep appreciation and thanks to Dr. M. M. Mpande, my supervisor, for his invaluable assistance and guidance throughout the stages of this study.

I am also grateful to the following institutions and organizations who assisted in various ways: University of Zambia; University of Zimbabwe; Mines Development Department, Zambia; Reserved Mineral Corporation of Zimbabwe.

I would like to express my deep and heartfelt gratitude to the following persons and groups whose invaluable assistance and encouragement served as a major stimulus for this study. These include: Dr. and Mrs. A.W.W. Tamakloe and his family, Mr. and Mrs. K. Agyeman and family, Dr. B.M. Kamuwanga, Messrs Amos Banda, Samuel Frimpong, Victor Temeng Amoako, Isaac Kodjo Afewu, Hanson Agyei Sarpong, Aston Chipanshi, Dr. E. k. Abosti, Mr. and Mrs. L.Chilengi, the entire Bible Study Group in the Chilengi's home, the Kasondes family, as well as the Christian Fellowships in Zambia and Zimbabwe and the entire Ghanaian Community and friends in Zambia.

I do also appreciate very much the pains Mrs.Catherine D.

Ngwira took to type the dissertation in this presented form. Her friendliness will ever be remembered.

Finally, I am extremely grateful to my sponsors, ANSTI(UNESCO) for providing me with a study fellowship.

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ABBREVIATIONS AND SYMBOLS

AGID	Association of Geoscientists for International Development
CSO	Central Statistics Office, Zambia
ITC	International Trade Centre
MEMACO	Metal Marketing Corporation of Zambia
NCDP	National Commission for development Planning
SADCC	Southern African development Coordination Conference
UNDP	United Nations Development Programme
UNCTAD	United Nations Conference on Trade and Development
US	United States of America
D	Demand
AR	Average Revenue
MC	Marginal Cost
MR	Marginal Revenue
AVC	Average Variable Cost
ATC	Average Total Cost
TC	Total Cost
TVC	Total Variable Cost
TR	Total Revenue
TFC	Total Fixed Cost
TT	Profit

INTRODUCTION, GENERAL SUMMARY AND CONCLUSIONS

INTRODUCTION

DEFINITION OF SMALL-SCALE MINE

"Small" is relative, a fact which makes a general definition of small-scale mine difficult. Mining operations in developed countries which would be categorized as small-scale would tend out to be very large scale operations in most developing countries.

Nevertheless, it is necessary to evolve a definition of a small-scale mine especially in less developed countries if their governments are to identify and assist the small-scale mining sector. Many definitions have been proposed using different criteria including: output; capital investment; number of men employed; managerial structure; investment per man; size of concession; and continuity of operations. For instance, the definition given by Berger(53) for small-scale mine include: those with less than 25 persons in the case of Philippines; and for size of concession of lease of less than 1,000 hectares for Peru. United Nations(54) defined small-scale mine as all operations with annual production of 50,000 metric tons or less. Carman(55) proposed that for a less

developed country a small-scale mine be defined as a sporadic producer with limited amount of deposits and a few known ore reserves with little use of mechanical energy but very labour intensive and under leadership which generally lacks technical, managerial or entrepreneurial skills. According to Carman(55) a mine with output less than 100,000 tonnes per annum should be considered small-scale.

The Mining Magazine(56) classified all mines with production output less than 150,000 tons per year as small-scale. Small-scale mine in India is also defined as a mine which produces a mineral in raw unprocessed form and up to a limit set according to the type of mineral (for example, 50,000 tonnes per year for bauxite and 100,000 tonnes per year for iron ore), subject to a maximum investment in plants, machinery and equipment of Rs 3.5 million, without any mechanized beneficiation and processing of Rs 10.0 million with such a unit, and subject to the limit of Rs 15 million in annual turnover(57).

The definitions of small-scale mine therefore varies widely and depends on local circumstances. None of the above definitions (especially those on output basis) suits this study entirely. This is mainly because gemstones are

low-volume and high-value mineral commodities. Nevertheless, apart from the output limit set by Carman in his definition, small-scale mine definition in the context of this study approximates to his definition. Most medium-scale mine operators referred to in this study own few earthmoving equipment such as bulldozers which they make available for hiring by some small-scale mine operators.

Importance

Small-scale mines play very important role in world economies especially in economies of developing countries. It is estimated that small-scale mines produce about 10 per cent of global mineral output(57,58). In Chile, for example, 20 per cent of copper used to come from small-scale mines(58), about 50 per cent of gold produced in Zimbabwe is from small-scale operations(59) and 100 per cent of all Sri-Lanka's gemstones is from small-scale mines(58).

In addition, in less developed countries small-scale mines assist in the following:

- (1) Creation of employment, full-time or seasonal of non-inflationary nature and in more dispersed form in remote areas helping to reduce drift to towns (urbanization problems).
- (2) Training of local population and generation of foreign exchange revenue.
- (3) Development of infrastructure and other service industries such as small-scale engineering in rural areas.
- (4) Production of import substitution and development of domestic linkages, and
- (5) Non-expensive prospecting of mineral deposits.

Issues and Problem

Inspite of the above-mentioned advantages, combined with the fact that small-scale mine require low investment and is less dependent on imported technology and equipment, governments in most less developed countries have not given the small-scale mine sector the attention it requires.

The major problems facing small-scale mine operators include the pricing and marketing of their commodities. Small-scale mine operations are in most cases widely

dispersed and require finances for various infrastructure developments. Small-scale mine operators generally lack market intelligence and market facilities and they are therefore handicapped in pricing and marketing of their products. Most government marketing institutions which replaced mineral marketing agents in less developed countries have effectively failed to assist small-scale miners in this all important problem. In most cases, these government marketing agencies have contributed to the severe working capital problems facing the small-scale mine operators. This problem has partly contributed to smuggling of gemstones and other precious metals in less developed countries. This study therefore seeks to find practical solutions to these pricing and marketing problems facing the gemstone industry in most less developed countries.

The framework used for the pricing and marketing analyses of the minerals in this study is adopted from Labys ("Market structure, Bargaining Power and Resource Price Formation"). Chapter 1 gives the expansion of this technique. Together with micro and macro-economic theories employed, the technique can also be applied for pricing and marketing of most mineral commodities from less developed countries. The selected period of years in

the study are based on data which were available for the study.

PRICING AND MARKETING OF MINERAL COMMODITIES

The primary export sector in developing countries rarely has an internal demand base. As a result, most primary mineral commodities produced in less developed countries are exported. For this reason, any study of pricing and marketing of minerals from small-scale mining operations should also consider the problems of international commodity markets. Chapter 1 therefore analyses the factors which are involved in the determination of prices and marketing of mineral commodities.

The problems of pricing and marketing of primary commodities (including minerals) have become an international economic issue, especially, after the Second World War. This is because the world is increasingly concerned not only with how prices are formed, but with the magnitude of prices as well as their stability.

Micro-economic theory has traditionally been used to study the problems of pricing and marketing of mineral commodities. The theory presumes that no firm has control over prices, all firms are identical, exit and entry are

limitless and costless, knowledge is perfect, and there is full utilization of resources. However, because of a number of peculiar factors which directly influence mineral markets, the application of theory to the problems of mineral pricing and marketing has not been effective. Essentially, mineral markets are characterized by:

- (1) the presence of monopolistically competitive producers organizations and cartels which inhibit free trade;
- (2) imperfect knowledge of the quantity and quality of mineral deposits;
- (3) difficulty of establishing and forecasting mineral prices internationally; and
- (4) the problem of how to allocate supply in the short-run and the long-run (conservation for future generations).

Because of these characteristics, it is difficult to find a universally-accepted theory explaining how mineral prices are formed and markets organized.

Chapter 1 therefore gives a detailed analysis of a more appropriate approach for pricing and marketing of mineral commodities. This is done in terms of:

- (1) mineral market conditions;
- (2) mineral market structure; and
- (3) mineral market implications.

Mineral Market Conditions

Mineral market conditions refer to those determinants which explain supply, demand and trade pattern of particular group of minerals.

Supply

Supply plays a very important role in mineral pricing and marketing. Important factors affecting supply are:

- (1) the rate of resource development and depletion.
- (2) economic conditions,
- (3) geologic conditions,
- (4) technology,
- (5) market institutions,
- (6) uncertainty,
- (7) public policies and political considerations, and
- (8) the organization of the mineral industry.

These factors have to be translated further into conditions which determine the nature of investment and the cost structures of the mineral industry. The organization of the mineral industry regarding market and price control normally reflects market power and should also be given due consideration.

The conversion of minerals as geological resources to minerals as economic goods depends on the following factors:

- (1) the rate of resource development and depletion;
- (2) economic conditions;
- (3) geological conditions;
- (4) technology;
- (5) market institutions, and
- (6) uncertainty.

Secondary production also affects the geologic conversion process.

Demand

Mineral commodities have derived demand and the elements of demand include:

- (1) end-use structure,
- (2) economic conditions,
- (3) technology, and
- (4) substitution.

The study shows that supply and demand inelasticities in the short-run are mainly responsible for the wide price swings that occur with shifts in quantity. Since shifts in supply occur less frequently for mineral commodities, it is primarily demand shifts in response to changes in business cycle in industrialized countries that tend to dictate price fluctuations. In the long-run however, supply and demand are more elastic and long-run price formation is more speculative in nature.

Mineral Market Structure

The major determinants of mineral market structure are:

- (1) the number and size of buyers and sellers;
- (2) barriers to entry;
- (3) nature of product differentiation, and multinational presence.

Essentially, most mineral market have high market concentrations and collusive pricing is common. Furthermore, in mineral market analysis at international

level, the presence of multinational companies require very important attention. This is because their power is not only related to their large market share, but their influence on market structures is also derived from their secondly political and economic capabilities.

Mineral Market Implications

Market Implications relate to the impact of market conditions and market structure on the various participants in the mineral market. At International level mineral market implications normally examined relate to the host governments in developing exporting countries and foreign mineral investors.

Labys(2) identifies the following underlying factors as relevant to mineral market implications:

- (1) resource export dependence,
- (2) magnitude of investment,
- (3) nature of technology,
- (4) control over reserves and production,
- (5) opportunities of increased processing,
- (6) material share in product prices,
- (7) obsolescing bargain,
- (8) nature of competition, and

(9) government learning.

These factors act in concert to explain the division of gains among mineral market participants.

COLOURED STONES AND DIAMONDS (GEMSTONES)

Gems are described as those specimens of minerals used for personal adornment that possess beauty, rarity and durability.

The gemstone industry plays an important role in many developing countries. For instance, 75 per cent of Botswana's foreign-exchange earnings is from exports of diamonds(60). Africa alone produces over 80 per cent(by value) of the world's diamonds(24).

Gems are grouped into two main classes; diamonds and coloured stones. Chapter 2 analyses the coloured stone industry.

Coloured Stones

Supply of Coloured Stones

There are two main geological environments for the occurrence of gemstones, viz: sedimentary/alluvial and insitu igneous/metamorphic. The most important source of coloured stones are from sedimentary/alluvial deposits. The important coloured stone deposits are found mostly in less developed countries.

In general, the mining and concentrating of most coloured stone deposits, is accomplished by the use of simple labour intensive methods(e.g. panning). Lead times are also short. In addition, coloured stone processing: cutting; polishing; and facetting require simple technologies. The investment costs in most coloured stone operations are therefore low compared to mining of other minerals. Since developing countries have low capital formation rates, those countries among the less developed countries with economically viable coloured stone deposits, should give priority in exploiting these coloured stone deposits. These operations will require little or no foreign dependence.

Demand and consumption of coloured stones

Coloured stone like other gemstones are demanded mainly for jewellery and investment purposes, though they are also used by hobbyists, for figurines, boxes, ashtrays, as specimens and for home decoration. In addition there are few industrial uses.

The value of coloured stones and other gems depends on their: beauty; durability; rarity; size; fashion; tradition; and portability. Coloured stones are luxury goods and are consumed mostly by wealthy countries.

Coloured stone trade takes place mainly at the cut stage. For instance, 90 per cent of coloured stones traded in Switzerland, the major import market for coloured stones, is in the cut form(21). However, most coloured stone dealers and manufacturers in developed countries(including Switzerland) are unwilling to buy cut stones directly from less developed countries who have no expertise for cutting.

Nevertheless, in order to add more value to the stones so as to generate high foreign exchange revenue, and to penetrate the major coloured stones import markets, all major coloured stone producers in less developed countries

without cutting facilities would have to invest in the establishment of a cutting industry. Besides, this will help build cutting expertise and create employment. It is estimated that the cutting of coloured stones increases its value about ten fold(61). Other developing countries, for example, Brazil, Thailand, Hong Kong and India who are now known to have cutting expertise faced similar initial marketing problems. ITC/UNCTAD gemstone study in 1971(62) reported that "too often the items seen in the retail outlets coming from these sources [Brazil, Hong Kong, India] are poorly polished, ill-shaped and generally unattractive." The situation with these countries is presently different since they have acquired experience over the years. However, cutting specifications in any less developed country should be with regard to target markets.

Stone dealers are at the centre of the coloured stone trade in most developed countries, and about 75 per cent of all stones (cut stones) imported into the developed countries pass through them(22). The stone dealers buy almost all the rough stones from the producers whose operations are small-scale and are widely dispersed. The stone dealers are a very closely knit community and they exhibit monopsonistic characteristics in their rough stone purchases. They are all small family companies who have

established their supply lines over the years and several of these dealers resist approach from other producers. As a result, exporters of coloured stones in less developed countries would have to spend more time to develop contact and confidence of several stone dealers in order to develop export markets. Initial contact with any potential dealer could be by correspondence in appropriate language, and subsequent personal introduction should also be arranged if possible. Should personal sales visit not be possible, consignment may be sent to a forwarding agent specified by the prospective buyer or through a registered importer or a bank for inspection. In any case, the prospective buyer should be made to pay the handling charges and necessary measures should be taken to ensure that the stones sent for inspection are not replaced with poor quality ones. In addition, exporters of coloured stones from less developed countries can establish a direct presence in a foreign country, however, this would be more expensive. Regular market visits are also prerequisites in developing new export markets and will assist in market assessment and planning. Commercial representatives in embassies located in these target markets could be of help in these market surveys. Attention should be paid to buying seasons in various countries. Due to the fact that stone dealers especially in a particular country are tightly-knit, prices are

sometimes transmitted from one dealer to another. Exporters from less developed countries should therefore, be very awake to check such collusive pricing practices in order to obtain fair prices for their stones.

The coloured stone industry is very competitive on the supply side and most dealers are not willing to pass their sales statistics regarding prices and quantities freely. This implies that a developing country which wishes to maximize revenue from sales should take time to develop expertise in the valuation and pricing of stones. This all important aspect of the coloured stone trade can only be achieved through initial training in gemmology and a period of apprenticeship in major cutting and trade centres under guidance of experienced dealers and institutions. Gemmological institutions could be established on regional basis, for example in the SADCC region where gemstone exports contribute immensely to many member countries' foreign exchange earnings. In addition, such gemmological institutions can assist in building expertise for cutting, polishing, making of jewellery, marketing of stones as well as exchange of knowledge of the gem trade and research on regional basis. The establishment of geological museums would also assist individuals to acquire knowledge of gemstones in various less developed countries. International Aid

Organizations such as UNDP, ITC/UNCTAD, AGID for example can assist in these training programmes.

Diamonds

The third chapter analyses the diamond industry. Detail analyses of De Beers control of the diamond market is also given (this type of market control does not exist in the coloured stone industry).

There are five main sources of diamonds:

- (1) Kimberlite pipes
- (2) Kimberlite dykes and fissures
- (3) Alluvial deposits in existing or ancient river courses
- (4) Alluvial coastal deposits, and
- (5) Deposits occurring in sedimentary rocks

The major sources of diamonds are from kimberlite pipes most of which are found in Africa. Africa supplies more than 80 per cent of all gem quality diamonds(24). In addition to Africa, diamonds are produced on commercial quantities only in South America, Russia and recently in Australia. Alluvial diamond digging is also very common in most diamond producing countries.

Like coloured stone operations, most diamond operations: mining, beneficiation, cutting and polishing are on small-scale and require low capital investment. In most cases therefore less developed countries with economically viable diamond deposits can invest in such operations without foreign assistance. In some of the diamond mining operations however, more capital intensive techniques are employed.

Demand for Diamonds

High quality natural diamonds are demanded for jewellery and investment purposes. Diamond's use for industrial purposes is also versatile and surpasses all other gemstones.

Unlike the primary commodities which fall under the UNCTAD "Integrated Commodity Programme", diamond prices have risen steadily over the years mainly because of De Beers control of the diamond market. Potential investor's therefore, have come to believe diamond as an asset they can trust in an age of uncertainty. Consequently, any development country who wishes to maximize revenue and create employment for her people in this relatively stable price industry, should embark on building expertise for valuing, pricing as well as cutting, polishing and

facetting diamonds.

Past and Present Control of the Diamond Market by De Beers

De Beers owns or controls all the important kimberlite pipe mines in South Africa and is also the most important producer of gem diamonds. De Beers holds stock as a buffer to support an orderly pricing structure, and maintains control of diamond prices through subsidiary companies. De Beers have entered into contractual arrangements to buy the output of all the important Africa mines together with the recent output from Australia (see Figure 0.1). De Beers controls about 80 per cent of the world rough diamonds(28).

THE GEMSTONE INDUSTRIES IN ZAMBIA, ZIMBABWE AND TANZANIA

The last chapter deals with case studies of the gemstone industries in Zambia, Zimbabwe and Tanzania. The chapter also reviews the pricing and marketing procedures of some major gemstones producers in developing countries including; Madagascar, Sri-Lanka, and Brazil. They were the major producing countries whose pricing and marketing systems were available for the study.

FIGURE 0-1 MARKETING FLOW OF ROUGH DIAMONDS FROM
MINES TO SIGHT

De Beers' Consolidated Mines, Limited Controls the diamond market through subsidiaries

Diamond Producers' Association consists of members such as the Government of South Africa, Premier Mine and Diamond Corporation Limited

Diamond Corporation Limited contracts for, and gathers diamonds from non members and channels them to the Diamond Producers Association

Send members diamonds to:

Send non members diamonds to:

Central Selling Organisation
Central Sorting Office,
Kimberley. Grades, sorts and
prices diamonds (Gems and
industrials kept separate at
all times)

Sends gem diamond to:

Sends industrial diamond to;

Diamonds Purchasing and
Trading Company Limited

Industrial Distributors Limited

Diamond Trading Company

Industrial Distributors Limited
(Sales)

Sights

Industrial Market

AFTER: Gemmological Institute of America, 1979.

The Gemstone Industry in Zambia

The major gemstones produced in Zambia presently include amethyst, emerald, tourmaline and aquamarine. Before the formation of Reserved Mineral Corporation(RMC) in 1980, all gemstones were marketed mainly by agents. The organisation of the gemstone industry in Zambia has not been satisfactory. Amethyst was the first gemstone to be produced commercially from Kalomo in the 1960-1970s. Specifically, amethyst initial sales was inappropriate and was opened to wide abuse. For instance some of the foreign private companies sold their stones cheaply to themselves or to their subsidiaries. In addition prices of similar grade amethyst varied considerably with identity and country of origin of buyers.

Though the formation of RMC, a government marketing agency, was commendable, the Zambia gemstone industry is still beset with serious pricing and marketing problems. The study further found out that Kagem Mine Limited, which is a joint venture company formed in 1984 between RMC(holding 55 per cent share) and a foreign company Hagura Limited(holding 45 per cent share) produced 73-92 per cent by value of Zambia emeralds from 1985 to 1987. Besides, 49 per cent of Kagem's production is sold to the minority shareholders at a reserved price set by a valuer

from Switzerland employed on contract basis by RMC to value Kagem's emeralds before each auction. Whereas the small and medium-scale emerald producers have been obtaining consistent high unit prices for their emerald sales, Kagem's unit prices have been consistently low.

Furthermore, delivery procedures of emeralds from small and medium-scale producers to RMC is very cumbersome and final payments of emeralds delivered to RMC from these group of producers are made after auctions, sometimes after eight months. These inappropriate delivery and payment procedures could in part be the cause of the alleged smuggling by the small and medium-scale producers.

Zambia's New Economic Recovery, 1987-1988(50) indicates a potential increase exports of gemstones as one of the policies to stimulate the country's economic recovery. This implies that a lasting solution has to be found to the past and present inappropriate marketing practices.

Taking cognisance of the complex marketing structure of the gemstone industry, combined with the fact that small and medium-scale gemstone producers generally lack market intelligence and market facilities to market their gemstones, it is very necessary that a State Marketing Agency like RMC should negotiate the best possible prices

for less developed countries. This will ensure better prices for the small and medium-scale producers and help to maximize government revenue and reduce smuggling. The State Marketing Agency, should, however, not be an expensive buying-selling organization with high overhead cost. This will help ensure a high payment to small-scale producers and help to check smuggling. The Agency should set up a network of collection points close to the mines to purchase the gemstones.

Individual governments operating through such Agencies in any less developed country should assist their Agencies with enough finance to hold stocks and to pay small-scale gem producers after delivery and valuing of their gemstones. A mining bank could help to finance such operations as well as extend credit to small-scale gem producers. Holding stocks will help the Agency to formulate better marketing programme and therefore help to obtain better prices for the gemstones. In addition, gemstone buyers would be presented with gems from a particular less developed country and this will help avoid any collusive pricing between a buyer and a producer. An example was the situation in Zambia where similar grade amethyst sale prices varied considerably according to identity and country of origin of buyers. Gemstone export policies in less developed countries should also be

conducive to the industry and complicated administrative procedures should be eliminated.

Smuggling of gemstones is very common in less developed countries. Most less developed countries' currencies are over-valued and, as a result, only a proportion of real value of minerals(including gemstones) is paid to producers in local currency. Gemstone producers therefore, feel cheated. This situation contributes immensely to smuggling of the low-volume, high-value gems in the less developed countries. Any less developed country who wishes to check smuggling and therefore maximize its foreign exchange revenue, would have to pay producers shadow prices for their gems. Producers of gems should be given part payment in foreign exchange to assist them in equipment purchases, though equipment could also be made available to the small-scale producers on hire purchase basis. In addition, royalties and taxes in the gemstone industry should be minimal. Governments in less developed countries should assist to maintain tight security in gemstone producing areas. Security men should however be changed for example, after every six months.

The Gemstone Industry in Zimbabwe

The main coloured stones presently mined in Zimbabwe include: emeralds, aquamarine, cordierite(iolite), chrysoberyl, and some garnet. In addition, magnesite, howlite, aventurine quartz and calcite are mined for ornamental purposes.

The gemstone division of the Metal Marketing Corporation of Zimbabwe (MMCZ), a government marketing institution, does the marketing of all gemstones in Zimbabwe. MMCZ markets the gems in two forms:

- (1) Cut and polished (from better quality facetable stones)
- (2) Rough stones.

MMCZ operates an internal pricing system and producers are paid on delivery of their coloured stones. The internal prices fixed by MMCZ remains fixed over a period of time after which they are adjusted to reflect international market conditions.

Generally, Zimbabwe is doing well in its gemstone pricing and marketing, and Zimbabwe's mode of pricing and marketing is worth adapting by major gemstone producers in less developed countries who have no cutting and polishing

expertise.

The Gemstone Industry in Tanzania

The main gemstone found in Tanzania include: ruby, sapphire, emerald, vanadian zoisite(tanzanite), tourmaline, the gem variety of pyrope(rhodolite), amethyst, cordierite, zircon and diamonds.

The Tanzania Gemstone Industries Limited, (TGI), is a government marketing institution marketing all Tanzania gemstones. TGI cut some of the gemstones before marketing.

In brief,there has been an evolution of gemstone marketing n Tanzania mainly because of illegal dealings and other marketing malpractices(collusion) by producers and middlemen. As a result of such malpractices, the country has lost huge foreign exchange, and solution has to be found for such marketing malpractices in Tanzania by adopting the policies recommended in this study.

SHORT REVIEW OF PRICING AND MARKETING OF SOME MAJOR
GEMSTONE PRODUCERS IN DEVELOPING COUNTRIES

There is a tendency for gemstone producers to conceal information regarding their marketing systems for fear that other producers may take advantage of such knowledge. This is a reflection of the keen competition on the supply side of the world coloured stone industry. These major producers, Sri-Lanka, Madagascar and Brazil, were those whose marketing systems were available for the study. In each case there is a central marketing agency involved in pricing and marketing of the gemstones, and emphasis is put on maximizing the quality of cut gemstones before export.

CHAPTER 1

1. PRICING AND MARKETING OF MINERAL COMMODITIES

1.0 Introduction

Small-scale mines play very important role in world economies especially in economies of developing countries. It is estimated that small-scale mines produce about 10 per cent of global mineral output(57,58). In Chile, for example, 20 per cent of copper used to come from small-scale mines, and 100 per cent of all Sri-Lanka's gemstone is from small-scale mines(58). In addition, in less developed countries small-scale mines assist in the following:

- (1) Creation of non-inflationary type of employment.
- (2) Training and generation of foreign exchange revenue.
- (3) Development of infrastructure and other service industries.
- (4) Production of import substitutes and development of linkages, and
- (5) Non-expensive prospecting of mineral deposits.

Inspite of these advantages combined with the fact that small-scale mines require low investment and is less dependent on imported technology and equipment,

governments in most less developed countries have failed to give the small-scale sector the attention it requires.

One of the major problems facing small-scale mine operators in most developing countries is pricing and marketing of their commodities. Small-scale mine operators generally lack market intelligence and facilities and they are therefore handicapped in pricing and marketing of their products. The investment costs especially in most coloured stone operations are low compared to mining of other minerals. Since developing countries have low capital formation rates, those countries among the less developed countries with economically viable coloured stone deposits, should give priority in exploiting these coloured stone deposits. These operations will require little or no foreign dependence.

Most primary products in developing countries are exported. This is because internal demand to further process and produce consumer goods is small or has not been developed. For this reason, any study of problems of pricing and marketing of minerals from small-scale mining operations in less developed countries should also consider the problems of international commodity markets.

The problems of pricing and marketing of primary

commodities(including minerals) have become international economic issues,especially after the Second World War. This is because the world is increasingly not only concerned with how prices are formed, but also with the magnitude of prices as well as their stability. Internationally, prices are supposed to be fair both to producers and consumers and should create economic development in producing countries. These concerns led to the United Nations adopting a Declaration and Action Programme on the Establishment of a New International Economic Order(NIEO) in 1974.

1.1 Pricing and Marketing of Mineral Commodities:

The Traditional Approach

Micro-economic theory has traditionally been used to study the problems of pricing and marketing of mineral commodities. The theory presumes that no firm has control over prices, all firms are identical, exit and entry are limitless and costless, knowledge is perfect, and there is full utilization of resources. But in the application of theory to the problems of pricing and marketing of mineral commodities, it is necessary to bear in mind that there are a number of peculiar factors which directly influence mineral markets. These factors make a straightforward application of theory difficult. Essentially, mineral markets are characterised by:

- (1) the presence of monopolistically competitive producers organisations and cartels which inhibit free trade;
- (2) imperfect knowledge of the quantity and quality of mineral deposits;
- (3) difficulty of establishing and forecasting prices internationally;
- (4) the problem of how much to supply in the short-run and the long-run (conservation for future generations); and
- (5) control (or distribution) of mineral resources

As a result of these characteristics, it is difficult to find a universally accepted theory explaining how prices are formed and markets organised. Bosson et al. (1) stated that a problem of obtaining a universally applicable theory for pricing and marketing of mineral commodities is compounded by the fact that the underlying factors which determine prices are constantly changing. Labys (2) attributes this dynamic feature of price determinants to the following: the extent and conditions of recent changes in oil prices, which have drawn attention to the possibility of exhaustion and substitutability and their effect on price formation; persistent inequality in distribution of income between the rich and the poor countries which has drawn attention

to price formation as a means of income transfers; and the increasing awareness that international market prices are difficult to determine for minerals. This is because there are no "free commodity markets" of any substantial size for many of these commodities, and the fact that price estimates are vulnerable to transfer pricing.

Mineral resource exploitation and consumption play important roles in most economies. Mineral prices are a measure of potential gains from resource exploitation, and lack of accurate information on prices is a source of weakness and an obstacle to effective planning. The structural imperfections of the mineral market account for the lack of accurate information and are source of distortion in the price movements.

1.2 Developing An Appropriate Approach for Pricing and Marketing of Mineral Commodities

To analyse prices of any group of minerals, it is necessary to study: the market conditions; the market structure; and the market implications.

Mineral market conditions refer to these determinants which explain supply; demand; and trade pattern of particular group of minerals. Mineral market structure is related to the number of participants involved in the

control of market prices, demand, supply, investment and rent. The major determinants of the mineral market are: the number and size of buyers and sellers, barriers to entry, nature of product differentiation, extent of vertical integration, and multinational presence. Specifically, at the international level, mineral market structure is characterized to a large extent by the existence of large multinational mining companies, ownership of firms by host governments, and existence of producer organizations and cartels. Market implications relate to the impacts of the market structure on principal market participants and help to explain the division of gains among the market participants.

1.3 Market Conditions: Supply

Supply plays a very important role in mineral pricing and marketing. The main factors that affect supply are:

- (1) the rate of resource development and depletion.
- (2) economic conditions
- (3) geological conditions
- ✓ (4) technology
- (5) market institutions,
- (6) uncertainty
- (7) public policies and political considerations, and
- (8) the organization of the mineral industry.

These factors are related and the interrelationships and their effects are difficult to explain especially as they relate to the market in the short and long-run. Whereas long-run supply is based on resources, short-run supply relates to reserves and and rate of extraction. The existing productive capacity as well as the status of mineral inventory or stock are very important short-run supply factors. The conversion of minerals as geologic resources to minerals as economic goods present additional problems. The conversion process is a sequential process involving:

- (1) exploration
- (2) extraction and mineral processing, and
- (3) depletion as shown in Figure 1-1.

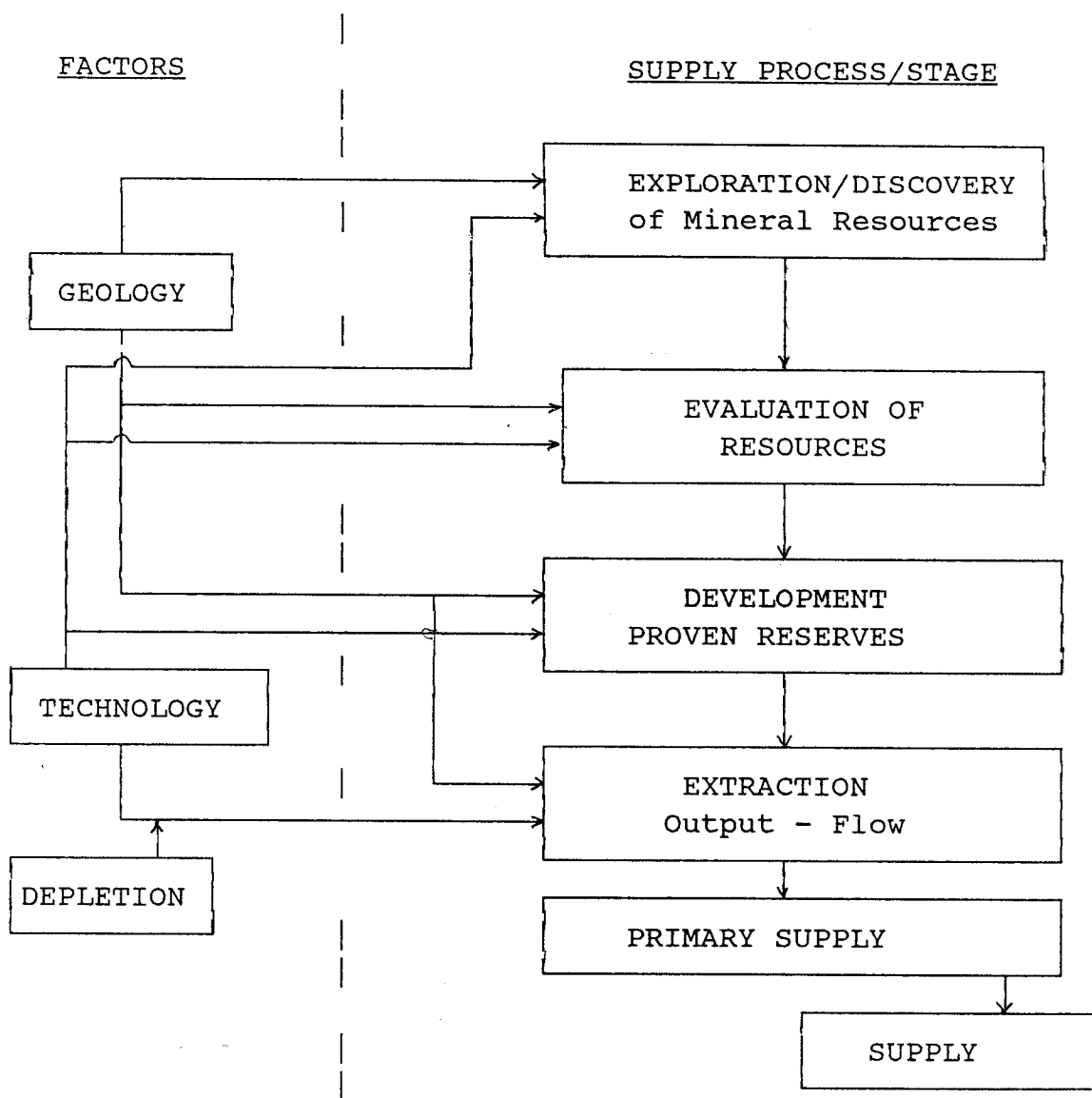
In some cases, Scrap is an additional important source of supply and can affect the conversion process.

1.3.1 Elements of supply

I. Resource Development

Resource development entails exploring and developing the deposit for subsequent mining and processing. Exploration is a process of resource identification with the aim of

FIGURE 1-1: THE (PRIMARY) MINERAL SUPPLY PROCESS



creating reserves out of resources. Resources include identified and unidentified deposits as well as identified deposits that cannot be recovered at the present price and level of technology. In contrast, reserves constitutes economically recoverable material in a particular deposits. A major problem in determining profitability of an exploration effort is due to the fact that the location, size, and grade of mineral deposits are rarely known accurately. This implies that the magnitude of potential revenue is uncertain.

Equally important in the definition of resources and reserves is a relationship between the uncertainty involved in the geologic discovery and the economics of exploiting a deposit. For a given deposit, the estimate would increase when a higher price or lower degree of certainty is accepted. Brooks(3) formalized this relationship through the use of a 2-dimensional diagram as shown in Figure 1-2. In Figure 1-2, the degree of geological uncertainty is shown on the horizontal axis and the degree of economic viability is given on the vertical axis. The degree of uncertainty Increases moving left to right as resources are classified as identified, hypothetical, or speculative. According to Brooks' classification, paramarginal and submarginal resources are classified as identified though sub-economic. Figure 1-2 gives detailed discription of the classification. The

Figure 1-2: CLASIFICATION OF MINERAL RESERVES AND RESOURCES

Quality of the Resource (Economic Dimension)	Degrees of certainty about the resource (Geologic Dimension)				
	Identified Resources			Undiscovered Resources	
	Proved	Probable	Possible	In Known Districts	In Undiscovered Districts
Recoverable under market and technological conditions	Reserves			Hypothetical Resources	Speculative Resources
Recoverable at Prices up to two times those prevailing now or with comparable Advance in Technology	Paramarginal Resources				
Recoverable at Prices two to ten times those prevailing now or with Comparable Advance In Technology	Submarginal Resources				

Totals: Potential resources= Paramarginal + Submarginal + Hypothetical + Speculative

Total Resources = reserves + potential resources

Resource base = total resources + other mineral raw materials

costs that indicate the extent to which a mineral is economically recoverable increase in moving from top to bottom in the figure. The above description implies that there is a relationship between exploration, resources, reserves and prices. Increased exploration for example reduces geological uncertainty, while improved technology of extraction makes some resources economical to mine.

II. Economic Determinants of supply

Major Economic determinants of supply are the market price of the product and the prices of the required inputs. Input costs are variable costs of production and fixed or quasi-fixed costs such as rentals of leased property or the cost of a new mine facility.

The application of either the pure theory of exhaustion or the theory of the firm for commodity price study reflects different conceptions of mineral prices and price mechanisms.

The theory of exhaustion pioneered by Grey(65) and formalized by Hotel in 1931 stipulates the possibility of a substantial future gains for hoarding mineral resources. The theory basically argues that, as long as demand for a product remains long enough to ensure depletion of a commodity as well as its close substitutes, market forces

will react to change the pattern of production from that which would occur in the absence of exhaustion. The following incentives to induce hoarding of exhaustible resources for the future generation are therefore given much emphasis(65). First, Hotelling advocated the possibility of sufficient higher price in later years. His reasons were that the anticipation of exhaustion will reduce production over time or rising demand will increase the willingness to pay higher future price. Second, Grey also stressed that, where marginal costs increase with output per period, reducing output can raise unit profits by lowering marginal costs. Third, technological progress can lower the marginal costs of any given output at any future time. Fourth, slowing depletion will conserve, not only more resources, but higher quality ones since they are mined first.

The theory of exhaustion among other things questions the efficiency of market processes. Gordon(65) argues that economic theory distinguishes a variety of conditions such as monopoly, imperfect institutions for financing risky investments, and taxes that distort economic choices. He agrees that these varieties of conditions produce inefficient use of exhaustible resources as well as non-exhaustible resources. However, he dismisses the existence of any additional special sources of inefficiency regarding exhaustible resources. Gordon(65)

concludes that if exhaustion is a major problem market developments should be creating incentives for hoarding and that the absence of such evidence suggests reasons to doubt the practical relevance of exhaustibility. Many technical experts seem to agree that the impacts of depletion are swamped by other forces and prices do not rise perceptibly because of exhaustion(65, 66). Some combination of technical progress in exploration, production, processing and use of greater than realized availability of minerals has prevented cost and price run-ups. It is worth noting however that, technology alone, cannot resolve all the related problems of the mineral commodity market. It is extremely important therefore, to appreciate mineral reserves as dynamic, and to note that they are affected by economic, sociological, technological, political and institutional factors(67).

The theory of the firm can therefore be used to explain the economic determinants of supply and their effect. Gross profit depend on: the price, cost, quantity as well as the quality of the mineral commodity produced and sold. The rates for short and long-run supply adjustments are determined primarily by:

- (1) an implementation lag
- (2) a technological or developmental lag,
- (3) an exploration lag.

- (4) productive capacity, particularly in case of short-run.

An implementation lag refers to the time between a change in price and reaction by a decision maker. This takes one to two years to implement. Price decline however, does not necessarily imply mine closure, since it is costly to discontinue operations if price is expected to rise again. Nevertheless, if the price decline is expected to exist for one or two years, then mining firms are likely to discontinue operations and output will fall. Such closure (4) will be due to the fact that variable cost is not covered and unit as well as total contribution to profit are negative at all positive outputs over the short-run.

Production also depends on how fast firms respond to price increase. Availability of excess mining capacity implies a rapid response by firms to expand supply when price increases. When output reaches full capacity price increases will not be followed by immediate supply increases and lags will therefore occur. Thus, once short-run capacity has been reached a very low price elasticity emerges though price elasticity subsequently increases with expansion of capacity in the long-run. (see Table 1-1).

Technological or developmental lag is the time required to place new techniques or new mining capacity into full

TABLE 1-1: PRICE AND INCOME ELASTICITIES FOR SELECTED
RESOURCE COMMODITIES

PRICE ELASTICITIES					
Commodity	SUPPLY		DEMAND		
	Short Run (1 year)	Long Run (3-5 years)	Short Run (1 year)	Long Run (3-5 years)	Income Elasticities
Aluminum/Bauxite	0	0.4	-0.13	-0.80 to 1.35	1.5 to 2.5
Cobalt	-	-	-0.68	-1.71	0.8 to 1.0
Copper	0.06	0.1	-0.3	Above 2.50	0.8 to 1.0
Iron	0	0.3	-0.1	-	0.7 to 0.9
Lead	-	-	-0.1 to 0.3	Elastic	0.1 to 0.3
Tin	0.19	0.44	-0.6 to 0.5	1.25	0.1 to 0.3
Tungsten	-	-	-0.15	-0.3	-
Zinc	-	-	-0.55	0.67	0.8 to 0.9
Petroleum	-	-	0.4 to 1.0	-0.7 to 1.6	-

Source: Labys: Market Structure, Bargaining, and Resource price formation, 1980

production. It varies between one and five years and occurs as a result of a sustained period of higher than normal prices. Factors affecting this gestation period are capital and skill intensity as well as the availability of infrastructure in the location of the investment.

Exploration lag refers to the time between the decision to explore new deposits and that of bringing the deposits to production. It is the longest and the most difficult period to assess. Where this lag is a large fraction of the time under consideration, it is irrelevant to be considered in the supply analysis. Cost of exploration however, affect short-run supply costs.

III. Secondary Production

In addition to primary supply, increasing environment disturbances as well as scarcity has resulted in an increasing dependence on secondary supply of minerals. The following are the main characteristics of secondary supply or scrap: First, scrap is derived from past production activities, and it accumulates as long as the rate of production is greater than the rate of recycling; second, secondary materials generated out of scrap from industrial production and movement of materials from the stock of existing products are generally independent of technological capabilities of primary deposit recovery; the amount of scrap usable also depends on technical

possibilities for scrap recovery and related cost and market conditions. There are three classes of scraps: Home scrap, which refers to scrap generated in the production of semi finished metal products; prompt industrial scrap are those created during the manufacturing of new products; and absolute scrap, which are generated as consequence of wear, damage or obsolescence of products.

Labys (2) stated that once obsolete scrap has been accumulated its use depends on cost-price consideration. Where the cost-price ratio is less than one, the materials are immediately used. He points out that the elasticity of price response is also an important factor. For prompt industrial scrap, response is fairly inelastic with all scrap being resold immediately over a wide range of prices. On the contrary, due to the processing requirement for most obsolete scrap, the elasticity is slightly higher. Furthermore, price response of obsolete scrap is becoming more elastic due to: the impact of environmental regulation on costs of primary supply; the more energy requirements of primary supply, and increases in royalty charges on primary supply.

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IV. Geological Conditions and Supply

Modes of occurrence (e.g. orientation), or variation in quality of mineral deposits are very essential in mineral supply. As previously discussed the cost-price dimension of the resource categorization is highly inter-related with the geologic dimension. Geological factors also affect long and short-run supply adjustments. Of importance in the latter case are ore grade, ore thickness and overburden.

V. Technology and the Supply Cycle

Depletion of mineral resources is accompanied by loss of high-grade readily accessible reserves. This results in increases in extraction costs over time. Technological innovations have an opposite and compensating effect. They cause real costs to fall. Technology has effected costs by increasing the usage of more abundant, low-grade resources. This has been achieved by:

- (1) Increasing reserves through the development of new resources.,
- (2) an improvement in recycling levels,
- (3) Increasing of recovery and utilization levels of by-products and coproducts,
- (4) the development of nondestructive approaches to

- mineral production, and uses,
- (5) assisting in protection of the environment, and
 - (6) Increasing the efficiency of level of utilization of the primary minerals(products)

VI. Institutions and Supply

Participation institutions also play an important role in mineral supply. Financial institutions for example, must not only be willing, but also capable of providing the capital needed to invest in the industry. And environmental organisations and laws are now having a lot of influence on mineral supply. In addition, mineral policies of governments and other political institutions also have an impact on mineral supply. The international mineral market supply, for instance, can be affected by policies concerning export taxes, export controls, or tariff barriers. Mineral supply can also be affected by activities of international organisations such as UNCTAD Intergrated Programme for Commodities(IPC). These organisations are concerned with export quotas, buffer stocks, compensatory financing, price indexation, multilateral contracts, and other measures which are designed to stimulate investment and to promote diversification.

VII. Uncertainty and Mineral Supply

Supply of mineral is uncertain. The uncertainty includes the uncertainty of the amount of mineral resources and the uncertainty of their discovery. At the development and extraction stages, uncertainties exist in as far as geological conditions are concerned. Uncertainty regarding the optimum marketing levels also leads to the frequent and wide price variations. Uncertainties arise also as a result of changes in cost of labour, energy and other factors.

VIII. Investment and Cost of Production

A. Investment

Prior to the final decision to develop a deposit a feasibility study has to be undertaken. The final stage of the investment cycle may come after extraction has begun. The geological characteristics will not be fully known until after the commencement of mining and this may require further exploration and modifications of mining and processing equipment.

Related to mineral investment is the question of desirable capacity levels and capacity adjustments. Costs-price relationships help in the assessment of profitability of

new extraction facilities. Bosworth(5) suggests that prices must approach cost in the long-run since deviations between the two will not provide proper capacity adjustments.

B. Cost of Production

Mineral production cost should be explained in relation to long and short-run period. The magnitude of the cost increase in the short-run depends on: the choice of appropriate mining and processing methods; the nature and degree of mechanization, which also dictates labour requirements; and the tonnage limitation. The geological and mineralogical aspects of the mineral involved are also important.

Long-run production costs are often determined by changes in resource quality and extraction technology. As resource quality declines overtime, lower grade deposits have to be exploited. In addition to the greater energy requirements, large volumes of ore has to be mined, transported and processed. Technological innovation however tend to offset these high production costs.

IX. Supply Organizations

In the mineral industry, production, processing and trading of mineral commodities is characterized by firms and institutions which have varying degrees of market power to influence market prices. This makes the application of competitive market model inappropriate in explaining mineral market behaviour. Industry concentration is normally computed as the percentage of total industry output from the largest firms and it helps to verify the presence of market power among particular mineral suppliers. Table 1-2 shows the market concentrations in some important metals. High market concentration is common in the mining industry. Among the factors contributing to high supply concentration in the mineral market are: economies of scale, absolute cost barriers, monopoly of technological knowledge, government policies, and control over resource commodity.

X. Market Power in Supply

Mineral producers do influence the mineral market substantially. Generally, it has been established that concentration and power of producers are more than that on the consumer side(2).

TABLE 1-2: CONCENTRATION IN INTERNATIONAL MINERAL
SUPPLY

	Number of Leading firms	Percent market share	Observations and Date
Copper	4	34.0	Mining capacity, 1975
	8	50.4	
Tin	4	50.4	Smelting capacity, 1976
	8	72.1	
Bauxite	4	38.3	Mining capacity, 1973
	8	56.4	
Iron	4	34.3	Mine Shipments, 1975
	8	56.6	

SOURCE: Labys: Market Structure, Bargaining, and Resource
Price formation, 1980

A. Competition

Market power and hence price influence exist and varies among mineral markets. Nevertheless, certain forces are present which tend to maintain a certain degree of competition. Among these are; division of interest among firms within a nation, the influence of secondary production of supply, desires to expand international trade, and the presence of competitive fringe firms which often surround the centre firms.

B. Monopoly

Within mineral markets, monopoly in the strict sense is non-existent. The examples which are often referred to are; the pre-world war II Aluminium Industry in the United States, where all aluminium ingots production were controlled by the Aluminium Company of America (ALCOA), and De Beers monopoly in the diamond industry.

C. Oligopoly

Supply power in the mineral market is between that of perfect competition and monopoly. One structure most frequently identified is oligopoly. To explain mineral prices therefore, we must evaluate underlying conditions that surround oligopolistic coordination of pricing and

output decisions. Sherer(6) identifies the following factors as those which perpetuate oligopolistic coordination: awareness that joint action will maximize collective profits; the relatively easy access to information among these few dominant firms; the awareness that price cuts will be promptly countered; and the maintenance of price discipline.

Labys(2) further endorses that pricing institutions which facilitate oligopolistic coordination include overt and covert agreement, price leadership, rule-of-thumb as well as focal point and tacit pricing. These other factors also facilitate coordination in the mineral industry. Some minerals have well defined grades or quality differentials, for example, copper, tin, zinc and silver. Others have a high degree of concentration at the export level, tin and iron are good examples. Other minerals also possess a relatively small competitive fringe, for example, aluminium(bauxite). Furthermore, some minerals have a history of price leadership and a high tendency to accumulate inventories, for example copper. However, oligopolistic coordination in pricing is not always possible, and some limiting factors are low concentration together with large competitive fringe, product heterogeneity, high proportions of fixed to total costs, substantial dependence on large and frequent orders, and lags in retaliation for price cuts.

The perception among suppliers especially in less developed countries that such cooperation can lead to higher profits has led to the formation of mineral producers organizations and other possible cartels. Among some governments in the developing countries, these producers organizations are seen as essential to the New International Economic Order (NIEO). These commodity cartel organizations have generally been unsuccessful. Some of the militating factors of their failure include; substitution induced by higher prices leading to loss of mineral markets, the high cost of stockpiling the minerals involved, the loss of cartel members' market to non-members, lack of substantial market shares, diverse interest among cartel members, and fluctuations in demand that prevent the maintenance of artificial prices especially in the long-run.

D. Analysis of Oligopoly Models

The attempt to explain price equilibrium using oligopoly models of price theory has been difficult. Varied and complex oligopoly models have therefore been suggested. Although it is difficult to link price equilibrium to cost and demand, explanation of price formation are possible. Scherer(7) mentions the more significant ones: Carnot's pure theory of oligopoly where a firm chooses to market that quantity of output which maximizes

its profits, assuming the quantities marketed by rivals to be fixed; Chamberlin's monopolistic competition theory where firms recognise their interdependence and set prices to maximize joint profits; Von Neumann's game theory approach where price formation satisfies conditions of the minimax strategy; the Hall and Hitch Sweezy theory of kinked demand where rivals hold prices constant when one firm raises its price but cut prices when one firm lowers its price (see Figure 1-3), and Salavunt application of Nash-Cournot bargaining theory where firm payments are minimized according to the nature of conditions formed.

Identifying common factors contributing to mineral price from such theories is not an easy task. What stands out however, is the tendency towards the maximization of collective industry profits. Yet such profit maximization is not easy to trace.

Scherer(7) confirms the pricing practices which facilitate oligopolistic coordination as: price leadership, rules of thumb pricing, and focal point pricing.

Price leadership is a practice where price changes are normally announced by a specific firm generally accepted as a leader by others who then follow the leader's initiatives. There are various modes of price leadership. Among these are: dominant firm price leadership; collusive

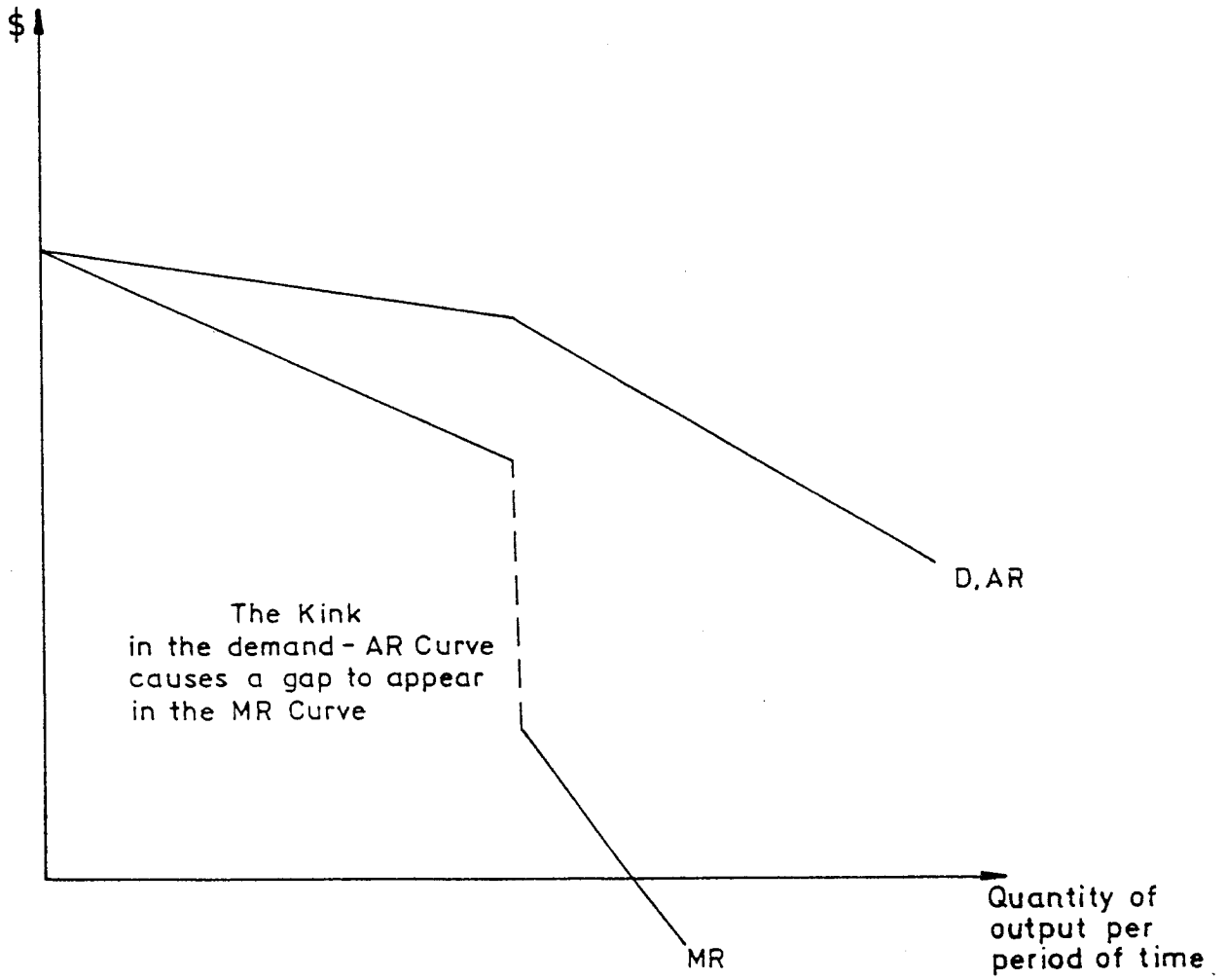


FIGURE 1-3 THE KINKED DEMAND CURVE

price leadership; and barometric price leadership.

Dominant price leadership occurs when the industry consists of few competitive fringe firms together with one firm controlling at least 50 per cent of total industry output(2). Collusive leadership is very common with mineral pricing. It requires that firms recognize their common interest in cooperate pricing and can therefore practice price discretion. In this case, one or several of the largest firms are dominant, and others follow. Peck(8) cites Aluminium Company of America to be the customary price leader because of its low costs as well as its large market share. Barometric price leadership is of a similar nature as collusive leadership, but the prices reached are not quite as monopolistic. According to Labys(2) barometric pricing has been suggested in the United States copper industry, but it does not exist in the international copper market. Rule-of-thumb pricing varies but normally follow full-cost or cost-plus pricing. In this case a desired profit or percentage return on investment capital is simply added to estimated unit cost to arrive at the commodity price. An advantage of this approach is that it can be employed to prevent price cutting where firms have similar costs.

Price leadership is however of a static, short-run nature. In the long-run, a firm will have to consider its price and profit-maximization policies for the following reasons. First, the long-run more elastic nature of a commodity implies a threat of competition from substitutes. Second, the dominant price leader's price may confer short-run profits on the competitive fringe firms who can expand their market at the expense of the dominant producer. As a result the market structure will depend more on the nature of the long-run costs. The dominant producer can however adopt low limit pricing technique to deter entry.

XI. Oligopolistic Industries and Transfer Pricing

Transfer pricing is commonly found in integrated oligopolistic industries. Demand power however, can lead to lower transfer prices, especially for the case of an oligopolistic market where sellers are too weak to confront strong buyers.

The meaning of transfer pricing is vague(2). This is because since firms can assign whatever prices they like to transactions within their domain, any of the traditional explanations of pricing therefore, becomes questionable. It is argued that although open market transactions involve sellers and buyers attempting to

maximize profits at each others expense, any intrafirm transaction reflects adjustment between two units to maximize joint profits. In effect, these firms use transfer prices to transmit profits, in the sense of maximizing them while minimizing risk and uncertainty. Transfer pricing practices and their effects on developing countries can be significant. In addition, their presence make the application of international trade theories less relevant. Transfer pricing, therefore, may not only limit exchange earnings from trade but may also prevent countries from pursuing areas of industrial developments suitable to their natural given factor endowments.

1.3.2 Market Conditions: Demand

Market conditions relating to demand include economic conditions, production technology, the derived demand level, changes in taste, product substitution, as well as demand side of market structure (and behaviour).

A typical mineral is utilized in many different products, and as a result there exist a diversity of demand stages. Gemstones may not fit very much in this description except those used for industrial purposes. These stages include primary or refiner's demand; intermediate; fabricators or manufactures demand; and final or consumers demand as shown in Figure 1-4. In other words, elements of demand

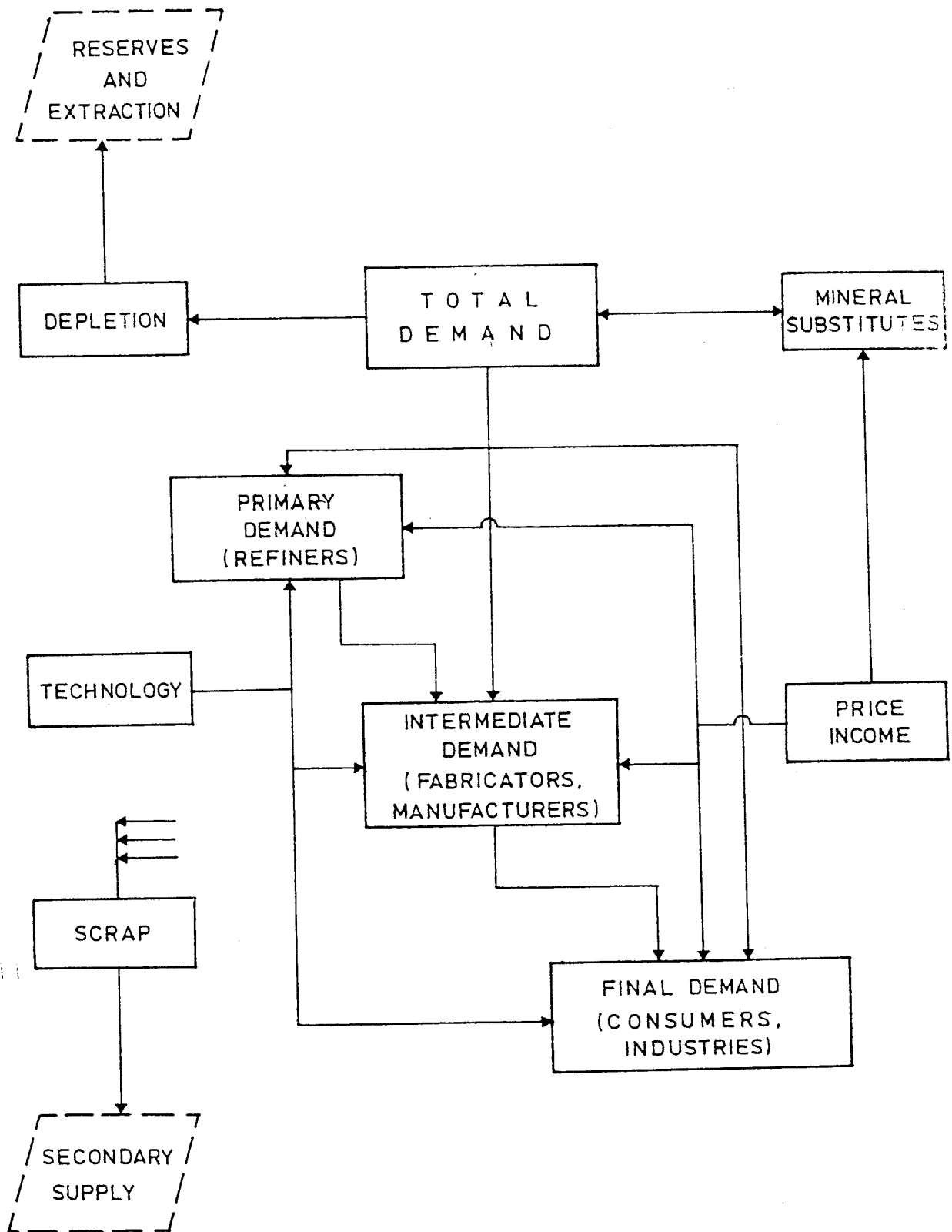


FIGURE 1-4 THE MINERAL DEMAND PROCESS

include: end-use structure, economic determinants, technology and substitution. In addition market organization of the particular mineral require important attention in demand analysis.

I. End-Use Structure

Mineral commodities have derived demand. Intermediate demand is derived from the markets for intermediate goods. The latter in turn are derived from the markets for final goods.

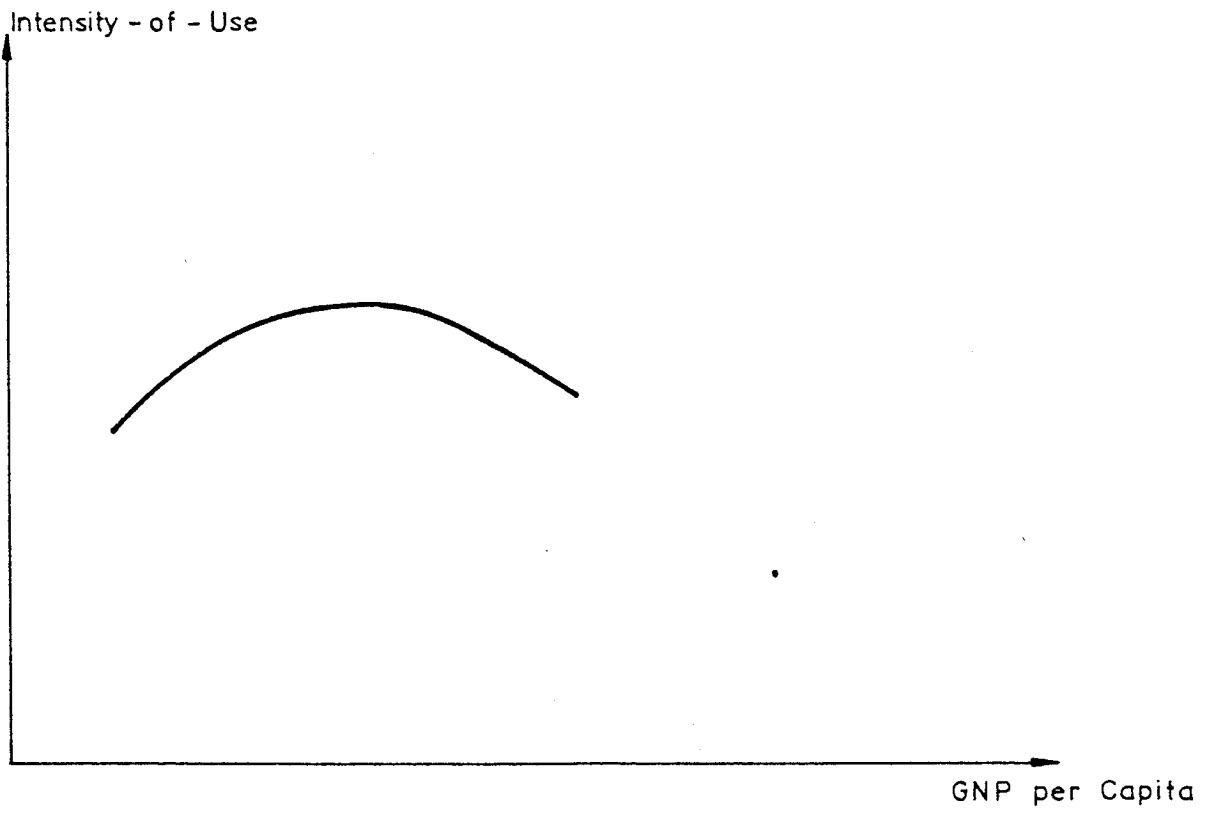
Also related to end of use is the intensity-of-use ratio which depends on the stage of industrial development. Nations in the initial stages of industrialization have high intensity-of-use ratios. Once the nation reaches a certain level of industrialization the ratios tend to decline (see Figure 1-5).

II. Economic Determinants of Demand

Major economic determinants of demand are: the price of the mineral commodity, the prices of substitutes and complements, the prices of other final demand goods; the prices of other material inputs and income.

The short-run demand for minerals is highly price inelastic. In this case, the end products use relatively

FIGURE 1-5 INTENSITY-OF-USE HYPOTHESIS



small amounts of the mineral to increase costs substantially. The cost of shifting to another mineral might be too costly, or the final consumer might consider the product as necessities. Changes in technology and substitution in the long-run however can make demand more elastic. Demand also changes with respect to changes in income, gross national product(GNP) or industrial activity. Increase in income(GNP or industrial output) will lead to greater demand for minerals and a decline in these factors will have opposite effect(see I under 1.3.2). Besides, energy has been one of the most important elements of production inputs. According to Labys(2), of all the energy consumed in the United States in 1972, 19 per cent was used in the production and processing of minerals. The higher energy prices are therefore contributing substantially to high mineral prices. As a result those minerals with a very high energy input may see a reduction in demand.

III. Technology

The role of technology as one of the most important elements of demand cannot be over emphasized. Since the demand for a mineral is derived from its use in the production of other goods, demand analysis requires the analyst to acquire technical knowledge of the user industry. Technology can provide a means for producers

to meet consumer preferences and requirements, and it can also affect changes in intensity-of-use ratio.

IV. Substitution

Demand for a minerals is positively related to the price of its potential substitutes. There are two main types of substitution. Functional substitution and product substitution. An example of the former is the replacement of copper by aluminium in the production of electrical wire or cable. A good example of the latter was the replacement of copper wiring in transmitters by a wireless transmitter.

Functional substitution is very common. Factors affecting the rate and direction of functional substitution are:

- (1) pricing and costs
- (2) technology
- (3) taste or quality
- (4) environment effects, and
- (5) availability

Several of these factors vary at the same time and as a result substitution is very difficult to explain.

Minerals which undergo functional substitution are mostly

those which have similar properties such as conductivity, ductility, and strength. Examples of such minerals are copper, aluminium, and iron as one group, and tin, zinc and lead as another. In addition, plastics are playing an increasing role in functional substitution. Plastics are now used more than aluminium, copper, lead and zinc combined(2).

V. Consumer Power

Consumers influence mineral prices. Little evidence has been gathered on consumer power. It has been established however that concentration and power of consumers generally are more modest than concentration of power on the producers side.

Sherer(6) suggests that most mineral refiners and fabricators sell their products to a large number of different industries and they are therefore, not so much dependent on few industrial buyers. Behrman(9) however, argues that market power among consumers in primary commodity markets exist since in most cases, buyers use the commodity as input in the production of products that are finally sold on markets with some market power. Applying the theory of countervailing power, Behrman argues that power in the supply side of a market creates the need for power on the demand side.

A. Monopsony

This refers to the case where the exercise of buyer power is in the hand of a single buyer. Monopsony can occur when a mineral is used more in particular end use sector than in another sectors. It can also arise where the buyer in question is not a consumer but a further processor. The buyer thus exhibits the same behaviour in buying as he would in selling. In this case, the aim of the buyer is to obtain the materials at the lowest possible cost. As a result, the monopsonist output level will be chosen with regard to its impacts on the demand for and the prices of these inputs. The demand curve reflecting this response will be a marginal curve that slopes downwards. Drawing upon price theory, the point of equilibrium of the monopsonist demand and marginal cost curve will result in input purchases smaller than those of a competitive industry or a group of ordinary consumers (2).

Approximating to this is the behaviour of De Beers in the diamond industry where it controls about 80 per cent of the diamond market mainly through purchases from other producers(27, 28).

B. Oligopsony

This is the case of buyer power that is of a concentrated group of buyers facing a large number of small sellers.

In mineral markets however, oligopsonists typically face a concentrated group of sellers. The bargaining strategy adopted by large buyers in the mineral market is that of threat and ability to integrate vertically upstream.

This threat therefore, forces sellers to hold prices near costs. The big buyers however find it advantageous in most cases to buy than produce their own requirements, and they are therefore likely to remain in this buying position.

The oligopsonist therefore look to bargaining devices which are reinforcing in nature, such as long-term contracts which can extend as long as thirty years. Sellers are also attracted to these arrangements since they help to: maximize the use of their production capacity, produce some cost savings, protect sellers from price fluctuations. Such contracting arrangements have been very common in sales arrangements among mineral producers and consumers. The underlying conditions regarding the behaviour of oligopsonists are similar to that of oligopolists previously discussed.

A good example of oligopsonistic market behaviour is observed in the bauxite-aluminium industry. The market is dominated by six major multinationals who have intergrated vertically from bauxite mining through smelting and even fabrication of aluminium end products. Three of the six multinationals are domiciled in United States and the other three are each managed from Canada, France and Switzerland respectively. Together they control more than 50 per cent of the Western capacity of bauxite, alumina and aluminium. There are also a small number of independent companies in the bauxite-aluminium market. However, the major multinationals in most cases produce less bauxite than they require at the alumina production stage. They acquire the remainder from the independent participants and in this process the multinationals exhibit oligopsnonistic market behaviour.

1.3.3 Mineral Market Structure

The major determinants of mineral market structure are: the number and size of buyers and sellers, barriers to entry, nature of product differentiation, extent of vertical integration and multinational presence. Labys(2) lists the participants in the mineral markets as:

- (1) Independent or non-integrated producers producing their own capital, management et cetera,

- (2) integrated producers including downstream marketing and processing,
- (3) government production and marketing enterprises,
- (4) producer cooperatives or state trading enterprises serving as a producer's agent to obtain a remunerative prices,
- (5) government market boards performing credit, collection, storage, shipping and other marketing functions,
- (6) private intermediate traders, brokers, and merchant firms specializing in international importing and exporting activities,
- (7) independent intermediate processors in exporting or importing countries,
- (8) multinational mining companies of a separate non integrated or conglomerate integrated type,
- (9) specialized trading organizations such as exchanges dealing in spot, forward, and futures trading,
- (10) financial companies such as banks and insurance companies providing finance for mining projects, and
- (11) governments of the producing and consuming countries.

I. Market Organization

Bain(10) categorizes the degree of market concentration as high, medium and low depending on quantity of minerals sold or bought by eight main firms in that industry. For high, medium and low market concentrations, the eight main firms should account for 80, 60 and 40 per cent of the industry's output or quantity purchased respectively. Competitive fringe firms can be considered small, medium and large if they number 5, 20 and 50 respectively. Bain suggests that highly concentrated oligopoly is one where the largest firms account for 70 per cent or more of the industry's output together with a medium fringe.

Barriers to entry refer to the advantage in cost or price which well established firms in the industry have over new firms seeking to enter the industry. Bain(10) suggests 3 levels of barriers to entry:

- (1) easy(no barriers),
- (2) moderately difficult(some barriers) or
- (3) blockaded.

These entry conditions have two main influences on market participants. First, a long-run limit on price can emerge, because established firms would not like to exceed that limit to forestall entry, and second, even when entry

is induced and competition exists, the firms taken together will not like price to rise beyond such limit.

In mineral market analysis at international level, the presence of multinational mining corporation (MNCs) requires very important attention. This is because their presence implies a gradual change of mineral markets away from competition towards more concentrated markets. MNCs are centre firms with diversified or conglomerate commercial and financial interests. They have control and access to a large proportion of mineral's sales, relevant technology, competent managerial ability, and capital for investments. Their power is further enhanced by their maintenance of favours with political groups in their home country as well as in the host country. Therefore, their power is not only related to their market share, but their influence on market structures is also derived from their secondary political and economic capabilities.

II. Measurement of Market Power

There are varieties of indicators which can be used to reflect market power. Among these are:

- (1) the share of raw material costs in final product prices,
- (2) the difference between prices and marginal costs.

The latter can help to detect distortions from competitive marginal cost pricing, yet acquiring the necessary data is a problem,

(3) long-run net profits can also reflect market power, yet data problems exist,

(4) the ability of trading parties to inflict losses on each other through negotiation can also be a

measure of market power, however, such information cannot easily be incorporated into power indices.

Alternatively we can examine the sensitivity of a firm's output to changes in prices of a competing firm, however, the measurement of such price elasticity present considerable problems.

Consequently the measurement of market power is generally undertaken in terms of market share. Concentration ratio is normally used for this purpose. In applying this ratio however we need to be cautious of the fact that counting the number of firms for a particular market suffers some deficiency. This is because the measure of market power depends on the size distribution of the firms as well as the definition of industry bounds. In addition, the actual domination of sales or purchases by a single firm does not necessarily imply the exercise of power or the control of a market.

There are four main indices used to measure market shares of producing or consuming units and hence market power. They include; Concentration Ratio, Gini Coefficient, Herfindahl-Hirschmann index, and Herfindahl-Gini Coefficient

A. Concentration Ratio (CR)

Concentration ratio reflects the percentage of total output of an industry accounted for by the largest units. These units can be producing or exporting countries or firms within a country or a market.

Let S = market share of unit i , the concentration ratio (CR) for n principal units is given by

$$CR = \sum S_i$$

$$\text{For } 1 \leq i \leq n$$

B. Gini Coefficient (GC)

Gini Coefficient is sometimes used to measure market power. Let S = market share of unit i , Gini Coefficient (GC) is constructed first by ranking the market shares in increasing order;

$$S_1 < S_2 < S_3 \dots < S_n$$

Sums are then taken in increasing steps

$$B_1 = S_1$$

$$B_2 = S_1 + S_2$$

$$B_3 = S_1 + S_2 + \dots + S_n$$

Let $Q_i = B_i/B_n$ and $P_i = i/n$

$$\text{Gini Coefficient(GC)} = \sum (P_i - Q_i) / \sum P_i$$

$$\text{For } 1 \leq i \leq n-1$$

This measures the unequal distribution of market shares. This index however suffers from the problems of instability in the choice of additional firms to be included in the computation. In addition, where there are few units with few equal shares, it gives the impression of little inequality and may give a false information regarding the market power.

C. Herfindahl-Hirschmann (HH) Index

This index is mostly used and is defined as the sum of squares of the market share of units.

Let S = market share of unit i , then

$$HH = \sum S_i^2$$

For $1 \leq i \leq n$

It has a value of one with only one unit, and it declines with increases in the number of units, but increases with rising inequality among any given number of units.

In addition, Herfindahl-Gini (HG) Coefficient defined as the square root of Herfindahl-Hirschmann (HH) index is occasionally used.

$$HG = \sqrt{(\sum S_i^2)}$$

For $1 \leq i \leq n$

Table 1-3 shows that for the commodities indicated there were high market concentrations for the exporting and importing countries. This is common in the mineral industry.

TABLE 1-3 PRINCIPAL CONCENTRATION INDEXES: EIGHT
EXPORTING AND IMPORTING COUNTRIES
RESPECTIVELY. 1972-74

Commodity	Year	EXPORTING COUNTRIES				IMPORTING COUNTRIES			
		CR	HH	HG	GC	CR	HH	HG	GC
Copper	1974	74.2	0.080	0.282	0.248	75.3	0.079	0.281	0.211
	1973	74.5	0.078	0.280	0.228	78.2	0.086	0.293	0.213
	1972	72.9	0.075	0.274	0.234	76.1	0.082	0.286	0.225
Tin	1974	90.8	0.272	0.521	0.615	82.6	0.125	0.354	0.414
	1973	92.6	0.276	0.525	0.634	84.3	0.143	0.378	0.458
	1972	93.8	0.251	0.501	0.606	85.9	0.168	0.410	0.507
Aluminium	1974	72.8	0.074	0.271	0.214	63.5	0.052	0.228	0.115
	1973	73.8	0.075	0.274	0.203	66.8	0.061	0.248	0.192
	1972	73.5	0.078	0.279	0.254	68.7	0.069	0.262	0.261
Iron Ore	1974	81.8	0.116	0.341	0.394	93.9	0.209	0.457	0.527
	1973	80.8	0.133	0.336	0.391	94.4	0.218	0.467	0.548
	1972	82.8	0.108	0.328	0.321	95.1	0.222	0.471	0.534

SOURCE: Yearbook of International trade statistics,
Vol. II, 1975 (New York: United Nations, 1976)

1.3.4 Market Implications

At the international level market implications normally examined relate to the host governments in developing mineral exporting countries and foreign mineral investors. We examine how gains in the market are divided, and how this has been affected by the evolution of bargaining amongst participants in the mineral market. Labys(2) identifies the following underlying factors as relevant to mineral market implications:

- (1) resource export dependence,
- (2) magnitude of investment,
- (3) nature of technology,
- (4) control over reserves and production,
- (5) opportunities of increased processing,
- (6) material share in product prices,
- (7) obsolescing bargain,
- (8) nature of competition, and
- (9) government learning.

I. Resource Export Dependence

Dependence implies that a country relies heavily on one

1.3.4 Market Implications

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- (5) opportunities of increased processing,
- (6) material share in product prices,
- (7) obsolescing bargain,
- (8) nature of competition, and
- (9) government learning.

I. Resource Export Dependence

Dependence implies that a country relies heavily on one

or at most several export commodities for the majority of its foreign exchange earnings and export income. Dependence can be indicated by:

- (1) the commodity concentration of a country's trade
- (2) the growth in export earnings from primary mineral commodities,
- (3) the change in the terms of trade taken on a single commodity basis, and
- (4) the instability of a country's earnings resulting from price and quantity fluctuations in the export level.

Such resource export dependence is very common in less developed countries. This is as a result of lack of internal demand base for these primary mineral commodities in the less developed countries. The lack of alternative exports of other products, for example, of industrial, or agricultural nature, compounds the dependence problem. It further explains in part the less developed countries inability to influence the prices of primary commodities in the international mineral markets, even when there are few dominant producing countries.

In addition, the foreign exchange earnings of these developing countries are mainly derived from primary commodities. These foreign earnings are so critical for

financing imports and other government operations that they put pressure on the developing countries to increase mineral commodity exports irrespective of mineral prices.

II. Magnitude of Fixed Investment

Generally, the initial fixed investment capital requirement for the mining industry is very large. According to Bosson(1) the trend toward massive mining projects has resulted in investment requirements often above 250 million US dollars, and in addition, mining investments of 500 million and 1,000 million US dollars are not uncommon. Table 1-4 gives a typical investment requirements for mining and processing facilities in 1975 US dollars. To decide a country's ability to finance such mining projects, the required investment value can be compared to the value of the country's domestic product, the mining sector's contribution to that product, and the gross domestic investment. Depending on whether the fixed investment is relatively large or small, we can judge the country's ability to invest in such projects. See Table 1-5. The fixed investment requirements for bauxite is large (Some diamond projects as already discussed have similar investment requirements). For instance, the expansion cost for the Boke deposit in Guinea in 1977 was estimated as 400 million US dollars(2).

TABLE 1-4 TYPICAL CAPITAL INVESTMENT REQUIREMENTS
FOR MINING AND PROCESSING FACILITIES

Mineral and Facility	Capital Investment Per Metric Ton of Annual Output (U.S.A. Dollars)
ALUMINIUM	
Bauxite Mining	25 - 85
Aluminium Refinery	200 - 750
Aluminium Smelter	1,000 - 2,800
COFFEE	
Mining, beneficiating, smelting, and refining	3,000 - 5,000
LEAD	
Smelter and expansion	100 - 500
NICKEL	
Mining and smelting	8,000 - 15,000
ZINC	
blast furnace and electrolytic refining expansion	300 - 700

SOURCE: Bossen, The mining industry and the developing countries, 1977; Labys, market structure, bargaining, and resource price formation, 1980.

TABLE 1-5 COMPARISON OF BAUXITE INVESTMENT
REQUIREMENTS AND OTHER ECONOMIC
INDICATORS (1972 MILLION US DOLLARS)

Country	GDP ^a	MS ^a	GDI ^c
Jamacia	1497	175	3
Guinea	344	26	8
Guyana	264	43	88

SOURCE: Labys, Market structure, Bargaining and
resource price formation, 1980.

^a Gross domestic product, 1972

^b Mining sectors contribution to GDP, 1972

^c Gross domestic investment, 1972

Comparing such costs which are typical of the bauxite industry with the Gross domestic investments of the respective countries in Table 1-5, it is obvious that these countries cannot finance such projects. In such situations foreign investors play very important role and in addition possess high initial bargaining power. Note that Jamaica, Guinea and Guyana are among the major bauxite producing countries in the world.

III. Nature of Technology

When the required technology of the mineral to be exploited is complex and change rapidly, it is difficult for a host developing country to provide such technology so as to share in the resource production and ownership control. In such cases foreign firms especially multinational mining companies play important role. On the other hand, for simple and stable technology, the host developing country has a better chance of processing downstream and therefore to add more value to the commodity.

IV. Control Over reserves and Production

Control over reserves and production also dictates benefits of participants in the mineral market. Most developing host countries have several devices of extending mineral control. Among these are:

- (1) expanding their shareholding in a firm,
- (2) organizing state owned mining firms, and
- (3) establishing trading enterprise to coordinate domestic production and sales with external purchases.

V. Opportunities of Increased Processing

Processing helps to add value to a product and therefore helps to increase foreign exchange earnings. The processing sector also establishes linkages within the domestic economy thereby increasing employment, income etc. As previously discussed technology plays a very important role in processing. Labys(2) reported that of the total exports of mineral commodities from the less developed countries to the developed countries only 10 per cent is semi or fully processed.

According to Smith(11) a host government can induce the foreign investor to construct processing facilities in several ways; first, the parties can come to an agreement when signing the contract that processing facilities are to be constructed by a certain date; second, the government may require the firm to undertake a feasibility studies on processing facilities; third, the government may offer tax incentives, such as refunding some or all of the taxes collected during the first few years of operation, on condition that the firm will use the money to construct processing facilities, or offer tax holidays to profit accrued from processing. The host government may also levy tariffs or quotas on raw materials leaving the country and raise protective tariffs on imports. Furthermore, the government may also require the foreign

investor to offer output to any local processor, at a price not higher than that sold to other buyers.

Nevertheless, the developing countries' attempt to increase processing should be analysed in the light of the nature of technology involved, the tightness of the industry integration, tariff and non tariff barriers, as well as other restrictive trade practices.

VI. Material Share in Product

Mineral producers stand a better chance of increasing prices when the cost of these raw materials used as inputs for other products is relatively small compared to the finished product sales price. The share of raw material cost in final product price depends on two main factors. First, it depends on the value added by the mineral producer through processing. Second, it is related to the value added later by the buyer before the final sales. The mineral producer's share is likely to be higher, the higher the value added through processing. The producer's share will be inversely related to the value added later by the buyer before the final sales.

VII. Obsolescing Bargain

Vernon(12) describes obsolescing bargain as a process whereby the foreign investor and the host government change position regarding bargaining power. Whereas initial risk and uncertainty in mineral investment give the foreign investor initial stronger bargaining power, with time, as these uncertainties decline the foreign investor's position becomes weaker. Thus, the host government can re-adjust agreements regularly with foreign firms. The process adopted by host government on this include; pressures for negotiations, surtaxes recomputations, and adjustments. As a result there has been an evolution from increased taxation to increased equity participation and finally to outright nationalization in most developing countries.

VIII. Nature of Competition

The extent to which new firms can enter markets and reduce any oligopolistic or monopolistic power is a good measure of the competitiveness in that market. The nature of competition in the market where raw material buyers sell their products is also important. A buyer is likely to give a strong resistance to raw material price increases depending on whether the buyer has to bear the price increase himself, or he can pass these on by way of

higher prices of his sales.

In this perspective, it would be advantageous for primary resource sellers to trade with processors or buyers who have a strong market power in the market where they finally sell their products. Furthermore, the lower the price elasticity of demand of the final product, the better the bargaining power of the raw material producer.

IX. Government Learning

Government learn mostly by improving their understanding of the industry and also by acquiring improved negotiation skills.

Ert(13) points out that government learning leads to tighter and more equitable contracts in developing countries. Governments in less developed countries have therefore increased their participation gradually in mining operations. This has led to increase in both ownership and managerial control. Moran(14) confirms that because of government learning, foreign investors now face tax rates ranging from 60 to 90 per cent, in addition to, demands for local ownership, local control over marketing, and negotiation of profit remittances irrespective of the original contract.

1.3.5 Price Formation

Mineral prices are a measure of potential gains from mineral resource exploitation. It is therefore essential for estimating future revenues available for development in the developing countries that are producers of minerals, and for their balance of payments. Mineral prices are also essential for the formulation of policies for the most effective utilization of the world's mineral resources; for the evaluation of mineral and alternative investment projects; for the assessment of measures for commodity price stabilization schemes; and for the management of stockpiles. Price forecast are made for different purposes. It can be for the short-term (even daily) by speculators, or for the long-term (e.g. 10 to 30 years) taken by many producers and by national and international organizations concerned with resource development, management and planning. It can also be for issues related to the stabilization of prices, for instance, UNCTAD concern on the Integrated Programme for Commodities and the Common Fund. The integration of market conditions, market structure and market implications provides a realistic basis for mineral marketing and price formation.

I. The Choice of Reference Price

The choice of reference price for mineral commodity analysis has posed problems over the years. The following price modalities have been observed:

A. Spot Prices

Spot prices refer to prices of contracts which demand immediate delivery of the commodity on the spot. These prices are also referred to as cash prices in situations where cash payment is required.

B. Forward Prices

To avoid disruptions in processing and intermediate production, commodities required as inputs are normally contracted for by forward transactions. Future prices are used in these transactions. They relate to contracts which specify delivery at some future time.

C. Future Prices

Future prices apply to contracts which specify forward delivery and also facilitate transfer of liability. In this case, speculators in the market

provide the required hedging or risk coverage.

D. Arms Length Prices

This price modality refers to quotation between individuals, firms, and other private organization on the open market.

E. Producer and Consumer Prices

Producer prices refer to prices quoted by producers on domestic sales whereas consumer prices are those paid by consumers for domestic purchases.

F. Base Price

Base price when used for contracts normally refers to a stated degree of quality or purity and always include a sliding scale for deviations from standard.

G. International Prices

These prices represent the values placed on primary commodities produced at one stage and subsequently included in the production at another stage. These prices are commonly used in vertically integrated industries.

H. Transfer Prices

Transfer pricing refers to the pricing of goods traded within some multinational enterprises, and refers to the use of internal prices which represent the prices arbitrarily placed on commodities produced at one stage (by a firm) that are then embodied in production at another stage. (15,16)

J. Accounting Price

This is an internal price which includes all internal cost but may or may not include tax elements.

K. Prices Relating to Government Contractual Arrangements

These are price quotations relating to price ranges set by government arrangements. These transactions refer to multilateral or bilateral contracts.

L. Free on Board(F. O. B.) And Cost, Insurance
And Freight(C. I. F.) Prices

F. O. B. and C. I. F. prices are export and import prices respectively. These prices are commonly known and are used as indicators in the absence of reliable open-market prices.

Given the wide range of prices, the important consideration is the appropriate one to be selected by the *price analyst*. *In addition to the problem of determining which price modality to adopt, there is also the problem relating to the change of the share among these modalities.* For instance, Bosson (1) reports 1960's iron ore marketing modalities as: about 40 per cent between importers (steel companies) and captive mines abroad; another 40 per cent took the form of long-term contracts of up to 20 years; and 20 per cent occurred on a modality somehow similar to a free market. Several solutions have been suggested to deal with these price modality problems. The first, is to compute a price index which involves the weights of prices and quantities traded within each modality or submarket. This approach has a defect regarding the long-term contract prices. They depend on the provision of each contract, including the terms of marketing, investment, and processing as well as mutual concessions agreed upon by the parties involved.

In such situations, if the mineral of interest is quoted on the London Metal Exchange(LME), or on the Commodity Exchange(COMEX) in New York, then these futures markets can provide alternatives. Even though the volume of transactions may be marginal on these public exchanges, they provide a good reference prices. The marginal transactional volume prevailing on these commodity markets is due to the fact that participants accept LME prices, especially, as basis for contracts particularly for tin and copper. There has been disagreement among experts regarding the usefulness of futures transactions prices. Empirical findings however, support their use though there can be inherent theoretical biases(68). When the mineral has neither a futures market nor a producer price, Metal Bulletin price quotations have been used. However, caution is required with some minerals because of variation in grade and degree of beneficiation, including the trend towards trading in concentrates. F.O.B. and C.I.F. prices can also be used as indicators in the absence of reliable open-market prices.

II. Price Trends and Fluctuations

By examining the patterns in mineral price formation we can gain further insight into mineral price formation.

A. Basic Price-Making Forces

Considering market conditions, traditional theory states that mineral supply and demand interact to determine an equilibrium price. The first problem in applying this theory is that of distinguishing between short and long-run equilibrium prices. As previously discussed, supply and demand inelasticities in the short-run are responsible for the price swings that occur with shifts in quantity. Since shifts in supply occur less frequently for mineral commodities, it is primarily demand shifts in response to changes in business cycle in the industrialized countries that tend to dictate price fluctuations.

Though determination of price ultimately involves the reconciliation of demand and supply, inventories held by the consumers or by the producers, and national and international stockpiles require important considerations. The major link between short-run and long-run price formation is inventory. Mineral inventories are held for

precautionary, transactions, and speculative motives. To avoid substitution, producers might hold inventories as a precautionary measure against swing in prices. Due to the strategic nature of resource commodities, consumers also hold inventories for precautionary reasons. Transaction motives relate specifically to inventory demand. Consumers need to maintain inventory consumption ratios at a certain level to ensure continuous production processes. Speculative stock holding is mainly for making capital gains and it is therefore influenced by price expectations. In a concentrated market structure, inventories are more likely to be used to support an orderly pricing structure. In addition to its use as a buffer, inventories also serve as a feedback for future production planning.

In the long-run, the role of inventories diminishes. Supply as well as demand are more price elastic though there are long time lags involved. Higher prevailing prices will lead to increase in development of previous short-run non-profitable deposits. The rate of exploration may also increase. On the demand side higher prices will cause consumers at the intermediate levels to shift to production functions in the long-run which utilize less expensive substitutes. The impact of these adjustments on long-run prices formation will depend on

the feedback prices on quantities. The degree of increase in mineral production cost will depend on factors previously discussed. Inflationary trend in both domestic and foreign economies are also relevant. In brief, we observe that, the forces which are dominant in mineral price determination are dynamic and they differ in the short and long-run perspectives.

CHAPTER 2

2. COLOURED STONES AND DIAMONDS (GEMSTONES)

2.0 Introduction

Gems may be described as those specimens of minerals used for personal adornment that possess beauty, rarity, and durability. Gems are grouped into two main classes; diamonds and coloured stones. In the jewellery trade the term "coloured stones" in the broadest sense refers to all gem minerals and organic materials, other than diamonds. In the narrower sense however, pearls are also classified separately from diamonds and coloured stones. Diamond is considered separately⁽¹⁷⁾ for several reasons. First, diamond in its finer qualities is usually nearly colourless whereas the finer qualities in major gem minerals are coloured. Second, the physical and optical properties of diamonds are sufficiently different from other gems and these make diamond's beauty and use totally distinctive. Unlike good quality coloured stones, diamonds have been constantly available in both quality and quantity to permit standardization in general marketing procedures and pricing. Furthermore, the subsequent competition in diamond sales has demanded a specialization that has not required of individual coloured-stone species. The cutting techniques and

marketing of diamonds are also totally different from those of coloured stones. Consequently, it is impractical to treat diamonds and other gemstones collectively other than at the retail sales level.

2.1 Precious and Semi-Precious stones

In the jewellery trade, the term semi-precious stone when used to describe a gem is rather ambiguous and confuses a great number of potential buyers. This is because it gives the impression that the value of these stones is low. But in the jewellery trade "semi-precious" stones may be just as expensive as any other gemstones. The term "semi-precious" is therefore incorrect and the Gemmological Society of America does not authorise its usage. However, as a matter of current practice the term "semi-precious" will be used for purposes of statistics.

2.2 Classification of Gemstones

In the classification of gemstones, each mineral that produces gemstone is termed a gem species. A gem species is characterised by a definite chemical composition and usually a characteristic crystal structure. Most species however, include a number of different types of material with variations that are usually based on colour, transparency or other phenomena. Each of these different

types is called a VARIETY. Equally important in gemstone classification is the term "GROUP". A group is a number of closely related species having the same crystal structure but with variations in chemical composition. Table 2-1 gives a detailed classification of gemstones.

TABLE 2-1 IMPORTANT GEM SPECIES AND THEIR VARIETIES

<u>MINERAL GROUP</u>	<u>MINERAL</u>	<u>VARIETIES</u>
	Diamond	bort(z), carbonado
	Corundum	ruby, sapphire
	Beryl	aquamarine, emerald, morganite, goshenite
	Chrysoberyl	alexandrite
Spinel	Spinel	pleonaste
	Topaz	
	Zircon	
Tourmaline	Elbaite	
	Dravite	
	Tsilaisite	
Garnet	Almandine	
	Pyrope	rhodolite
	Spessaritite	
	Grossular	tsavolite
	Andradite	demantoid, topazolite
	Uvarovite	

TABLE 2-1 IMPORTANT GEM SPECIES AND THEIR VARIETIES
(CONTINUATION)

<u>MINERAL GROUP</u>	<u>MINERAL</u>	<u>VARIETIES</u>
	Taaffeite	
	Quartz	rock crystal; citrine; rose; smoky; amethyst; aventurine; sagentic quartz
	Chalcedonic	chalcedony, agate;
	Quartz	carnelian, sard, heliotrope (bloodstone) chrysoprase
Olivine	Peridote	
	Chrysotile	
Epidote	Zoisite	tanzanite
	Jadeite	
	Nephrite	
	Spodumene	hiddenite, kunzite, triphane
Feldspar	Microcline	amazonite
	Labradorite	
	Orthoclase	
	Oligoclase	sunstone and aventurine feldspar

TABLE 2-1 IMPORTANT GEM SPECIES AND THEIR VARIETIES
(CONTINUATION)

<u>MINERAL GROUP</u>	<u>MINERAL</u>	<u>VARIETIES</u>
	Turquoise	
	Lazurite	lapis lazuli
	Opal	common, fire, black, white
Organic		amber, jet

2.3 Coloured Stone-Market Conditions

2.3.1 Production

Accurate production statistics are regularly published for the diamond industry. But, accurate statistics for coloured stones are not readily available. There are a number of reasons accounting for this lack of statistics covering the coloured stone industry. This is partly because production operations in the major producing countries are relatively small. Secondly, there is no central buying organization such as exists in the diamond industry. And, finally, there is a tendency for the small operators in the coloured stone industry to conceal information of both production and sales figures. In many countries producing coloured stones, operators conceal