

CHAPTER XVI

GOLD AND GOLD INVESTMENTS

I. Introduction

Gold has enjoyed a reputation as a good medium to store value, since Ancient History. In an Egyptian tale from the eleventh century BC, the wandering hero Wen-Amon goes to Lebanon to buy lumber to build a barge. As payment, he carries sacks of gold and silver. The first gold coins are believed to have been minted by King Gyges of Lydia (in today's Turkey) in 670 BC. The Lydian coins bore the essential features of today's gold coins. They were made of small, precisely measured pieces of gold, they were stamped with the figures of lions and other beast -the seal of authenticity of prominent Lydians. Soon the Greek city-states copied the Lydian concept and Greek gold and silver coins were routinely used by people and merchants around the Mediterranean Sea. Five hundred years later, Julius Caesar minted gold coins to pay the Roman Legions. The portability, durability and divisibility of monetary metals helped to make these metals a store of value. Not long ago, gold and silver were money. A gold or silver standard exists when a country's currency and its banking are based to some degree on the value of gold or silver. Governments either used the metals as coins or defined their currency in terms of weights of gold and/or silver. When these metals are equivalent to money, the money prices of gold and silver, by definition, do not change.

Example XVI.1: When the U.S. was on a gold standard, a USD 20 gold piece was legally worth USD 20. ¶

Today, in most countries, money is *fiat money*. Fiat money is unbacked money, a unit of domestic currency can not be returned to the Central Bank and exchanged for a tangible commodity, such as gold. Gold has been relegated to being a commodity traded worldwide. For many investors, gold is still regarded as an investment that represents the ultimate store of value. When a fiat currency prevails and when gold and silver trade freely, returns from metals are computed like those on any other investment. If gold rises in price from USD 280 to USD 300 an ounce, it is correct to say that the investment provided a 7.14 percent return.

Over long periods of time, gold and silver have had real returns near zero. Their effectiveness as a long-run inflation hedge, and as insurance against economic and political disruptions, make them interesting candidates for a well-diversified investment portfolio. Gold represents between 5 and 10% of a typical European or Middle Eastern portfolio. Ibbotson, Siegel and Love, in a paper published in the Journal of Portfolio Management in 1985, estimate that gold bullion represents 5% of total investable world wealth.

Gold investment could be done through the following vehicles:

- Coins (primarily, for small investors)
- Gold bullion
- Bonds
- Mining equities and gold mutual funds
- Futures and options

There are alternatives to gold, as a long-run hedge against political and economic disruptions. The list should include:

(1) Precious stones, stamps, rare coins, paintings also offer similar features as gold (store of value), however, they are not very liquid investments.

(2) Real estate (private housing, commercial, or agricultural properties). Local taxes, paperwork, liquidity concerns and political factors make real estate a different investment.

In Table XVI.A, we show the returns on different tangible assets and on financial asset from 1970-1991.

TABLE XVI.A
Returns on Tangibles vs. Returns on Financial Assets

| June 1970-June 1980 | | June 1981-June 1991 | |
|---------------------|-------------------|---------------------|-------------------|
| Asset Class | Annual Return (%) | Asset Class | Annual Return (%) |
| Oil | 34.7 | Stocks | 16.0 |
| Gold | 31.6 | Old masters | 15.8 |
| U.S. coins | 27.7 | Bonds | 15.2 |
| Silver | 23.7 | T-bills | 8.8 |
| Stamps | 21.8 | Chinese ceramics | 8.1 |
| U.S. farmland | 14.0 | Housing | 4.4 |
| Old masters | 13.1 | CPI | 4.3 |
| Housing | 10.2 | Foreign exchange | 3.6 |
| CPI | 7.7 | Stamps | -0.7 |
| T-bills | 7.7 | U.S. farmland | -1.8 |
| Foreign exchange | 7.3 | Gold | -2.9 |
| Stocks | 6.1 | Oil | -5.9 |

The 70's were a period of high inflation, economic uncertainty and political disruptions (Vietnam War, Watergate, oil shocks, Iran crisis, etc.), while the 80's were a more stable period.

In 1994 (and updated in 1996), James Turk estimated that the total aboveground gold stock was 107,717 metric tons (see James Turk monograph "Do Central Banks Control the Gold Market?," published by Free Market Gold & Money.). The distribution of the aboveground gold stock is displayed in Table XVI.B.

TABLE XVI.B
Distribution of World Gold Supply (1996)

| Use | % |
|------------------------|----|
| Official Reserves | 31 |
| Private Bars and Coins | 9 |
| Monetary Jewelry | 31 |
| Fashion Jewelry | 19 |
| Industrial and dental | 10 |

Source: Free Market Gold & Money Report (www.fgmr.com/gold.htm).

Golden Puzzle

Almost 40% of the worldwide aboveground gold stock is held as a pure reserve of value. Mining stocks are liquid instruments that give the rights to gold underground. Why don't central banks and investors buy the rights to gold underground instead of the physical gold? After all it's cheaper to leave the gold underground.

1.A The Gold Market

The center of world gold trading is London. The London Bullion Market Association (LBMA) operates the London Bullion Market. The LMBA has 14 members acting as market makers and almost 50 members acting as ordinary dealers. The gold market is a highly liquid, 24-hour-a-day market for the purchase or sale of gold. Price quotes in the spot market are expressed in USD, and are quoted as the price per fine troy ounce.

The gold market has a benchmark price: the *fixing* price. The fixing of the gold price starts at 10:30 AM and again at 3:00 PM. The London gold price fixing takes place in the "fixing room" of the firm of N. M. Rothschild. Five individuals, one each from five major gold-trading firms, are involved in the fixing. Each representative keeps an open phone line to his/hers firm's trading room. Each trading room in turn has buy and sell orders, at various prices, from customers all over the world. The fixing lasts until a single price representing an equilibrium between supply and demand is found, usually, a couple of minutes after the fixing starts.

The London fixing price allows all market participants to deal on equal terms, and large volumes to be transacted at a single price. Transactions at the London fixing price are carried out with a fixed bid-ask spread. A seller on the fix receives the fixing price plus USD .05 per ounce of gold. A buyer on the fix pays the fixing price plus USD .25 per ounce of gold.

Most gold is traded "loco London," which means the gold is sold for delivery in London. Spot delivery take place in terms of London *good delivery bars* on the spot date, which is the second business day after the trade date. The good delivery bars are a benchmark standard set by the LBMA for spot gold

transactions. According to the LMBA standard, a good delivery bar should weight between 350 and 430 fine troy ounces.

Example XVI.2: On October 9, 1997, the *Wall Street Journal* published the following quotes for Cash Prices of Gold.

PRECIOUS METALS

Gold, troy oz

| | | | |
|------------------------------|---------|--------|--------|
| Engelhard industrial bullion | 332.82 | 333.16 | 382.65 |
| Engelhard fabric prods | 350.50 | 349.82 | 401.78 |
| Handy & Harman base price | 332.60 | 331.95 | 381.35 |
| Handy & Harman fabric price | 349.23 | 348.55 | 402.00 |
| London fixing AM 331.90 PM | 332.60 | 331.95 | 381.35 |
| Krugerrand, whol | a335.00 | 333.00 | 382.00 |
| Mapple Leaf, troy oz. | a344.50 | 342.50 | 394.00 |
| American Eagle, troy oz. | a344.50 | 342.50 | 394.00 |

Although the price is quoted in USD per ounce, trade must take place in terms of a number of gold bars. The standard amount for a dealer spot ten 400 oz. bars, or 4,000 ozs. of gold.

Example XVI.3: Oro Lindo, a Mexican firm, sells the standard amount at the dealer's bid rate of USD 332.60. This transaction amounts to:

$$10 \times 400 \times \text{USD } 332.60 = \text{USD } 1,330,400.$$

In two business days, Oro Lindo receives USD 1,300,400 and delivers, 4,000 ozs. of gold at one of the bullion clearing houses. ¶

1.B The Motivation for Investment in Gold

For centuries, gold has been regarded by investors as the best-possible protection against unexpected inflation and social, political or economic crises because it can be easily traded in world markets at any time and its real value increases during crisis.

Example XVI.4: Gold kept its real value during the U.S. stock market crash from 1929 to 1932 and the London Stock Exchange collapse in equity and bonds from 1973 to 1975. ¶

In general, gold allows an investor to diversify against the kind of risks that affect all stock markets simultaneously. For example, in 1973 and 1974 bullion price tripled when stock markets worldwide dropped dramatically during the oil crisis - the U.S. stock market dropped by 50%. On the other hand, in 1997 and 1998 bullion price depreciated by 13 percent per year, while the U.S. stock market appreciated by 30% per year. Several studies have shown the existence of a small or negative correlation between gold and stock prices. For example, the monthly correlation coefficient from 1975-1994 is .056, in the U.S.; -.027, in the U.K.; and .031, in Japan.

To illustrate the diversification benefits of gold, Table XVI.C compares the risk and return of a portfolio

invested in stocks (S&P 500 and MSCI World Index) with a portfolio of 90% stocks and 10% gold.

TABLE XVI.C
Risk and Performance of Simulated Portfolios
Monthly U.S. dollar returns, 1971 to 1989

| Portfolio | Risk (%) | Return (%) |
|------------------------------|----------|------------|
| 100% Gold | 26.4 | 14.2 |
| 100% S&P 500 | 16.2 | 9.9 |
| 100% MSCI World Index | 14.4 | 13.8 |
| 90% World Index and 10% Gold | 13.6 | 14.0 |

There are two things to notice here:

- (1) Purchase of gold-linked assets usually reduce the variability of returns on a diversified portfolio because they tend to appreciate when other securities depreciate (and viceversa).
- (2) The low or negative correlation does not eliminate risk.

In many years, gold and stock prices move in opposite directions, but in others they move in the same direction. This was the case in 1981, when U.S. gold, stock, and bond prices dropped together. This co-movement usually happens when real interest rates rise.

Example XVI.5: In a paper published in the journal of the International Gold Corporation, in March 1984, E. J. Sherman found that gold prices are related to the acceleration of inflation. In Table XVI.D we report the main result's from Sherman (1984)

TABLE XVI.D
Differential Rates of Return in Different Countries

| | Gold CPI | Gold Stocks | Gold Bonds | Stocks CPI | Stocks CPI |
|-----------------------------------|-------------|----------------|---------------|---------------|---------------|
| Accelerating inflation, 1977-1980 | | | | | |
| U.S. | 34.3 | 33.1 | 46.0 | 1.2 | -11.7 |
| U.K. | 19.7 | 10.7 | 20.9 | 9.0 | -1.2 |
| Japan | 31.1 | 25.7 | 33.8 | 5.5 | -2.7 |
| Decelerating inflation, 1980-1983 | | | | | |
| U.S. | -14.9 | -24.6 | -16.6 | 9.7 | 1.7 |
| U.K. | -6.6 | -28.5 | -14.7 | 16.1 | 8.1 |
| Japan | -12.9 | 24.4 | 17.9 | 11.5 | 5.0 |
| Total, 1977-1983 | | | | | |
| U.S. | 7.8 | 4.2 | 11.2 | 3.6 | -3.4 |
| U.K. | 8.0 | -4.0 | 4.3 | 12.0 | 3.7 |
| Japan | 7.6 | -0.6 | 3.4 | 8.2 | 4.2 |

Gold returns and Inflation: Inverse Relation

Gold prices outperformed other investments in periods of accelerating inflation, but underperformed them in periods of decelerating inflation.

Because gold is a highly volatile investment a small investment in gold provides a good protection against inflation. In a global portfolio, gold is primarily used as an instrument for long-term risk protection.

A theoretical comment

In modern portfolio theory, a small or negative beta implies that the expected return on gold should be small. For example, a negative beta caused by a negative correlation between gold and the market portfolio implies, in the CAPM, that the expected return on gold should be less than the risk-free interest rate.

II. Gold Price Determinants

In a sense, the price of gold should be easy to forecast. The product is well defined. Gold is a tangible international asset with a limited supply. The current estimate of the total past worldwide mining extraction is approximately 100,000 metric tons. The supply sources are clearly known and reserves can be estimated. The major demands are clearly identified: carat jewelry, industrial needs, coins and investment.

In Table XVI.E we present some historical supply and demand figures. (Source: <http://www.bullion.org.za>.)

TABLE XVI.E
Annual Supply and Demand for New Gold (in metric tons)

| Year | 1987 | 1996 |
|-----------------------|------|------|
| Supply | | |
| Mine Production | 1733 | 2345 |
| Old Gold Scrap | 470 | 644 |
| Official Sector Sales | 18 | 239 |
| Gold loans | 55 | 0 |
| Forward sales | 72 | 0 |
| Option hedging | 22 | 96 |
| Implied disinvestment | 0 | 163 |
| Total | 2370 | 3490 |
| Demand | | |
| Carat Jewelry | 1334 | 2807 |
| Other Industries | 334 | 420 |
| Coins and Medallions | 207 | 63 |
| Bar hoarding | 259 | 181 |
| Gold loans | 0 | 5 |
| Forward sales | 0 | 14 |
| Implied Investment | 236 | 0 |
| Total | 2370 | 3490 |

Supply and demand determine the price of gold. The supply/demand gap determines if prices go up or down. In the second quarter of 1999, the price of gold dropped by 5% when several Central Banks - among them the Bank of England- announced plans to sell their gold reserves. And as gold prices change, prices of gold-linked investments also change. For example, in the first quarter of 1996, as the gap between supply and demand widened to an estimated 700 metric tons, prices of gold mutual funds increased by almost 20%.

We should be careful when we consider the supply flows in the market. An axiom among gold traders is that most of the gold that's ever been mined is around somewhere: in bank vaults, jewelry boxes, etc. Thus, mine output doesn't have to match demand. In 1995, in fact, a third of the 343-ton supply deficit was made up by sales from central banks and from fabricated above source. The other two-thirds was

covered by "forward sales" by mining companies. A forward sale is a contract by which miners borrow gold from banks, sell it, and eventually replace the borrowed bullion with new-mined gold.

We need to build a model for supply and demand.

(1) Supply: It is a function of technological considerations, South Africa extraction policies, and the political situation in sensitive countries. Official sales may also be induced by monetary and balance-of-payments problems.

Supply has been growing during the past 10 years, as seen in Table XVI.E. The supply from South Africa, however, has been decreasing during these years. In 1987, South African mines produced 607 tons, or 35% of total world production. More recently, in 1996, South African mine production decreased to 494.6 tons, or 21% of total world production. The ex-Soviet Union countries, Canada, the U.S., Peru, Chile, Australia, Indonesia, Philippines and Papua New Guinea have been the source of growth. For example, the second gold producer, the U.S., has increased its gold production from 154.9 tons in 1987 to 393.3 in 1996. In addition to the increase in mine production, during the 1990s, several central banks have been selling their gold reserves.

(2) Demand: Industrial demand depends on technological innovations and the discovery of cheaper substitutes. Jewelry is sensitive to short-term gold price movements as well as fashion. The investment demand for gold is determined by political events and expectation of future price movements.

Overall, jewelry is the major source of gold demand. The jewelry demand, historically, has been fairly stable. The demand for industrial needs is also stable. Nevertheless, jewelry demand has seen recent increases due to changes in consumer's tastes. In the first half of 1996, jewelry demand went up 10%, while industrial demand increased by 5%.

Gold analysts suggest that the investment demand for gold is heavily influenced by interest rates. Gold is most attractive to buyers in times of low interest rates. The opportunity cost of gold is the interest foregone on the investment. Recall that gold, in the retail market, provides no income, the sole return is through capital gains. In general, price expectation that are not directly linked to income flows are quite volatile, which explains the large volatility of gold prices.

From (1) and (2), it should be clear that substantial changes in gold prices are mainly driven by supply considerations or political events. For example, the last tightening in gold's global supply/demand picture created a big jump in the price of gold. In the first half of 1993, the price of bullion increased over 30% in less than a month due to the tension fostered by the war in Bosnia.

2.A The Valuation of Index-Linked Securities

Gold bonds, gold mining equities and gold mutual funds are found on several national markets. The value of these securities is, in effect, linked to an index: the price of gold bullion. The indexation is explicit for index-linked bonds, but implicit for gold mining equity and gold mutual funds.

2.A.1 Valuation of Gold Bonds

Gold bonds have a long history. During the 1800s, foreign governments, companies and states routinely issued gold-backed bonds. For example, in the U.S., the State of Mississippi issued a 6% gold bond in 1833. Many U.S. railroad companies financed their expansion through gold bonds. For example, the Galveston Houston & Henderson Railroad Company issued gold bonds in 1855. The bonds had a 10% coupon and were issued in denominations of USD 100.

Today, governments faced with large interest rate risk because of high inflation have often been forced to offer loans with coupons or principal indexed to either the price of a specific good -dollar, for example- or a global inflation index.

Example XVI.6: Inflation index-linked gilts have been introduced in the U.K. The Argentinean government has issued several bonds index to the U.S. dollar (BONEX). The Mexican government has issued bonds linked to the price of oil (Mexican Petrobonos). ¶

Gold bonds are attractive because they give an investor the choice of investing in either the index or the bond.

Example XVI.7: The Indian government issued in March 1993 gold bonds, which matured in March 1998. The bonds were issued in denominations of 10, 50, 100 and 500 grams. The Reserve Bank of India (India's central bank) was required to pay a lumpsum interest at the rate of 40 rupees per each gram of gold on redemption of the bond. ¶

Refinement International, a U.S. corporation, issued a 3.5% gold-indexed bonds for 1981 to 1996. Each bond is worth 10 ounces of gold, and the coupon is worth .35 ounce of gold. Lac Minerals Ltd., a Canadian company, issued 8% debentures for 1984 to 1989 with warrants. Each warrant entitles the holder to buy 0.5 troy ounce of gold for Lac Minerals Ltd., at a price of USD 230.

The French government issued two gold bonds: the Pinay and Giscard. The Pinay is a 4.5% bond issued in 1973 with expiration date 1999, which is indexed to the Napoleon, the French gold coin. The Giscard may be thought of as a bond that is reimbursed in full at maturity in the form of 95.3 grams of gold (or rather, its value at the time) and pays coupon worth 6.67 grams of gold every year. Although payment is made in FRF, the amount is solely determined by the gold price during the month of payment. If the bond sold at par, it would amount to a bond yielding exactly 7% in real gold terms.

The valuation formula for the Giscard may be written as

$$P = C_g G_1/(1+r) + C_g G_2/(1+r)^2 + \dots + C_g G_n/(1+r)^n + FV_g G_n/(1+r)^n, \quad (\text{XVI.1})$$

where

G_t : is the expected price of gold at time t

C_g : is the gold content of the coupon (6.67 grams in our example)

FV_g : is the gold content of the redemption value (95.3 grams)

r: is the discount factor, or nominal YTM
P: is the price of the gold bond.

Strictly speaking (XVI.1) holds only on the day of coupon payment. A more precise formula would take into account the exact number of days before the next coupon payment. Moreover, we do not consider taxes.

The value of the bond depends on both the current gold price and the long-term expectation of its value. Suppose we assume the price of bullion follows a trend with a yearly price appreciation rate of $\alpha\%$. Suppose at time $t=0$, the price of gold was G_0 . Therefore,

$$G_t = G_0 (1+\alpha)^t. \quad (\text{XVI.2})$$

Therefore, replacing (XVI.2) into (XVI.1) yields,

$$P = G_0 C_g \sum_t (1+\alpha)^t / (1+r)^t + G_0 FV_g (1+\alpha)^n / (1+r)^n. \quad (\text{XVI.3})$$

As a result, we may define the real gold return, p , on the bond as

$$1/(1+p) = (1+\alpha)/(1+r) \text{ or}$$

$$p \approx r - \alpha.$$

This means that P is a function of the real rate of return p , where r and p are the nominal and real YTM, respectively, and α is the expected rate of increased in the price of gold. With gold-linked bonds, expectations of future gold prices play a role similar to that which the term structure of interest rate plays in valuing a coupon bond. There is no long-term futures market for gold, and thus, no direct way of determining the equivalent of long-term market interest rates, that is, long-term expectation of gold prices. The best we can do is use equation (XVI.3) to derive an implicit measure for market expectations of long-term gold values.

The Giscard is influenced by two factors:

- i. fluctuations in the nominal rate r ,
- ii. changes in the long-term expected gold price appreciation α .

The value to use for r is not straightforward. Most analysts use the YTM on a straight government bond of the same maturity.

At the end of 1983, the Giscard offered a real gold return of approximately 8%. This gross return is quite attractive when compared to a direct investment in gold bullion with a zero return. In addition, because the French ingot price adjusts to any fluctuation in French currency, this bond is not exposed to currency risk.

A gold bond follows short-term movements in gold prices with an elasticity, or *gold beta*, of approximately one. We define the gold beta as the percentage return on an investment following a 1%

gold price appreciation, a traditional measure of return elasticity.

Straight bond prices do not follow short-term interest rate movements, but rather long-term movements. Similarly, a gold bond can soften gold spot price volatility thanks to the long-term price expectations built into the indexation clause.

Finally, we should note that like any other gold bond, the Giscard bond *does not* offer leverage over gold. Instead, it is an index-linked bond contingent on the present and future prices of gold.

2.B Gold Mining Equity

In Graph XVI.1 we show the relationship between gold mining share prices and the price of gold.

GRAPH XVI.1
Comparative Performance of Gold Bullion and FT Gold Mines Index
1972 to 1989

[FIGURE XVI.1]

There is a high correlation between the two series, although the stock index amplifies movements in gold price. The yield on gold shares was very high over the period (10 to 20%), given the mines payout policy, which is not taken into account in the graph.

Gold mines are also paper securities, the value and coupon of which are linked to gold prices. These securities differ from index-linked bonds in that the indexation clause is not fixed by contract, but it depends on mining economics. The mining industry is probably the simplest activity to describe in a valuation model.

Mine earnings (E) depend on the quantity of gold sold (Q), the gold price received (G) and the total cost per unit (C),

$$E = Q (G-C) \quad (\text{XVI.4})$$

To value the mine (P), we assume a dividend policy with a fixed percentage of distributed earnings, d .

$$P = d \sum_t Q_t (G_t - C_t) / (1+r)^t$$

Our next question is how the mine stock price reacts to a change in gold bullion price? Or in other words: What is its gold beta? A gold beta may then be obtained by regressing stock returns on percentage changes, r_t , in gold prices over a recent period:

$$r_t = \alpha + \beta(dG/G)$$

Gold betas find their origin in the technical aspects of mining activities. Different betas are the result of the differences in cost structures found among mines because of their differential influence on mine earnings.

Example XVI.8: A Western Area mine, in South Africa, has a cost per ounce produced of USD 331. When the price of gold is USD 381 per ounce, like in October 1996, Western Area mines make a USD 50 profit per ounce. When the price of gold is USD 335 per ounce, like in October 1997, Western Area mines make only a USD 4 profit. That is, if the price of gold decreases from USD 381 to USD 335, the profits of Western Area mines decrease by 92%.

Yandan, a Queensland mine, in Australia, has a cost per ounce produced of USD 214 (AUD 271). At a gold price of USD 381 per ounce, Yandan makes a USD 167 profit per ounce. At a gold price of USD 335 per ounce, Yandan makes a USD 121 profit. That is, if the price of gold decreases from USD 381 to USD 335, the profits of the Yandan mine decrease by 28%. ¶

Now, we will formalize the gold beta concept. Assume that production plans at a given mine are set, and wages and other costs are fixed. That is, Q and C are constant. Then, by total differentiation of (XVI.4), the percentage change in earnings (dE/E) depends on the percentage change in the gold price (dG/G) and a multiplier, b , defined for each mine as:

$$(dE/E) = b (dG/G).$$

It is straightforward to show that $b=1/[1-(C/G)]$. The multiplier b is also called *operating leverage*. It helps us measure the short-term potential of a mine if gold prices change.

Example XVI.9: High-cost mines, like Western Area mines, may have a ratio of total cost to gold price (C/G) of .87 per ounce; that is, a profit margin of 13%. Thus, the operating leverage, b , equals 7.69 ($=1/.13$). Then, a short-term 10% increase in the price of gold would push earnings up by 76.9% as long as both the quantity produced and cost remain constant.

On the other hand, a low-cost mine, like Yandan, may have a C/G ratio of only .56, for a profit margin of 44%. Thus, the multiplier is equal to 2.27 ($=1/.44$). The lower multiplier would push earnings up by only 22.7% when gold prices increase by 10%. ¶

South African gold mines tend to have higher than average production costs. Therefore, the value of South African gold mine should be quite sensitive to the price of gold. For example, during the gold price increase of 1993, Lexington Strategic Investments Gold Fund increased in value by 270%. Lexington is the only gold mutual fund that invests virtually all of its assets in South Africa. The reverse is also true, when gold prices drop South African gold mines tend to fall in value faster than their peers.

Table XVI.F gives recent estimates of average operating leverage and average ore grade. The lower the ore grade is, the higher the ratio of cost to revenue.

TABLE XVI.F
Statistics on Gold Mines: Estimated Present Value Statistics

| Mine | Cost/ounce produced (dollars) | Life (years) | Ore Grade (grams/ton) | | Working profit | Estimated ^a gold price sensitivity |
|-----------------|-------------------------------------|-----------------|--------------------------|------|-------------------|---|
| | | | max | min | | |
| Blyvooruzicht | 220 | 9 | 7.5 | 5.8 | 51.3 | 18 |
| Buffelsfontein | 219 | 21 | 9.1 | 5.6 | 59.6 | 22 |
| Deelkraal | 340 | 25 | 7.0 | 4.6 | 10.8 | 84 |
| Driefontein | 124 | 48 | 13.0 | 11.0 | 128.7 | 12 |
| Elandsrand | 245 | 32 | 9.0 | 5.8 | 40.3 | 37 |
| Grootvlei | 262 | 14 | 3.9 | 2.6 | 17.1 | 25 |
| Harmony | 319 | 15 | 7.5 | 7.1 | 68.9 | 14 |
| Kinkross | 203 | 17 | 6.2 | 5.3 | 45.9 | 17 |
| Kloof | 121 | 22 | 15.4 | 12.8 | 158.2 | 13 |
| Libanon | 235 | 21 | 6.2 | 4.1 | 30.1 | 20 |
| President Steyn | 218 | 16 | 6.7 | 5.0 | 45.1 | 18 |
| Randfontein | 147 | 28 | 7.0 | 5.0 | 48.1 | 18 |
| Sitlfontein | 291 | 12 | 6.6 | 5.7 | 285.5 | 18 |
| Southvaal | 128 | 26 | 11.3 | 6.0 | 117.1 | 14 |
| St. Helena | 217 | 19 | 6.0 | 5.2 | 45.0 | 18 |
| Unisel | 159 | 15 | 7.5 | 7.1 | 68.9 | 14 |
| Vaal Reefs | 218 | 26 | 8.4 | 6.0 | 57.9 | 20 |
| Western Areas | 331 | 23 | 5.1 | 4.8 | 11.5 | 46 |

Note:

a: It is the percentage change in distributable earnings in the second financial year for a 10% increase in the gold price. It is equal to 10 times the multiplier b that we have defined in the text.

We should note that the operating leverage and gold betas are not constant. Gold betas vary with the price of gold. Higher gold prices reduce the multiplier, b , and the elasticity, β . Gold costs and production plans change with time. Gold costs can exhibit high variability from year to year. The ore grade (grams of gold per ton) of a mine might substantially change from year to year.

Example XVI.10: In 1992, Yandan's cost per ounce was over AUD 350. However, in 1995 the cost per ounce decreased to AUD 189, while in 1996 they increased to AUD 268. ¶

Financial newspapers routinely publish stock prices of gold mining companies. For example, *Barron's* publishes, in a special column, quotes for South African ADRs. The majority of those ADRs are gold mine stocks.

Exercises:

1.- Krang Or issues a five-year Eurobond with the following characteristics:

- (a) Par value 100 gold ounces. Each bond is issued and repaid in dollars at the market value of 100 ounces of gold.
- (b) Annual coupon payment of the dollar market value of three ounces of gold.
- (c) Maturity of five years with no early redemption.

A few days after the issue, the bond yield on straight dollar Eurobonds for issuers of the quality of Krang Or is 10%. The price of gold is USD 300 per ounce. The gold-linked bond sells for USD 31,000. What can you say about the market expectation of gold prices?

2.- Assume you believe in the CAPM. The beta of gold relative to the market portfolio is -0.2. The risk-free rate is 6% and the market risk premium is 5%. Therefore, your current expectation of the market return is 11%, which is consistent with the long-term historical estimate of the market risk premium. What is the expected return on gold? Give an intuitive explanation for such a low expected return.

3.- Assume you are a U.S. investor who wants to invest USD 20,000 in gold. The current price of gold is USD 310 and you expect it to go up by 5% in the very short term. You consider buying gold mines, you hesitate between Oro Lindo and Barra de Oro. Your broker gives you the following information:

| | Oro Lindo | Barra de Oro |
|------------|-----------|--------------|
| Cost/Ounce | 110 | 350 |
| Gold Beta | 2.2 | 5.5 |

The gold beta is obtained by running a regression of the gold mine stock price changes on the gold bullion price changes. It indicates the stock market price sensitivity to gold. Which mine would you buy and why? What is your expected return, given your scenario?

4.- You expect the price of gold to decline by 20%. You want to take a derivative position to profit from your expectations. Near-delivery futures contracts are quoted at USD 290 per ounce with a margin of USD 1000 per contract of 100 ounces. Call options on gold are quoted with the same delivery date. A call with an exercise price of USD 295 costs USD 7 per ounce.

- (a) What is your expected return at maturity of both contracts (assuming a 20% decline in gold prices)?
- (b) Simulate the return of the two investments for different prices of gold.
- (c) Would you prefer in-, at-, or out-of-the-money options?

5.- Table XVI.B shows that 40% of the gold stock is stored. Investors trade property rights on gold mines (mining stocks). Why does people buy gold to store it, instead of leaving the gold underground and trading property rights on those underground reserves?