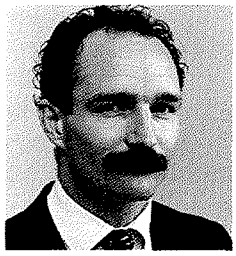


Daniel Daugaard

Tom Valentine

FUTURES Golden triangle OPTIONS SWAPS

Australia's position as a major gold producer makes it a likely market for gold risk management products. Goldmining companies face extraordinary price volatility in addition to their exposures to fluctuating interest and foreign-exchange rates. Risk-management products enable them to reduce the variability of their earnings or to take positions when appropriate. Determining the precise value of different risk management products is a difficult task requiring complex models. However, it is quite easy to establish a useful valuation benchmark for the products. In this article, ***Daniel Daugaard*** *and* ***Tom Valentine*** *show how forward gold prices are created and how they can be used to evaluate other risk management products.*

Australian goldminers can use risk-management techniques to increase the stability of their profits and make themselves more attractive to equity investors and lenders. A further benefit of effective risk management is that producers are able to make direct improvements to their operating performance by focusing management resources on core activities.

The valuation of risk-management products is causing a great deal of confusion, not only for goldminers, but also for their lenders and the legal profession. Some transactions may appear to be bargains but turn out to be onerous obligations; other opportunities may be neglected because they seem unattractive, when in fact they would be beneficial.

The simplest risk management product is a gold loan in one of two basic forms: the structured term loan for goldminers or a loan in the interbank gold market with a typical maturity of three months. The two forms have similar characteristics, the main difference being the credit enhancements required for a goldminer's loan.

Gold loans are a source for gold producers of funds to cover operating costs, as well as providing a hedge against a falling gold price. The standard gold loan structure consists of the borrowing of gold and the repayment of the gold plus interest in the form of gold. Interest is usually compounded quarterly and is known as a gold fee. Diagram 1 illustrates this typical structure.

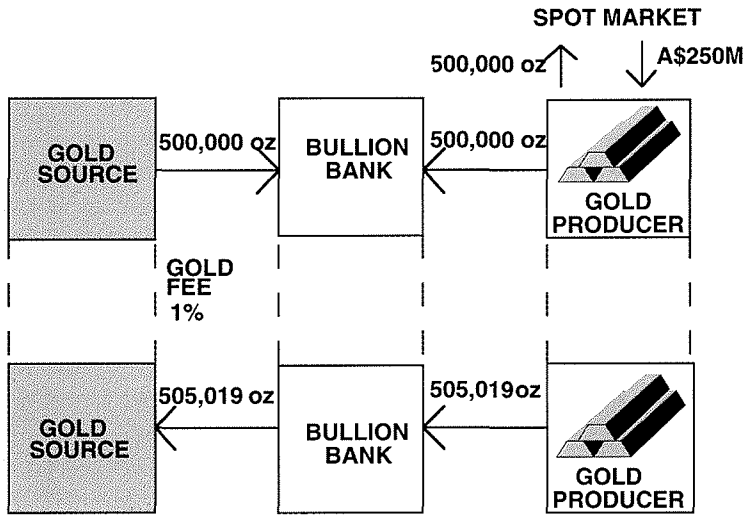
In the diagram, a gold source has lent 500,000 oz of gold and will receive 505,019 oz of physical gold (ie, $500{,}000 \times (1 + 1\%/4)^4$) as repayment of the loan in one year's time. The gold source might be a central bank desiring to earn a return on its gold holdings or a bullion bank taking a view on the price of gold or making use of existing stocks.

The bullion bank illustrated in Diagram 1 is acting as an intermediary. It borrows gold and on-lends it to the gold producer. The producer sells the gold in the spot market at $A500 per ounce to raise $250 million to finance its normal production costs. Typically, the bullion bank will also carry out the actual sale of gold for the producer through the spot or forward gold markets.

The gold producer obtains two main benefits from a gold loan. First, the loan hedges its gold production. If the price of gold falls, the revenue on gold sales will drop, but so does the dollar value of the loan commitment (which is in terms of gold). Second, the cost of funding is greatly reduced because the gold fee is usually much

Daniel Daugaard *is a consultant with Financial Training and Analysis Services Pty Ltd. and the author of The Swaps Handbook (FTAS, Sydney).* ***Dr Tom Valentine*** *is Professor of Finance, University of Technology, Sydney, and the author of Interest Rates and the Money Markets in Australia (FTAS, Sydney).*

Diagram 1: Gold loan structure



> *Forward gold agreements are the over-the-counter equivalent of futures contracts. They are typically traded between bullion banks and gold traders*

lower than money-market interest rates. Diagram 2 shows the three-month gold fee over the past three years. It is determined by supply and demand for gold loans and these arise from a range of activities: speculative investments in precious metals, holdings to support currencies or jewellery manufacture and arbitrage in futures and forwards markets.

Futures and forwards

Futures and forwards are the most basic of the derivative instruments. They are used to lock in the future selling price for gold producers and are a way of taking a leveraged speculative position in gold.

Gold futures contracts are traded on many exchanges throughout the world: New York, Chicago, Sao Paulo (Brazil) and Tokyo. Each contract involves strict specifications in regard to quantity, quality and settlement dates.

Although the specifications can cause mismatches between the contracts and the physical exposures being hedged, they encourage the development of deep, liquid markets which is the case with the three-month New York and Chicago contracts and the 12-month Tokyo contract. The price of a futures contract is close to the forward price of gold for that particular date.

Forward gold agreements are the over-the-counter equivalent of futures contracts. They are typically traded between bullion banks and gold traders and are usually provided to gold producers in the form of forward sale agreements.

Forward gold prices

All transactions involving the delivery of gold at future dates are valued using forward gold prices. The forward price reflects the cost of borrowing money to buy gold now in order to hold it until the specified forward date. Because the gold can be lent to others, the cost of owning the gold will be reduced by the gold fee. For example, a forward gold price can be established by a bullion bank using the structure illustrated in the gold loan example shown above.

Diagram 3 shows a forward sale structured for a gold producer by using a gold loan.

Instead of passing the physical gold on to the gold producer, the bullion bank sells the gold into the spot market at $500 an ounce and invests the $250 million in the money market for the term of the forward. In this way the bullion bank will have a commitment to supply physical gold and a receipt of $286,880,750 cash (ie, $250 million x $[1 + 14\%/4]^4$). The bank can therefore offer a predetermined price to receive gold from the gold producer on the forward date. In effect, the bullion bank is matching all flows of physical gold and cash and, by doing so, transforms a gold loan into a forward sale. The gold producer is given a locked-in forward gold price

Diagram 2: Gold fee

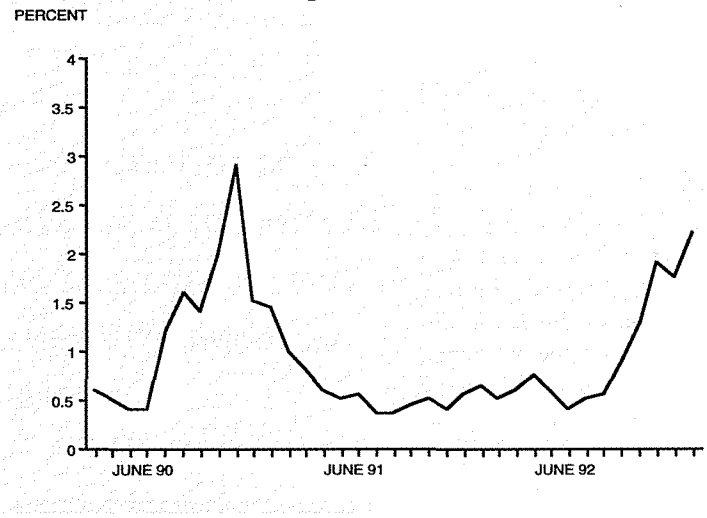
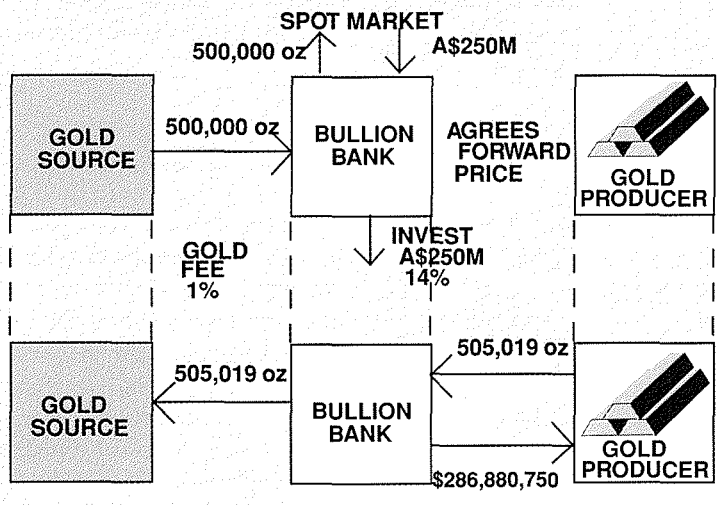


Diagram 3: Establishing a forward price



of $568 an ounce (ie, $286,880,750 ÷ 505,019 oz).

A forward purchase price can be constructed in a similar way. The bullion bank would purchase spot gold and lend the physical gold in order to earn the gold fee. The funds used to make the initial spot purchase are raised in the wholesale market for the term of the forward.

When interest rates are high, the forward gold price will be significantly higher than the spot price. For example, with interest rates of 14 per cent a year and a gold fee of 1 per cent a year (both compounded quarterly), the forward prices increase as follows:

$A spot gold	500
1-year forward	568
5-year forward	946
7-year forward	1222

Calculating the forward price is obviously essential for evaluating hedging mechanisms involving forward sales, but it also gives a good guide to the value of options.

Gold options

Options can be traded on the futures exchanges in Chicago and New York, but they are typically over-the-counter instruments and can take the form of long-term hedging structures. A put option gives a gold producer the right to sell its gold at a known price (the option's strike price). If the market price rises above the put's strike price, the option will become unattractive and the gold producer will ignore it and sell its gold production at the higher market price. By using a put option instead of a "fixed price" hedging instrument (ie, forward sale, futures or swaps) the gold producer is able to benefit from any rise in the gold price.

The only drawback of a put as a hedging instrument is the premium to be paid. To offset this cost, the gold producer could consider an additional strategy of selling a call option to earn revenue. If the put and call options have the same premium then the net cost is zero, resulting in a structure known as a zero-cost collar. The gold producer has a hedge against the gold price falling but if the gold price rises, the producer can only benefit up to the call level. Beyond this price, any higher price gained on the sale of gold will be offset by the payment of profits to the purchaser of the call options (typically the same bank which sold the put options). "Blue sky" gains have been forgone in order to reduce the cost of the hedging structure. The collar is not restricted to any particular strike prices and for any desired put strike price there will be a call strike price that enables a zero-cost collar to be constructed.

The zero-cost collar is also used with a series of options on different dates. This structure provides a term hedge for gold producers and is constructed from bought puts and sold calls. The value of this structure depends on the costs of the individual options making up the hedging structure.

Option premia depend on a number of market-driven factors. Volatility is one factor that is important for pricing options. Its estimation and use in pricing is well documented[1] but its effect on prices is not essential to achieving a basic understanding of the instrument's worth. Interpreting an option's strike price by comparison with the relevant forward price (ie, calculating the intrinsic value) should be the first step in evaluating any option structure.

To illustrate, assume that the spot and forward prices for gold are as in the examples above. We are offered an option transaction whereby we can sell our gold production in five years' time for $1,050 per oz or higher if the market price is above $1,050 per oz (ie, we have bought a five-year put at a $1,050 strike). In return for this option we will have to sell our next year's production for $450 per oz unless the market price is lower than this strike price (ie, a one-year call at $450). The five-year selling price of $1,050 per oz

The only drawback of a put as a hedging instrument is the premium to be paid. To offset this cost, the gold producer could consider an additional strategy of selling a call option to earn revenue.

looks spectacular, but how does it stack up against the $450 per oz price next year? If we compare these strike prices against the appropriate forward prices, we find they are roughly equivalent and the deal is quite reasonable, as in Example A.

The difference is partly because, as the gold price changes, the call's value changes more quickly than the put's value (ie, it has a higher delta), and partly because the bank providing the transaction requires a profit.

In contrast, suppose the same put option is offered in exchange for a $450 per oz call with a seven-year maturity. A simple comparison with the appropriate forward prices would show that the low call strike price is very valuable and its value is far greater than the benefit of the put option being received (see Example B).

Example A

	Strike price	Forward price	Intrinsic value (ie, strike - forward)
5-year put	1050	946	104
1-year call	450	568	118

Example B

	Strike price	Forward price	Intrinsic value (ie, strike - forward)
Put	1050	946	104
Call	450	1222	772

Gold swaps

There are two main forms of gold swap. The simplest is a fixed-for-floating gold price swap.

Diagram 4 shows the cashflows for this form of gold swap. A bullion bank has provided the gold producer with a fixed sale price on its gold for the term of the commodity swap. To hedge its exposure, the bullion bank must also lock in the sale price for gold. It can do this by selling gold futures or forwards (ie, taking in the forward prices).

The bullion bank could also choose to go to the physical gold market, borrowing physical gold from the interbank market and then selling it in the spot market. The bullion bank is left with a commitment to deliver gold at the end of the loan but does not presently hold gold, ie, it has a short position in gold which is a hedge for the swap[2].

This is equivalent to the process used in pricing forward gold contracts and gold futures. The fixed gold price in this swap will therefore be the average of the forward prices that occur over its term.

The gold fee represents a cost when pricing a swap as it did in pricing forward contracts. The fact that it is quite low provides the opportunity to construct an even more attractive form of gold swap ie, the gold-for-interest-rate swap illustrated in Diagram 5.

The gold producer has swapped the interest rate on its funding for the gold fee (ie, the interest rate on borrowed gold). The interest received by the gold producer is used to offset the interest paid on its existing source of funds. The gold producer is thereby left with paying the gold fee, which benefits the producer in the same ways as a gold loan. ■

Diagram 4: Fixed for floating gold swap

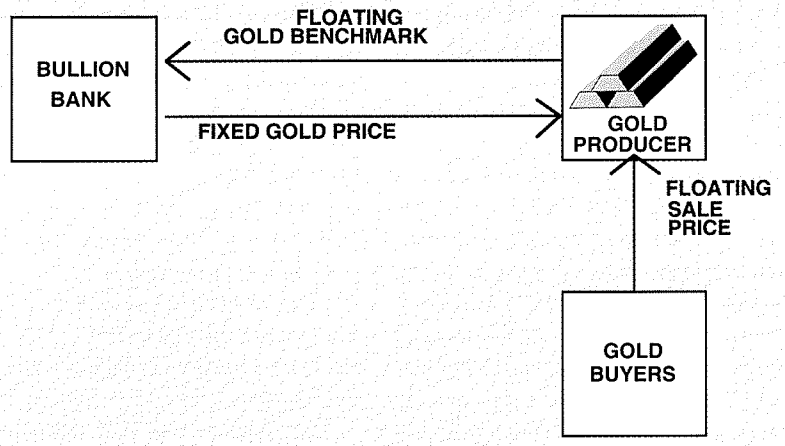
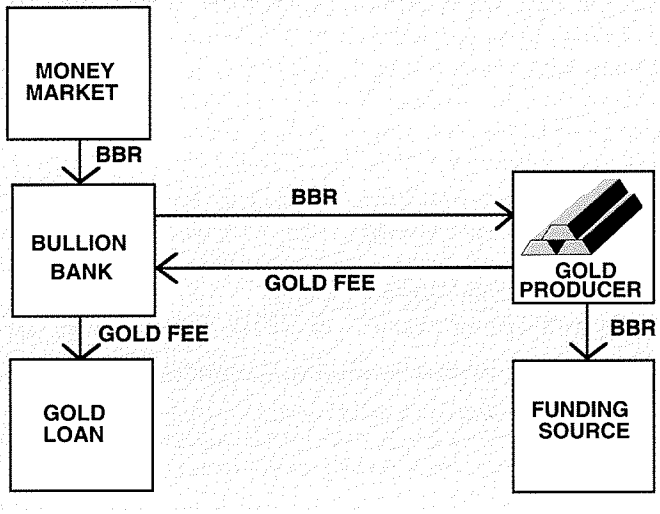


Diagram 5: Gold for interest rate swap



NOTES

1. For example: J. Hull, 1989, *Options, Futures and Other Derivative Securities*, Prentice-Hall.

2. The inter-bank gold lending market is typically short-term (eg, the three-month term being the most liquid) and the short position must therefore be rolled over every three months. This will create a three-month floating gold fee rather than a fixed fee.