

The issue of rockburst damage is dealt with in various sections of the paper, including Tables I and II. The results of observations of rockburst damage sites are summarized in the section entitled 'Control of Rockburst Damage'. It is indicated that, if the backfill is not placed 5 to 6 m from the face, rockburst damage may increase. The ability of backfill to absorb seismically generated energy compared with timber support is demonstrated to be considerable.

The authors believe that the factors listed above, which were possibly overlooked by Mr Curtis, reasonably explain the influence of backfill on rockburst damage.

Reference

1. HEMP, D.A., and GOLDBACH, O.D. The influence of backfill on seismicity. COMRO Reference report 39/90, 1990.

The impact of forward sales on the price of gold

by H.L. Monro*

CONTRIBUTION BY P.J.D. LLOYD†

The thought-provoking paper by Monro deserves serious consideration. If he is correct, the practice of selling gold forward should cease forthwith. However, similar arguments may well be advanced against the selling forward of many other commodities, and this runs counter to the success of futures markets worldwide. If, indeed, the practice were basically flawed, then such markets should long since have failed.

I believe the flaw in Monro's argument arises when he says 'The accuracy of the... calculation depends on the data shown in Table I, which consist of tonnages and price elasticities. *The latter are exact or close estimates....*' [emphasis added].

For non-Communist mine supply, he argues that 'the current price of gold has no effect on the current production'. This goes totally counter to the whole spirit of South African gold-mining taxation, which forces mines to reduce the grade when the price increases. Because there is limited surplus milling capacity to increase the tonnage treated, the tonnage of gold produced drops as the price increases and the grade goes down.

Thus, far from the elasticity in respect of new production being zero, as Monro argues, in fact it should be negative. This was tested using the data he employed¹. Mine production was correlated with the average annual gold price in constant 1990 rands. For the period 1980 to 1990, the unlagged price elasticity had a value of -1.02, not 0.00.

Lagged price elasticities were close to 1, depending on the lag assumed. This is what one would expect: as the gold price increases, so new producers are attracted into the market and contribute in due course to the gold production.

In a similar vein, Monro argues that 'Forward sales... have a price elasticity of supply of +1.0'; that is, the higher the gold price, the greater the volume of forward sales. However, it could well be argued that forward sales reflect hedging against downward price movements, so that the owner who perceives a risk of a downward movement is

more likely to sell forward, giving a negative price elasticity, not a positive one.

Again this was tested on the available data. Unfortunately, supply from hedging transactions commenced only in 1984, and grew from 13 t in that year to a peak of 259 t in 1988. Thus, there are two components in the relationship between volume of hedging transactions and price: the growth of this vehicle as a feature of the supply, and the growth of the impact of the supply on the market.

Within the limited data available, these two effects cannot be satisfactorily deconvoluted, but the second effect seems to have the anticipated negative elasticity. In the absence of firmer data and to be fair to Monro, it is probably adequate to assume a forward sales elasticity of zero in place of his +1.0.

If these elasticities for mine production and forward selling are incorporated in Monro's equations [1] and [2], the result is

$$-14 + 441Q^{1.4} - 1986Q^{-0.6} + 1559Q^{-1} = 0, \quad [1]$$

which still balances when $Q = 1$, and

$$-254 + 441Q^{1.4} - 1986Q^{-0.6} + 1559Q^{-1} = 0, \quad [2]$$

for which the solution is found at $Q = 0.510047$.

Following Monro, this means a gold price inflator of \$187,94/240, or an increase of \$0,783/oz for every ton sold forward.

In summary, therefore, Monro is correct to draw attention to the possible effects of forward selling, but his model depends critically on the values he has assumed for the elasticities.

There are grounds for believing that his values for the elasticities, far from being 'exact or close estimates', are actually of the wrong sign. If this is so, his conclusion that 'every extra ton of gold sold [forward] per annum reduces the price by about \$0,2/oz' could be seriously in error. Indeed, I have shown that some reasonable values for the elasticities lead to an increase in the price of gold if gold is sold forward.

Reference

1. *Gold 1991*. London, Gold Fields Mineral Services Ltd, 1991.

* J. S. Afr. Inst. Min. Metall., vol. no. 2, Feb. 1992, pp. 49-52.

† Industrial and Petrochemical Consultants (Pty) Ltd, P.O. Box 8061, Ravenmoor, 1469 Transvaal.

REPLY BY H.L. MONRO

Herewith my comments on Dr Lloyd's contribution to this paper.

It appears from the first paragraph of Lloyd's contribution that he has confused forward sales with futures transactions. Gold is the only commodity that I know of that is sold forward, but there may be others. It is the sale of gold that has not yet been produced and is borrowed from the banks to effect an immediate sale. A Futures sale is the result of a contract entered into between a seller (usually a producer) and a buyer for the seller to deliver an agreed quantity of gold at a future specified date and price. Thus, my argument against forward sales has nothing to do with futures markets. However, it seems that many mines enter into contracts on the futures market and so sell forward to meet their obligations if short of gold.

In the third paragraph of his contribution, Lloyd implies that South African taxation forces mines to reduce production when the price rises. This applies to ore reserves, but not to gold mined from other sources, which is considerable. Output is usually maintained by increasing the percentage mined from reserves.

Lloyd comes to the conclusion that the price elasticity of gold from mine production is $-1,0$, and that for forward sales it is zero. The substitution of these values for my values results in his version of my equation [1], which, when solved, leads one to the extraordinary conclusion that the price of gold increases as the supply increases. This result surely shows that something is amiss.

There is a very good linear relationship between the annual gold production in the non-Communist world and the price of gold 8 years earlier. The time lag of 8 years is understandable because of the time taken to find, evaluate, and exploit new discoveries. The price is a 6-year moving average. This is also understandable in that investors do not consider the price over a shorter period to be very reliable. The 6-year moving average smooths out minor irregularities and gives a better correlation.

Thus, the model for gold production is

$$\text{Production} = KP_x \text{ tons,}$$

where K is a constant and P_x is the 6-year moving average lagged by 8 years. The components of the moving average price are determined as explained under the heading *Jewellery* in the paper.

It follows that the price elasticity of supply is $+1,0$, the index of P_x , which is understood.

When last derived, the fit of the model was so good using only the 6-year moving average lagged by 8 years as a variable, that the remnants were insufficient to support another variable. This meant that all the other variables were statistically insignificant.

Lloyd also questions my figure for the price elasticity of forward sales. Here he has a point. The value worried me until I discovered that it had no effect on the final result and can thus have any value! Normally, all supplies have a basic price elasticity of $+1$, which may be lagged or not. For this reason, I assigned a value of $+1$ to this supply, which is not lagged in this case.



First notice to all members

Annual General Meeting

Details of the Annual General Meeting of the Institute are as follows:

Date:	Wednesday, 12 August 1992
Time:	16:30
Venue:	Transvaal Automobile Club 60-5th Street Lower Houghton Johannesburg

There will be a Cocktail Party for all members and their guests immediately after the Annual General Meeting at 18:00.

The *second notice* of the Annual General Meeting will be sent at the beginning of July and will contain the following information:

- Annual General Meeting Agenda
- Synopsis of the Presidential Address
- Curriculum Vitae of Mr J P Hoffman - Incoming President
- Details of the Cocktail Party