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The Alchemist

Outsmarted by gold…

Introduction

Imagine commodity price forecasters as Dr Strange in The Avengers Endgame, sifting through an infinite number of possible futures. Like the ex-surgeon turned mystic hero, they must juggle all potential outcomes, trying to piece together a recommendation that won't implode. In the wild world of mining and commodities, their superpower? Navigating the chaos of commodity price predictions. While the Avengers manage to nail their 1 in 14 million shot at victory, the real question is: How does the industry fare when it comes to cracking the code on commodity price forecasts? We'd argue that it's at longer odds than The Avengers….

Accurate commodity price forecasting is essential for both public and private sectors. These forecasts are used in resource estimates and mining feasibility studies, influence government policies and fiscal budgets, and impact entire economies by affecting potential future trade balances.

In this issue of the Alchemist, we take a deep dive into gold price forecasts and utilise a number of statistical tools, analysing their performance.

Key Findings of The Alchemist Issue 43

1. **Consensus forecasts are susceptible to anchoring bias.** Forecasts often "anchor" to the current spot price, closely following short-term price movements rather than accurately predicting significant shifts or volatility. This leads to a persistent bias that has continually underestimated both upward trends and the true volatility of the gold market.

2. **Consensus forecasts lack statistical accuracy in predicting gold price trends.** Statistical analyses reveal that consensus forecasts frequently fall short as predictors of actual gold price movements. They often project a flat or declining trend, which contrasts with the observed price increases over time.

3. **Forecasts typically predict a declining nominal gold price while actual historical gold returns are positively weighted.** Historical data since the 1980s shows an average annual change of +4.9%, with a standard deviation of 15.5%, reflecting a long-term upward trend. This positive weighting contrasts sharply with the conservative, often flat or declining forecast profiles, suggesting that forecasting models fail to fully incorporate gold's historical upward momentum, particularly over longer time frames.

Consensus Forecasts

In this analysis, we examine the accuracy of gold price forecasts as compiled by Consensus Economics, a widely recognised aggregator of commodity price forecasts. Consensus Economics gathers predictions from over 30 leading global forecasters each month, and by averaging these forecasts, a single consensus forecast is produced, designed to incorporate multiple market perspectives and forecasting methodologies.

To assess the performance of these forecasts, we selected the period from January 2018 to October 2024 for it is a mix of market conditions, including relatively stable range bound periods, and bull runs. While the data includes instances of price declines exceeding 10% (notably between August 2020 and March 2021), no structural bear markets are considered present in this period, although it could be argued that gold has not seen this for a decade where in the period between 2012 and 2015 gold fell by approximately 40%.

This analysis is not intended to evaluate the accuracy of individual forecasting groups or their methods. Instead, it aims to examine how effectively the industry forecasts gold prices overall, given its critical nature.

How has the forecasting industry performed?

To visualise gold price forecasts alongside actual performance, the data was aggregated by monthly forecast and plotted in Figure 1. The actual gold price is shown in red, while forecasted prices are represented by dotted lines.

Over the past five years, it is apparent that consensus forecasts have consistently underestimated the actual gold price. Forecasts appear to have projected a continuation of prevailing prices, struggling to capture the impact of volatility or significant upward movements. While there is a common perception that forecasts merely "follow the spot price," in practice, it appears that during volatile periods, forecasts simply adjust in response to spot market shifts. As they move with the spot price, they tend to predict a reversion to historical base levels. As the spot price stabilises, forecasts seem to establish new baselines, suggesting that gold price forecasts have not effectively accounted for volatility over the past seven years.

A notable observation from Figure 1 is the high number of forecasts falling below the spot price at the equivalent time, highlighting the magnitude and persistence of the issue. As an aggregate 80% of all predictions when assessing all periods underpredict the gold price. This is clearly illustrated in the huge, persistent area of dotted forecast lines UNDER the red spot price line compared to those above. Further, at the 12-month mark, 81% of forecasts have underestimated the gold price, increasing to 90% at the 20-month mark.

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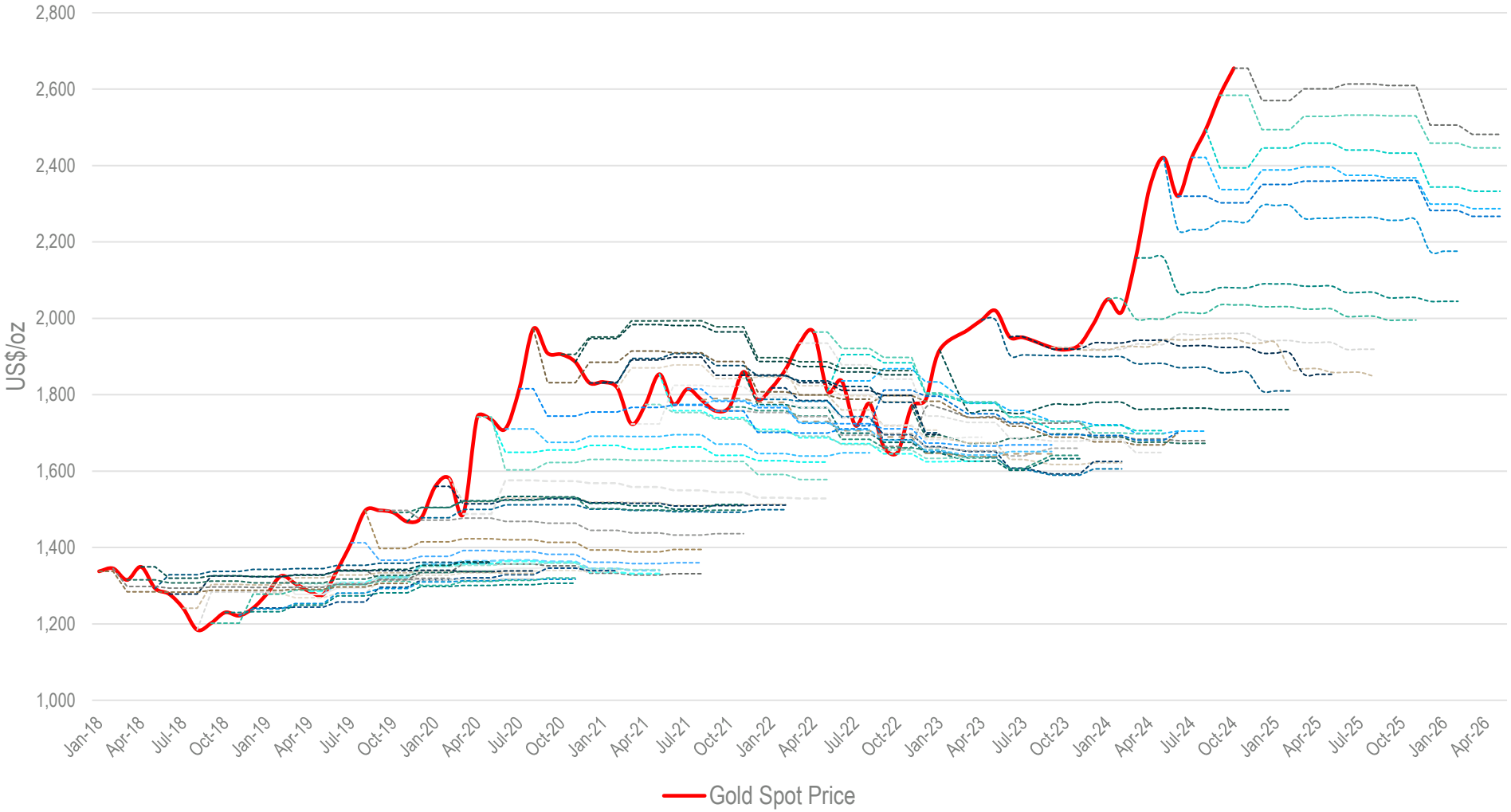

Figure 1. Consensus gold price forecasts (shown by dashed lines) since 2018 vs spot price

Black Panther and the Anchoring Bias?

The concept of "Anchoring Bias" originated from Amos Tversky and Daniel Kahneman's 1974 paper titled *"Judgment under Uncertainty: Heuristics and Biases"*. In their seminal work, they noted that people often make estimates by starting from an initial value and then adjust it based on a limited set of heuristic principles. This approach simplifies the estimation process but can lead to inaccuracies, often because the predictor or model makes insufficient adjustments from the initial "anchor" point, resulting in inaccurate forecasts and, specifically, an underestimation of volatility.

To assess the presence of anchoring bias, an analysis of consensus forecast gold price performance versus actual gold price performance can be conducted. If anchoring bias is present, one would expect an underestimation of volatility, with forecast price distributions clustering around the initial gold spot price.

To measure forecast accuracy, the following equations were used:

$$FC_n = \frac{F_n - G_0}{G_0} \quad and \quad GC_n = \frac{G_n - G_0}{G_0}$$

where:

G_0 = Gold price at commencement of forecast period

F_n = Forecast gold price at period n

G_n = Actual gold price at period n

FC_n = Forecast gold price performance from spot price at prediction at period n

GC_n = Actual gold price performance from spot price at prediction at period n

Plotting these outcomes on a smoothed histogram indicates that consensus gold price forecasts generally vary within a ±10% range of the initial spot price across most forecast intervals (see Figure 2). A shift from a neutral to a slightly negative bias between 6 and 12 month forecasts can be observed, suggesting that, over longer horizons, forecasts tend to predict negative nominal price movements for gold.

In contrast, actual gold price movements, shown in Figure 3, display a distribution with wide tails that expand over longer intervals. Additionally, actual performance is positively skewed, and this skew intensifies over extended time frames.

This analysis highlights a form of Anchoring Bias in consensus forecasts, an overreliance on a "safe" view and starting point that limits both adaptability and volatility. Much like Marvel's Black Panther, who initially restricts Wakanda's potential by clinging to the "safe" and stable, but outdated, tradition of isolation, consensus price forecasts appear to remain tethered to the "safe" initial spot price. This conservative bias in forecasting leads to an underestimation of price volatility and an, ultimately inaccurate, negatively weighted forecast distribution, in contrast to the far more volatile and positively weighted actual price performance of gold.

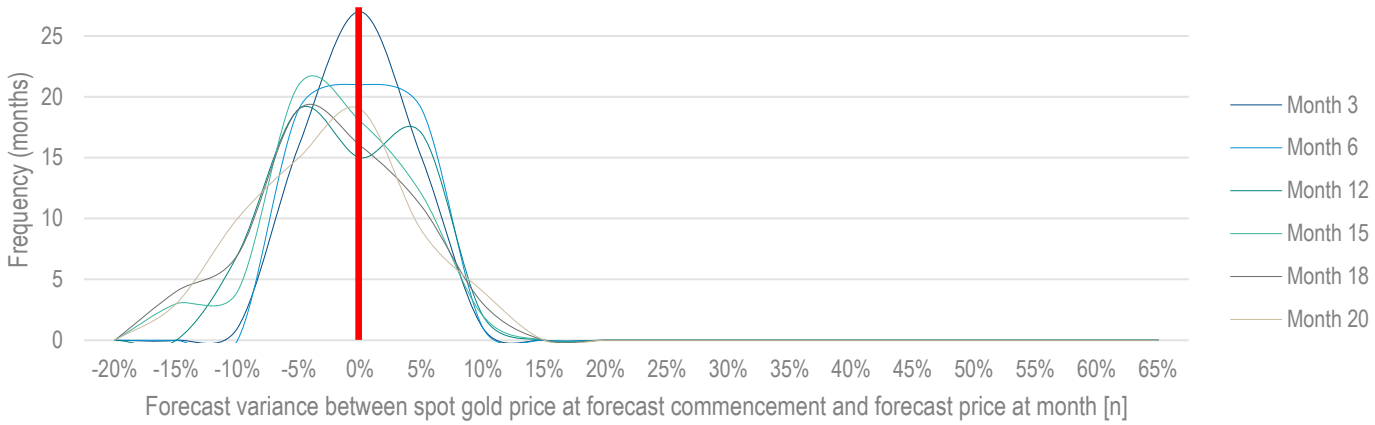

Figure 2 Predicted gold price changes based on the consensus forecast, measured at various monthly intervals from the start of the forecast period

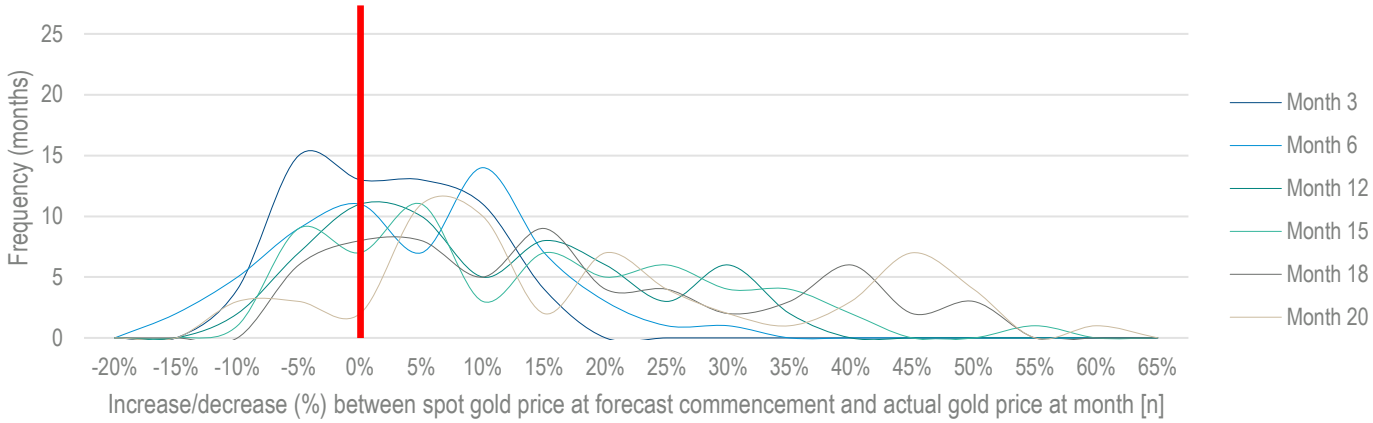

Figure 3. Actual gold price changes, measured at various monthly intervals from the start of the forecast period

Analysis of Residuals in Forecasting

One way to assess forecast accuracy is through residual analysis. In a forecasting model, residuals represent the difference between observed values and the model's predicted values. For this analysis, the residuals of all 80 consensus forecast periods were calculated using the following equation:

$$e_t = G_n - F_n$$

where:

e_t = Residual

F_n = Forecast price in period n

G_n = Actual gold price at period n

In a reliable forecasting model, residuals should behave as "white noise", exhibiting two key properties:

1. **Uncorrelated Residuals.** Residuals should not display patterns over time. If they are correlated, this suggests that the model is missing information that could improve forecast accuracy

2. **Mean of Zero.** If the residuals' mean deviates from zero, this indicates a potential inherent bias in the model (ie consistently over- or under- estimating values)

To test these properties, an aggregate approach was used. The residuals for each forecast period were averaged to calculate the mean residual for that period.

The first property (uncorrelated residuals) was tested by measuring autocorrelation at various lags and then applying the Ljung-Box (LB) test. Autocorrelation describes the correlation of a series of variables between two successive time intervals. By adjusting the lag (the interval), we measure the correlation between values that are separated by k periods, revealing any potential patterns that suggest missing information in the model (or an "inaccurate model").

The LB test, which provides a Q_{LB} value, was then used to quantify the degree of autocorrelation. A large Q_{LB} value suggests that autocorrelation does not result from white noise, as Q_{LB}. is essentially the sum of all the autocorrelations at various lags, with large values representing a persistent pattern in the forecast, which is therefore unlikely to be random.

The formulas for autocorrelation and the Ljung-Box test are:

Autocorrelation at various lags:

$$\hat{p}_k = \frac{\hat{cov}(\bar{e}_t, \bar{e}_{t-k})}{\hat{var}(\bar{e}_t)}$$

Ljung-Box test for randomness:

$$Q_{LB} = T(T+2)\sum_{k=1}^{L} \frac{\hat{p}_k{}^2}{(T-k)}$$

where:

k = the associated lag

$\hat{p_k}$ = the autocorrelation at lag k

Q_{LB} = result of the Ljung-Box test

T = sample size

L = the number of lags being tested

To confirm this, the LB test is checked against the expected outcomes of Q_{LB} where the system is assumed to be random (white noise). This is done by assessing Q_{LB} against the Chi-squared (X2) distribution. A probability value below 0.05 from the X2 distribution would indicate a low probability of the calculated Q_{LB} value being returned in a truly random system, thereby telling us that the actual system being assessed – as represented by the Q_{LB} value – is in fact autocorrelated and not random. This would reflect a systematic issue in the model.

Using the calculated residuals, the LB test yielded a Q_{LB} of 121.6, a high value for this test. The probability of obtaining this Q_{LB} value is essentially zero (2.4×10^{-21} to be precise). This is far below the 0.05 significance threshold, meaning the residuals can't statistically be considered random "white noise" and the model's errors likely reflect systematic issues. To improve the accuracy additional information is therefore required to be incorporated into the forecast.

To test whether the residuals have a mean of zero, the aggregated residuals were further analysed, as shown in Figure 4. The results confirm that the mean is not zero, with residuals drifting further from zero as the forecast period extends, revealing an inherent and persistent bias in the model indicating that it tends to systematically underestimate values. One potential approach to correct this bias would be to adjust forecasts by adding these mean residuals; however, as the gold price evolves over time, repeated re-analysis would be necessary to maintain accuracy.

In conclusion, the consensus forecasts do not satisfy the required properties for an accurate forecasting model given the presence of autocorrelation and a non-zero mean, suggesting potential for significant improvements.

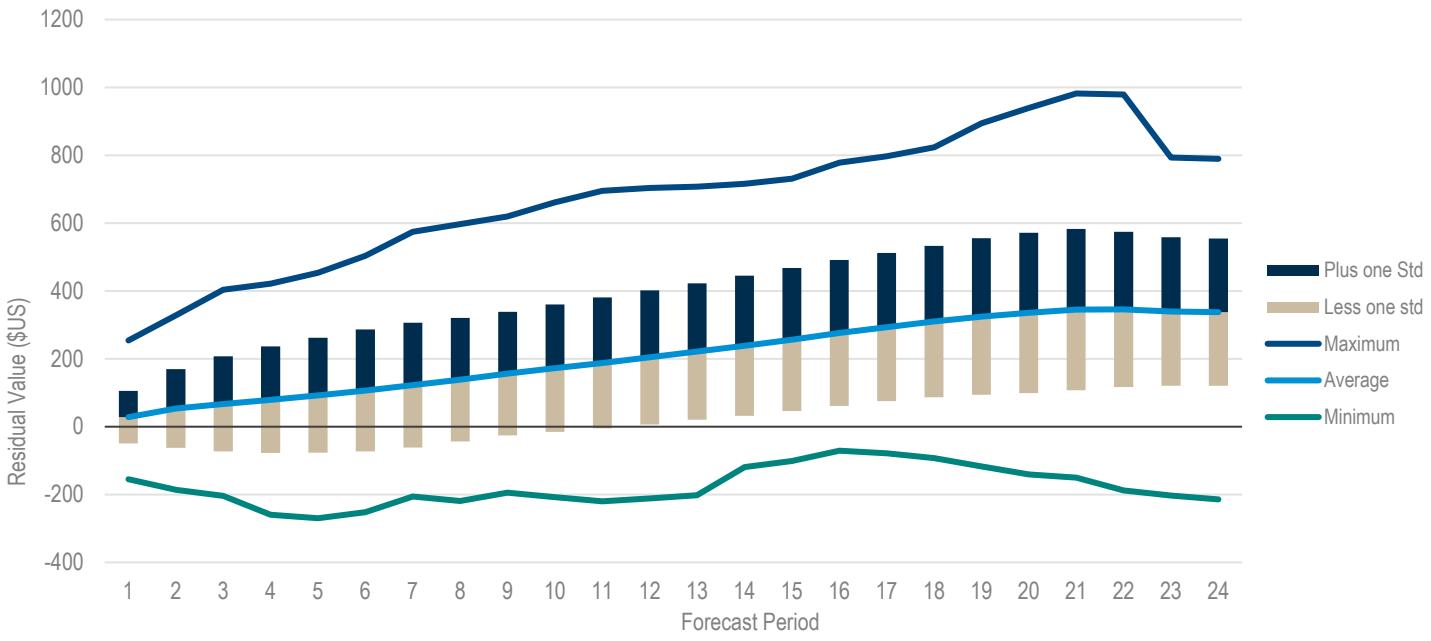

Figure 4. Average residuals from consensus gold price forecasts at respective forecast period

History - Positively Charge Like Thor's Hammer?

As discussed in the previous sections, consensus forecasts tend to track closely with, and are anchored to, the spot gold price. Additionally, these forecasts have increasingly underestimated gold prices over longer time horizons. But is this underestimation rooted in historical gold price trends?

Gaining a comprehensive understanding of historical gold price trends requires looking back beyond just 2018 to see a fuller picture. Much like the enduring power of Thor's hammer, Mjolnir, which is challenging to control but holds immense energy when harnessed, gold's long-term returns show an underlying positive trend that forecasts often struggle to fully capture. By extending our analysis back to the 1980s, we gain greater insight into gold's actual performance across a wider range of market conditions and this broader perspective could help inform whether consensus forecasts are justified in their often conservative assumptions (in both nominal and real terms).

We chose to begin this retrospective in the post-Bretton Woods era of the 1980s, as by this time the market had adjusted to the final abandoning of fixed exchange rates and the US$35/oz "Gold Standard" in the early 1970s, allowing gold prices to reflect broader market forces.

The annual performance of gold, summarised in Table 1 and the histogram in Figure 5, highlights a key insight: gold's returns are positively weighted in the long term as well as the shorter term, much like the latent power in Mjolnir. Table 1 shows an average annual return of +4.9% with a standard deviation of 15.5%, further reflected in the positive weighting of gold price returns in Figure 5. Given this persistent upward trend, one might expect consensus forecasts to project gradual price increases. However, as discussed earlier, the opposite holds true with consensus forecasts often anticipating flat or declining prices, both in real and nominal terms, underestimating the full potential energy behind gold's longer and shorter term trends.

Table 1. Annual performance of gold

Parameter	Value
Average Return	4.9%
Return Standard Deviation	15.5%
Median Return	3.1%
P80 of Returns	21.1%
P20 of Returns	-6.1%
Variance of Returns	2.4%

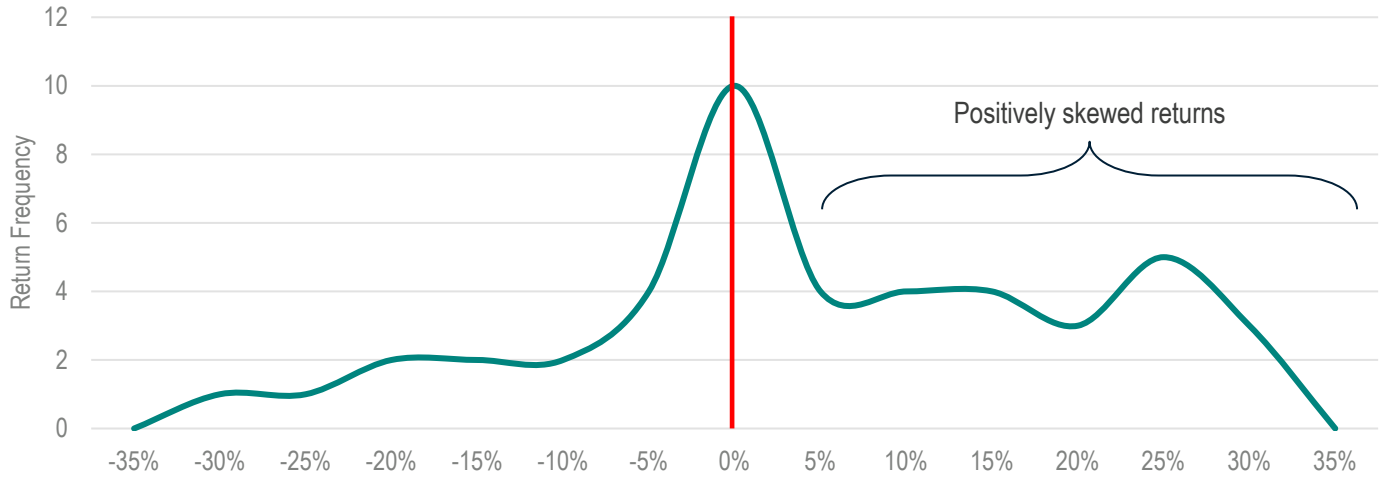

Figure 5. Distribution of annual return of gold since 1980

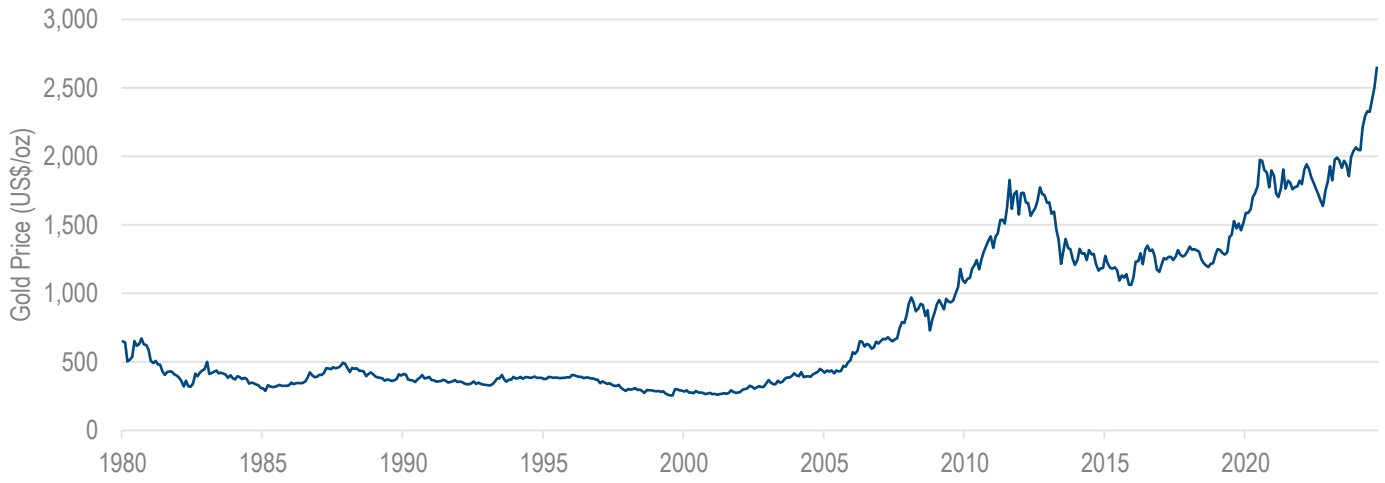

Figure 6. Real gold price since 1980

Impact

Commodity prices have far-reaching impacts, from influencing terms of trade between nations, to guiding decisions in mining projects at all stages of progress: study, development and operational.

Hedging is a particularly high-profile manifestation of this, as not only a common requirement in project financing to reduce lender risk, but because the real-world impacts of it are obvious for all to see in company reporting of financial performance and position. However, given the consistent underestimation of gold prices, volatility, and the positive weighting of actual price performance, reliance on consensus forecasts for hedging decisions may prejudice project owners and increase their project risk (or least limit their upside exposure at best) rather than reducing it. This effect would be especially pronounced in operations that faced underperformance or cost escalations, particularly if coincident with rising gold prices where buying contracted ounces to deliver into a hedge is beyond the company's financial capacity.

Companies seeking to secure financing and to develop operations should consider these factors carefully when optimising their gold hedging strategies. However, it's also important to note that overestimating gold prices within a feasibility study can jeopardise a project's viability. As highlighted in previous sections, historical forecasts have often misjudged gold price movements, leaving unutilised information that could improve model accuracy.

Equally important is how the industry uses and interprets commodity price forecasts. As the old saying goes, "The only person who gets to bring belief to a meeting is a priest; everyone else must bring data." It's imperative to revisit historical forecasts and establish a feedback loop to ensure continuous improvement in the industry's forecasting tools. Enhanced forecasting methods that better account for volatility ranges and long-term trends (upward in the case of gold) are essential to improve the accuracy of gold price predictions and support informed investment and operational decisions in the gold industry.

Conclusion

In conclusion, while Dr Strange and the Avengers may be better at predicting the future than the gold price forecasters, the recent surge in gold prices has likely drawn more attention to the gold market than to the latest superhero movie.

Consensus commodity price forecasts play a critical role in shaping investment, operational, and financing decisions across the gold industry and beyond. However, it's clear that forecasting gold prices faces significant challenges due to inherent "safety first" biases and underestimations of volatility. Anchoring Bias, has in particular, led to forecasts that remain tethered to initial spot prices, failing to adequately account for the positive weighting and volatility evident in actual gold price performance over time. This shortcoming is potentially especially impactful given the wide use of consensus forecasts in both public and private sectors, and the influence that it has on decision making.

Our analysis suggests that the forecasting industry may benefit from refining its approach to gold price forecasting. By adopting improved methods and critically evaluating past forecasts, forecasters could build more resilient strategies for pricing, hedging, and long-term planning, ultimately enhancing the value of gold investments and operations across the industry.

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