

Comparative Analysis of Returns and Volatility Between Physical Gold and Gold Mining Stocks Listed on the Indonesia Stock Exchange During the 2020–2026 Period

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Global economic uncertainty during the 2020–2026 period has generated significant volatility across investment assets, making the selection between physical gold and gold mining stocks increasingly important for investors. This study aims to compare the returns and risk (volatility) of physical gold (XAU/IDR) with four major gold mining companies listed on the Indonesia Stock Exchange (IDX), namely PT Aneka Tambang Tbk (ANTM), PT Bumi Resources Minerals Tbk (BRMS), PT Hartadinata Abadi Tbk (HRTA), and PT J Resources Asia Pasifik Tbk (PSAB). A quantitative descriptive approach with a comparative design was employed. Secondary data consisting of monthly closing prices collected during the observation period were analyzed using descriptive statistical techniques to evaluate the performance characteristics of each investment instrument. The results indicate that all investment instruments generated positive returns, although with substantially different performance characteristics. Physical gold produced a stable return of 299.64% with a very low level of risk, reflecting its role as a conservative investment asset. In contrast, gold mining stocks achieved a considerably higher average return of 724.53%, with BRMS recording the highest return of 1,411.11%. However, these higher returns were accompanied by substantially greater risk, as reflected by a standard deviation of 607.41%. The findings suggest that operating leverage in gold mining companies amplifies return potential while simultaneously increasing investment risk. Overall, physical gold is more suitable as a safe-haven and wealth preservation instrument, whereas gold mining stocks are better suited for aggressive wealth accumulation strategies targeting investors with a high risk tolerance and long-term capital growth objectives.

Keywords: Physical Gold, Gold Mining Stocks, Return, Standard Deviation, Return Variability.

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1. Introduction

The period from 2020 to 2026 has been characterized by exceptionally high volatility in global financial markets, driven by a series of simultaneous macroeconomic shocks. This period began with the unprecedented disruption caused by the COVID-19 pandemic, which fundamentally transformed the global economic structure. It was subsequently followed by tighter monetary policies through successive increases in the Federal Reserve's benchmark interest rate, as well as escalating geopolitical tensions. These developments created an environment of considerable investment uncertainty, making asset price movements increasingly difficult to predict (Akhtaruzzaman et al., 2021). The situation became even more complex with the emergence of geopolitical conflicts in the Middle East involving countries with substantial influence on global energy stability, such as Iran and the United States, which exerted additional pressure on commodity markets and increased systemic risks in the global economy (Vidada, 2026).

Under these highly uncertain conditions, gold has once again attracted considerable attention as an investment instrument with hedging characteristics. Historically, gold has been recognized as a safe-haven asset capable of preserving wealth during periods of inflationary pressure and economic instability (Baur & Lucey, 2010). However, developments in modern financial markets, particularly in Indonesia, have expanded gold-based investment alternatives beyond physical gold ownership. Investors can now allocate their funds to equity instruments, particularly the shares of gold mining companies listed on the Indonesia Stock Exchange (IDX), including PT Aneka Tambang Tbk (ANTM), PT Bumi Resources Minerals Tbk (BRMS), PT Hartadinata Abadi Tbk (HRTA), and PT J Resources Asia Pasifik Tbk (PSAB). While these investment alternatives provide greater opportunities for portfolio diversification, they also require investors to understand the distinctive characteristics of each instrument in responding to changing market conditions.

The fundamental difference between physical gold and gold mining stocks lies in the mechanisms underlying their value formation and associated risk profiles. As a tangible commodity, the price of physical gold generally follows global supply and demand dynamics and tends to exhibit relatively stable price movements. In contrast, the value of gold mining stocks is influenced not only by fluctuations in the underlying gold price but also by company-specific factors, including operational efficiency, cost structure, and managerial performance, as well as external factors such as market sentiment, liquidity conditions, and overall capital market dynamics (Tandelilin, 2017). Consequently, the responses of these two investment instruments to economic conditions are not always aligned.

Empirical evidence indicates substantial differences in the performance of these investment instruments during periods of economic turbulence. Physical gold generally demonstrates relatively stable price movements, whereas several gold mining stocks have experienced significantly higher price appreciation within relatively short periods. Although this phenomenon suggests greater return potential for gold mining stocks, it also reflects considerably higher levels of investment risk and volatility. Therefore, examining these differences within the framework of the risk–return trade-off is essential to determine whether the higher returns generated by gold mining stocks adequately compensate investors for the additional risk incurred.

Based on these considerations, a comprehensive comparative analysis is required to evaluate the performance and risk characteristics of both gold-based investment instruments. A descriptive statistical approach can provide an objective assessment of the return and volatility patterns of each investment alternative, thereby supporting more rational investment decision-making. Furthermore, this study is expected to contribute to the literature on the application of Modern Portfolio Theory, particularly regarding the comparative performance of commodity assets and equity assets in emerging capital markets (Markowitz, 1952; Tandelilin, 2017).

2. Literature Review and Problem Statement

Gold as a Safe-Haven Investment

Gold has long been recognized as one of the most reliable investment instruments for preserving wealth during periods of economic uncertainty. Unlike financial assets, physical gold possesses intrinsic value and is generally less affected by corporate performance or financial market fluctuations. Previous studies have consistently demonstrated that gold functions as a safe-haven asset, particularly during periods of financial crises, inflation, and heightened market volatility (Baur & Lucey, 2010). Consequently, investors often increase their demand for gold when uncertainty in financial markets intensifies, resulting in relatively stable price movements compared with other investment assets.

In recent years, global macroeconomic shocks—including the COVID-19 pandemic, tightening monetary policies, and geopolitical conflicts—have reinforced gold's role as a portfolio diversification instrument. As uncertainty increases, investors tend to shift their investments toward assets with lower risk exposure, making gold an attractive alternative for capital preservation.

Gold Mining Stocks and Risk–Return Characteristics

Unlike physical gold, gold mining stocks represent equity investments whose values are influenced by both gold prices and firm-specific performance. According to Tandelilin (2017), stock prices are determined not only by external market conditions but also by internal corporate factors such as profitability, operational efficiency, financial leverage, and managerial performance. Therefore, the returns generated by gold mining stocks are generally more volatile than those of physical gold.

Although gold mining stocks offer greater opportunities for capital appreciation during periods of rising gold prices, they also expose investors to higher levels of systematic and unsystematic risk. Consequently, investors must consider both return potential and volatility when evaluating the attractiveness of gold-related investment instruments.

Risk–Return Trade-Off and Modern Portfolio Theory

The relationship between investment return and risk has become one of the fundamental concepts in finance. Modern Portfolio Theory (MPT), introduced by Markowitz (1952), explains that investors seek to maximize expected returns while minimizing investment risk through portfolio diversification. According to this theory, investment decisions should not rely solely on expected returns but should also consider the associated level of volatility.

Within this framework, physical gold and gold mining stocks represent two different asset classes with distinct risk–return profiles. Physical gold generally provides relatively stable returns with lower volatility, whereas gold mining stocks tend to generate higher expected returns accompanied by greater investment risk. Comparing these two investment alternatives therefore provides valuable insights into portfolio allocation decisions under uncertain market conditions.

Research Gap and Problem Statement

The increasing uncertainty in global financial markets during the 2020–2026 period has created growing interest in comparing the performance of different gold-based investment instruments. Nevertheless, existing studies have predominantly focused either on the safe-haven characteristics of physical gold or on the financial performance of gold mining companies. Limited attention has been given to comparative analyses evaluating both return and volatility of physical gold and gold mining stocks listed on the Indonesia Stock Exchange (IDX) within a single analytical framework.

Furthermore, previous studies rarely incorporate the recent macroeconomic environment characterized by post-pandemic recovery, monetary tightening, and geopolitical instability. These conditions may substantially alter the relative performance of gold-based investment instruments and influence investors' portfolio allocation decisions.

Based on these research gaps, this study addresses the following research questions:

- 1) How do the returns of physical gold compare with those of gold mining stocks listed on the Indonesia Stock Exchange during the 2020–2026 period?
- 2) How do the volatility characteristics of physical gold differ from those of Indonesian gold mining stocks?

- 3) Which investment instrument provides a more favorable balance between return and risk under recent global economic uncertainty?

This study aims to provide empirical evidence regarding the comparative performance of physical gold and gold mining stocks by employing descriptive statistical analysis of returns and volatility. The findings are expected to enrich the literature on Modern Portfolio Theory while offering practical insights for investors seeking optimal investment strategies under volatile market conditions.

3. Methods

Research Design

This study employed a quantitative research approach to objectively evaluate the performance of investment instruments using historical numerical data. A descriptive comparative research design was adopted to compare the characteristics of returns and risk between two categories of investment assets, namely physical gold as a commodity asset and gold mining stocks as commodity-based equity investments (Bodie et al., 2021). This research design enables a systematic comparison of the performance of both investment instruments under fluctuating market conditions throughout the observation period.

Research Objects and Unit of Analysis

The study examined two categories of gold-based investment instruments. The first category consisted of physical gold, represented by the global gold price (XAU) converted into the Indonesian Rupiah exchange rate (XAU/IDR) to reflect the purchasing power and investment perspective of domestic investors. The second category comprised gold mining stocks listed on the Indonesia Stock Exchange (IDX), including:

- 1) PT Aneka Tambang Tbk (ANTM)
- 2) PT Bumi Resources Minerals Tbk (BRMS)
- 3) PT Hartadinata Abadi Tbk (HRTA)
- 4) PT J Resources Asia Pasifik Tbk (PSAB)

The unit of analysis for all investment instruments was the monthly closing price, which was selected to represent long-term price movements while minimizing short-term market fluctuations.

Data Source and Observation Period

The study utilized secondary time-series data obtained from the TradingView financial database. The observation period covered approximately six years, from January 2, 2020, to March 17, 2026. This period was deliberately selected to capture several important economic phases, including the COVID-19 pandemic, the post-pandemic economic recovery, and the period of heightened market volatility associated with global geopolitical tensions.

Data Processing and Analysis

Data analysis was conducted systematically using statistical software to ensure computational accuracy. Investment risk was measured using the standard deviation of investment returns across the observed assets. Unlike conventional time-series volatility, which measures daily or monthly price fluctuations, the standard deviation employed in this study represents the dispersion of returns among different investment instruments throughout the observation period. Therefore, the concept of risk in this study emphasizes differences in investment performance rather than short-term price volatility.

The investment performance analysis consisted of four sequential stages.

1. Holding Period Return (HPR)

The Holding Period Return (HPR) was calculated to measure the total investment return over the observation period using the following equation (Bodie et al., 2021):

$$Return = \frac{(P_t - P_0)}{P_0} \times 100\%$$

where:

P₀= asset price at the beginning of the observation period (2020);

P_t= asset price at the end of the observation period (2026).

2. Descriptive Statistical Analysis

Descriptive statistics were employed to evaluate both the average return and investment risk of each instrument.

a. Mean Return

The average investment return was calculated using:

$$Return = \frac{(P_t - P_0)}{P_0} \times 100\%$$

where:

$\bar{R}$ = mean return;

R_i = return of each investment instrument;

n = number of investment instruments.

b. Standard Deviation

Investment risk was measured using the standard deviation of returns:

$$\sigma = \frac{\sqrt{\sum (R_i - \bar{R})^2}}{(n - 1)}$$

where:

σ = standard deviation;

R_i = individual investment return;

$\bar{R}$ = mean return.

The use of Holding Period Return and standard deviation follows the principles of Modern Portfolio Theory, where expected return and risk constitute the primary indicators for evaluating investment performance (Markowitz, 1952; Bodie et al., 2021).

3. Investment Simulation

Based on the statistical analysis, an investment simulation was conducted assuming an initial investment of IDR 100,000,000 for each investment instrument. The simulation was intended to illustrate the potential wealth accumulation generated by physical gold and gold mining stocks during the observation period.

4. Macroeconomic Thematic Analysis

As the final stage, the quantitative findings were interpreted in relation to major macroeconomic conditions affecting financial markets during the observation period. The discussion considered external factors including interest rate movements, U.S. dollar exchange rate fluctuations, and global geopolitical stability. Integrating these macroeconomic conditions with the quantitative results provides a more comprehensive understanding of the determinants influencing the performance of gold-based investment instruments during the 2020–2026 period.

4. Results and Discussion

Historical Performance Analysis of Investment Instruments (2020–2026)

Based on the analysis of secondary data collected during the observation period from January 2, 2020, to March 17, 2026, all investment instruments exhibited positive growth throughout the study period. However, the findings reveal substantial differences in performance between physical gold and gold mining stocks. A comparison of the initial price, final price, and total return for each investment instrument is presented in Table 1.

Table 1. Historical Performance Comparison of Investment Instruments (2020–2026)

Investment Instrument	Initial Price (IDR)	Final Price (IDR)	Total Return (%)
Physical Gold (XAU/IDR)	683,749	2,732,617	299.64
PT Bumi Resources Minerals Tbk (BRMS)	45	680	1,411.11
PT Hartadinata Abadi Tbk (HRTA)	220	2,510	1,040.91
PT Aneka Tambang Tbk (ANTM)	845	3,750	343.79
PT J Resources Asia Pasifik Tbk (PSAB)	262	530	102.29

Source: Processed data (2026).

As shown in Table 1, physical gold (XAU/IDR) generated a relatively stable return of 299.64%, with its price increasing from IDR 683,749 at the beginning of the observation period to IDR 2,732,617 by the end of the study. In contrast, gold mining stocks exhibited substantially more aggressive yet heterogeneous performance. BRMS recorded the highest return at 1,411.11%, followed by HRTA with 1,040.91%. Meanwhile, ANTM and PSAB achieved returns of 343.79% and 102.29%, respectively. These considerable differences in performance were further evaluated through descriptive statistical analysis to identify the corresponding risk profiles of each investment instrument.

Descriptive Statistical Analysis and Risk Profile

Descriptive statistical analysis was conducted to examine the characteristics of investment returns and evaluate investment risk based on return variability. The statistical summary for both investment categories is presented in Table 2.

Table 2. Descriptive Statistics of Investment Returns

Statistical Parameter	Physical Gold (XAU/IDR)	Gold Mining Stocks
Minimum Return	299.64%	102.29%
Maximum Return	299.64%	1411.11%
Mean Return	299.64%	724.53%
Range	0.00%	1308.82%
Standard Deviation	0.00 (Stable)	607.41%

The descriptive analysis demonstrates that the average return of gold mining stocks (724.53%) was considerably higher than that of physical gold (299.64%), indicating that gold mining equities provide greater wealth accumulation potential for investors pursuing growth-oriented investment strategies. However, these higher returns are accompanied by substantially higher investment risk.

The standard deviation of 607.41% observed for gold mining stocks reflects significant differences in performance among the four companies included in the study. It is important to emphasize that this standard deviation does not represent price volatility over time. Instead, it measures the dispersion of aggregate returns among different investment instruments during the observation period. Consequently, the results indicate that not all gold mining companies deliver comparable investment performance, making stock selection a critical determinant of investment success. Investors capable of identifying companies with

superior operational performance are likely to achieve significantly higher returns than those investing without careful selection.

Conversely, physical gold demonstrated considerably greater stability. The zero standard deviation reported in this study does not imply the absence of price fluctuations. Rather, it results from the analytical approach, which employed a single Holding Period Return (HPR) value representing the aggregate return over the entire observation period. Therefore, this value should not be interpreted as evidence that physical gold experienced no price volatility but merely indicates the absence of variation within the aggregated return measurement. Nevertheless, physical gold remains widely recognized as an investment instrument with relatively lower risk than equities.

The range statistic further illustrates the substantial heterogeneity among gold mining stocks. The observed range of 1,308.82% indicates a considerable difference between the highest-performing company (BRMS) and the lowest-performing company (PSAB). These findings emphasize that investment success in gold mining stocks depends heavily on company selection based on sound fundamental analysis. Accordingly, stock picking plays a crucial role in maximizing investment returns within the gold mining sector.

The findings support the risk–return trade-off proposed by Modern Portfolio Theory, which argues that investments with higher expected returns are generally associated with higher levels of risk (Markowitz, 1952). Gold mining stocks therefore represent high-risk, high-return investment instruments, whereas physical gold functions as a relatively stable portfolio anchor capable of mitigating investment risk.

Investment Growth Simulation

To illustrate the practical implications of these findings, an investment simulation was conducted assuming an initial investment of IDR 100,000,000. The simulation indicates that an investment in physical gold would have grown to approximately IDR 399,640,000 by the end of the observation period. In comparison, the same investment allocated to BRMS would have increased to IDR 1,511,110,000, while an investment in HRTA would have reached approximately IDR 1,140,910,000. It should be noted that these figures represent gross returns and do not account for transaction costs, capital gains taxes, brokerage fees, or storage costs associated with physical gold. Nevertheless, after considering transaction efficiency, gold mining stocks generally remain more profitable than physical gold because stock market transactions involve lower implicit costs than the relatively wide bid–ask spread typically observed in the retail gold market (Vidada, 2026).

Macroeconomic Determinants of Investment Performance

The performance of both investment categories is fundamentally influenced by several macroeconomic variables. This study identifies three primary determinants affecting the movement of gold-related investment instruments. First, global interest rates influence the opportunity cost of holding non-yielding assets such as gold. Rising interest rates generally reduce the attractiveness of gold investments as investors shift toward interest-bearing assets (Vidada, 2026). Second, fluctuations in the U.S. dollar exchange rate have historically demonstrated a strong inverse relationship with global gold prices, as reported by Reboredo (2013). Third, geopolitical uncertainty significantly increases demand for gold as a safe-haven asset, particularly during periods of international conflict.

Unlike physical gold, the performance of gold mining stocks is additionally influenced by firm-specific operational factors, including production efficiency, cost structure, and managerial policies. The concept of operating leverage explains why the returns of gold mining stocks often exceed those of physical gold. Small increases in commodity prices can generate disproportionately larger increases in corporate earnings, resulting in significantly higher stock returns (Brigham & Houston, 2019). Consequently, the market

performance of gold mining companies depends not only on global gold prices but also on operational efficiency and corporate management quality.

Strategic Implications for Portfolio Management

The findings provide important implications for investment portfolio construction. Physical gold continues to serve as an effective portfolio stabilizer, providing protection against systemic risk and inflationary pressures. Conversely, gold mining stocks function as growth assets, offering investors opportunities to generate returns exceeding market averages. In accordance with Modern Portfolio Theory, a balanced allocation between physical gold and gold mining equities can create a more efficient investment portfolio by combining capital preservation with long-term capital appreciation (Markowitz, 1952; Tandililin, 2017). Such a diversified investment strategy is expected to enhance portfolio resilience while optimizing investment performance amid persistent global economic uncertainty.

5. Conclusion

This study provides a comprehensive comparison of the performance of physical gold and gold mining stocks during a period characterized by complex global economic dynamics. The findings indicate that both investment instruments experienced positive growth throughout the observation period, although they exhibited substantially different return characteristics. Gold mining stocks generated significantly higher investment returns than physical gold, suggesting that corporate operational performance amplified the benefits of rising gold prices. These findings indicate that the profitability of gold mining stocks is influenced not only by commodity price movements but also by company-specific factors and prevailing global market conditions.

The study also confirms the existence of a positive relationship between investment return and investment risk. Gold mining stocks offer greater return potential but are accompanied by higher levels of uncertainty due to differences in corporate performance and operational complexity among issuers. In contrast, physical gold demonstrates greater stability and continues to function as an effective hedging instrument, preserving investors' purchasing power during periods of economic uncertainty. These findings support the risk–return trade-off proposed by Modern Portfolio Theory (Markowitz, 1952). Furthermore, macroeconomic factors, including global interest rate policies, exchange rate fluctuations, and geopolitical developments, were identified as important determinants influencing the performance of both investment instruments. Therefore, an optimal investment strategy should combine stable assets, such as physical gold, with growth-oriented assets, such as gold mining stocks, while incorporating a comprehensive understanding of global economic conditions to achieve sustainable portfolio performance.

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