Inflation Risk Premium and Gold Pricing: An Empirical Study Based on Asymmetric Effects

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ABSTRACT

The traditional inflation hedging theory cannot effectively explain the realistic contradiction that "gold price does not rise when inflation soars". This paper decomposes inflation expectations into expected inflation and inflation risk premium, and uses gold price monthly data from 2018 to 2025 to test the asymmetric impact of inflation risk premium on gold yield. The conclusions are as follows: First, IRP has a clear positive driving effect on gold yield (coefficient = 3.86, p = 0.030). Second, the effect is highly asymmetric: when IRP is positive (the market is worried about inflation risk), the coefficient is as high as 15.09 (p = 0.003), while when IRP is negative, the coefficient is only 1.58 and not statistically significant. More importantly, when the short-term inflation expectation difference is used as an alternative measure, the variable is no longer significant, which leads to the conclusion that the long-term term structure of inflation risk premium is extremely important, and thus supports the rationality and specificity of the benchmark measure selected in this paper. Therefore, the logic of this paper is supported: gold hedging is not inflation itself, but the market's concern about currency credit depreciation, that is, "inflation risk".

Keywords: Inflation risk premium; Gold pricing; Asymmetric effects; Inflation expectation decomposition

1. INTRODUCTION

Gold has always been recognized as a classic inflation hedging tool (Fama and Schwert, 1977) [6], but the market reality in recent years has posed a strong challenge to this traditional conclusion (Erb and Harvey, 2013) [5]: In the period of global inflation rising sharply from 2020 to 2022, the price of gold did not rise synchronously, but fell back in several stages. Therefore, it can be concluded that the traditional inflation hedging theory ignores the important structural differences within inflation expectations.

The existing literature generally treats inflation expectations as a single-dimensional indicator (Baur and Lucey, 2010) [3], thus ignoring the fundamental difference between "expected inflation level" and "inflation risk premium": the former is the benchmark judgment of the market on the average price increase in the future, and the latter is the compensation required by the market for the risk of inflation exceeding expectations and currency credit depreciation. Starting from the pricing logic: gold, as a hedged asset that does not rely on sovereign credit, its price should be more reasonably linked to inflation risk, rather than simply expected inflation level. However, because the existing research does not clearly distinguish between the two, the empirical defect of "high inflation and gold price trend deviation "has not been properly explained for a long time.

The core contribution of this paper is to break through the traditional research on the single dimension of inflation expectation, decompose inflation expectation into expected inflation and inflation risk premium (IRP), and clarify the different effects of the two on gold yield. Secondly, it systematically and rigorously identifies the asymmetric characteristics of IRP on gold yield, that is, only when IRP is positive and the market has included inflation risk premium, IRP is the actual core factor of gold pricing. Thirdly, the method of proxy variable substitution is used to test the rationality of IRP measurement based on long-term term structure, which also proves that ordinary short-term inflation expectation index cannot replace its information content.

2. DATA AND VARIABLES

2.1 Sample Period

The sample interval of this paper is from January 2018 to November 2025, a total of 94 monthly observations. The sample selects the late normalization of the Fed's monetary policy as the starting point of the sample, thus avoiding the structural

mutation during the global financial crisis, and covering the rapid expansion of the global central bank's balance sheet from 2020 to 2022, and the Fed's aggressive interest rate hike from 2021 to 2023, so the sample has excellent representativeness, and the conclusion has strong practical significance (Auer, 2015) [1].

2.2 Variable Definitions

Table 1. Variable Definitions and Data Sources

Variable	Definition	Source
Gold return	Monthly log return of London gold spot price (%)	FRED
IRP	10-year CPI inflation expectation – 1-year CPI inflation expectation	FRED
VIX	CBOE Volatility Index	FRED
DTWEXBGS	Broad U.S. dollar index	FRED
DFII10	10-year TIPS-implied real interest rate (%)	FRED
GPR	Geopolitical Risk Index	Caldara and Iacoviello, 2022

Gold return is calculated as:

$$gold\_return = (price_t / price_{t-1} - 1) * 100 \quad (1)$$

The definitions and data sources of all variables used in this paper are presented in Table 1. the core explanatory variable IRP uses the inflation expectation spread structure that can be directly observed by the market to avoid endogenous and subjective bias caused by model estimation. The average IRP is-0.17, indicating that the inflation expectation curve is inverted in most of the sample period (short-term inflation expectation is higher than long-term). This is consistent with the Fed's aggressive rate hike cycle in 2021-2023.

3. EMPIRICAL RESULTS

3.1 Baseline Regression

To examine the effect of IRP on gold returns, we estimate the following baseline model:

$$gold\_return_t = \alpha + \beta * IRP_t + \gamma * Controls_t + \varepsilon_t \quad (2)$$

The control variables include VIX, US dollar index, real interest rate implied in 10-year inflation-protected bonds and geopolitical risk index. In order to alleviate heteroscedasticity and autocorrelation interference, all regressions use HAC robust standard error (lag 4).

Figure 1. Time Series of IRP and Gold Returns

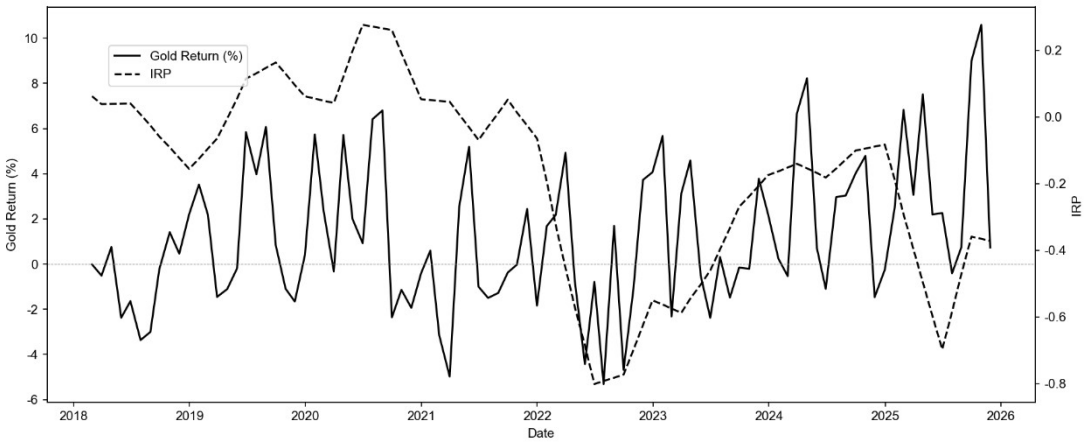


Table 2. Baseline Regression Results

Variable	Coefficient	P-value
IRP	3.856	0.030
VIX	0.023	0.605
U.S. dollar index	0.156	0.098
Real interest rate	0.359	0.390
GPR	0.020	0.004
Constant	-19.58	0.064
R^2	0.134	

The time series trend of IRP and gold returns is illustrated in Figure 1. The distribution of gold returns under different IRP signs is presented in Figure 2.

The results of Table 1 show that the IRP coefficient is 3.856 ($p = 0.030$), indicating that for every 1 percentage point increase in IRP, the monthly yield of gold increases by an average of 3.86 %. Among the control variables, only GPR was significantly positive at the 1 % level (0.020, $p = 0.004$), in line with the traditional perception of gold as a safe haven asset (Baur and McDermott, 2010) [2]. The US dollar index is marginally significant ($p = 0.098$), and the direction is in line with expectations (the depreciation of the US dollar pushes up the gold yield).

3.2 Asymmetry Tests

To identify asymmetric effects, we split the sample into two groups based on the sign of IRP: IRP > 0 (markets price in inflation risk premium) and IRP < 0 (inflation risk subsides).

Figure 2. Gold Return Distributions by IRP Sign

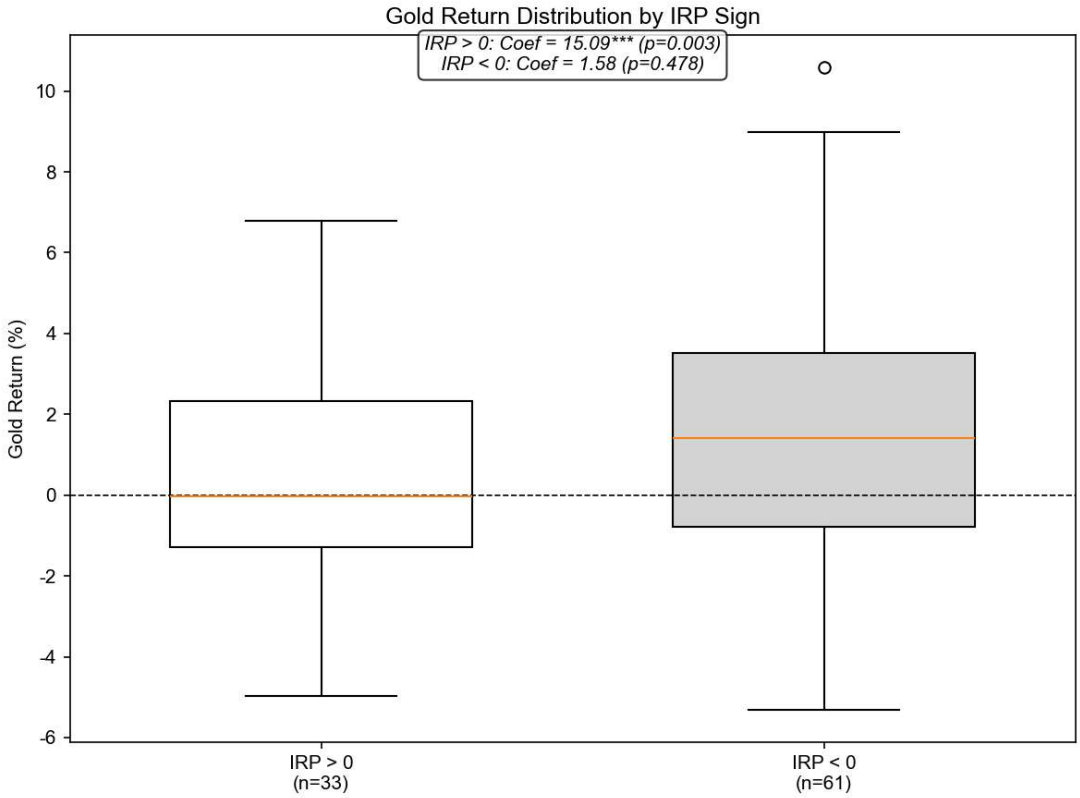


Table 3. Asymmetric Effects

Sub-sample	IRP coefficient	P-value	Observations
IRP > 0	15.086	0.003	33
IRP < 0	1.577	0.478	61

The distribution of gold returns under different IRP signs is presented in Figure 2. The results of robustness checks are shown in Figure 3.

The results show significant asymmetry: when IRP is positive, the driving coefficient is as high as 15.09 ($p = 0.003$), and the economic significance and statistical significance are highly significant; when IRP is negative, the coefficient decreases to 1.58 and is not significant ($p = 0.478$).

When IRP > 0, the market price inflation is out of control and the risk of currency credit depreciation, the credit hedging value of gold is strengthened; when IRP < 0, the inflation risk expectation falls back, and gold is no longer driven by inflation risk. It is concluded that gold hedges inflation risk rather than inflation itself (Ryan et al., 2024) [7].

3.3 Robustness Checks

This paper conducts a robustness test from four dimensions to ensure that the core conclusions are reliable.

1.Lag term test: adding IRP lag 1-3 periods, the lag term is not significant (p = 0.554), indicating that the impact of IRP on gold yield is predominantly contemporaneous, and the model setting appears parsimonious.

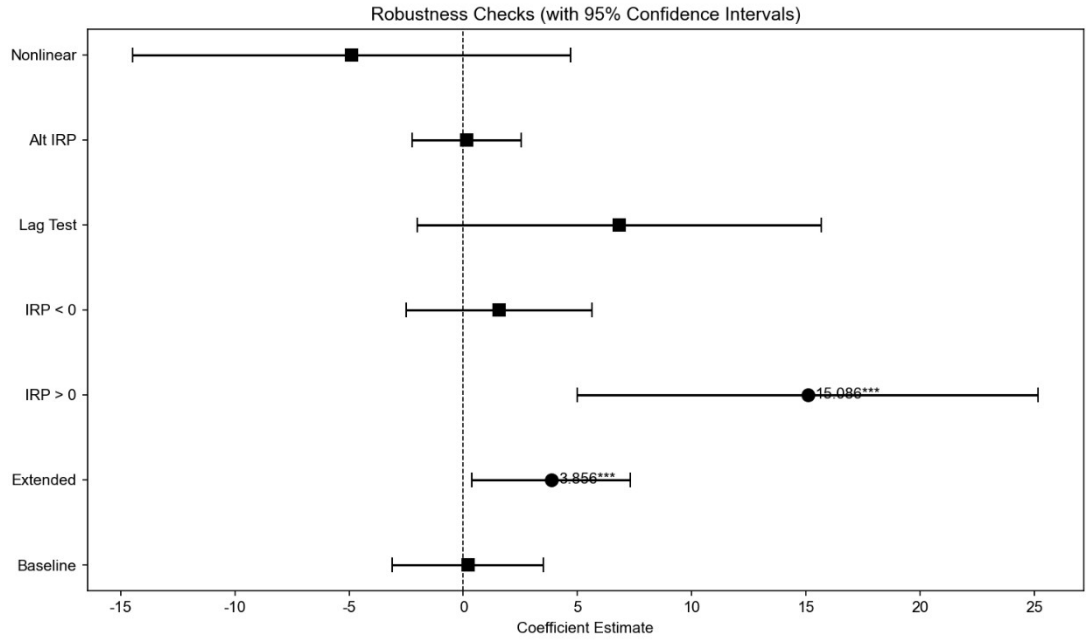
2.Replacement proxy variables: using short-term inflation expectation difference (T5YIE − INFCPI1YR) as an alternative measure, the results are not significant (p = 0.898), providing evidence that the pricing effect of inflation risk depends on long-term term structure, and the benchmark measure in this paper is relatively more informative.

3.Non-linear test: the coefficient is not significant after adding the square term of IRP (p = 0.319), indicating that the effect of IRP on gold yield is linear, and the group asymmetric test has shown its heterogeneity.

4.Multicollinearity test: VIF test shows that the VIF value of the core variable IRP is 2.40, which is much lower than the critical threshold of 10. Multicollinearity does not appear to be a serious concern in the model, and the regression results are unlikely to be substantially biased by it.

The detailed results of the four robustness checks are displayed in Figure 3.

Figure 3. Robustness Check Results



4. CONCLUSION

This paper decomposes inflation expectation into expected inflation and inflation risk premium (IRP). Based on the monthly data from 2018 to 2025, this paper empirically tests the driving effect and asymmetric characteristics of IRP on gold yield, and draws the following conclusions.

1.The core findings are as follows: First, IRP has a significant positive driving effect on gold yield (coefficient 3.86, p = 0.030), which is an important factor in gold pricing; second, its impact has a strong asymmetry. Only when the IRP is positive and the market includes inflation risk, the driving effect is obvious. When the IRP is negative, the effect disappears. Third, the short-term inflation expectation index has no pricing power. Therefore, the long-term term structure of IRP appears necessary for gold pricing.

2.Theoretical contribution: This paper corrects the unclear defects of traditional inflation hedging theory, confirms that gold hedges inflation risk (currency credit depreciation concern), rather than pure inflation level, and enriches the research framework of gold pricing and macro risk.

3.Practical enlightenment: Because investors should track the inflation risk premium (IRP) rather than simply look at the CPI data in the stage of monetary credit expansion and rising inflation uncertainty, they can arrange the gold allocation more reasonably, and policymakers should pay attention to the market credit concerns reflected by the IRP.

4.Research Limitations: The sample interval of this paper is relatively limited, and does not cover multiple rounds of currency and credit cycles; in the future, it can be extended to a longer time window and test the impact of IRP on gold pricing among different economies.

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