

The Analysis and Prediction Concerning the Impact of International Incidents on the Gold Price

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Abstract: Since 2020, the world has faced a series of significant events, including the COVID-19 pandemic, the Russia-Ukraine war, the Israeli-Palestinian conflict, the rise of right-wing politics in Europe, and the election of Donald Trump as President of the United States. These events have contributed to a period of global uncertainty, which is reflected in the price of gold, often seen as a safe haven during times of crisis. Beginning in early 2024, both international and domestic gold prices surged, with domestic gold prices increasing by 40%. This study compiles gold price data from 1984 onward, along with a selection of representative international incidents during this period. Using Student's t-test and the 3-sigma rule, abnormal fluctuations in the data were identified. The Analytic Hierarchy Process (AHP) was then applied to classify the international incidents. The relationship between the severity of international incidents and abnormal fluctuations in gold prices was explored, and the correlation coefficient between these variables was calculated, revealing a positive correlation. Based on the findings, potential future impacts of international incidents on gold price fluctuations are predicted.

Keywords: International Incident, Gold Price, Student's t-test, AHP, Correlation Coefficient

1. Introduction

Gold is significant precious metals with properties of merchandise, hedge and credit. Over the long term, gold prices exhibit regular fluctuation, causing corresponding industries alternatively flourish and decay [1]. Since 2024, the world's situation has been turbulent, which has enhanced the hedging properties of gold, driving its price to unprecedented levels.

Previous researches have demonstrated that no precise model that can consistently predict gold prices. Former researchers primarily analyzed the gold price in macroscopic aspects, for instance, global environment and the Kondratiev Wave. However, research specifically focused on individual international incidents remains relatively underdeveloped, and much of the existing work in this area tends to be qualitative. This paper aims to apply Analytic Hierarchy Process (AHP) to quantitatively analyze international incidents in order to compare conveniently afterwards.

Based on this approach, the paper attempts to explore the correlation between certain international incident and the gold price's abnormal fluctuation, and qualitatively give out some latent correlation.

2. Theoretical basis: factors affecting the gold price

Gold has the properties of merchandise, so the supply and demand relationship is naturally a decisive factor in the price of gold. The supply and demand relationship can be discussed from the two aspects of supply side and demand side.

2.1. The impact of the supply side

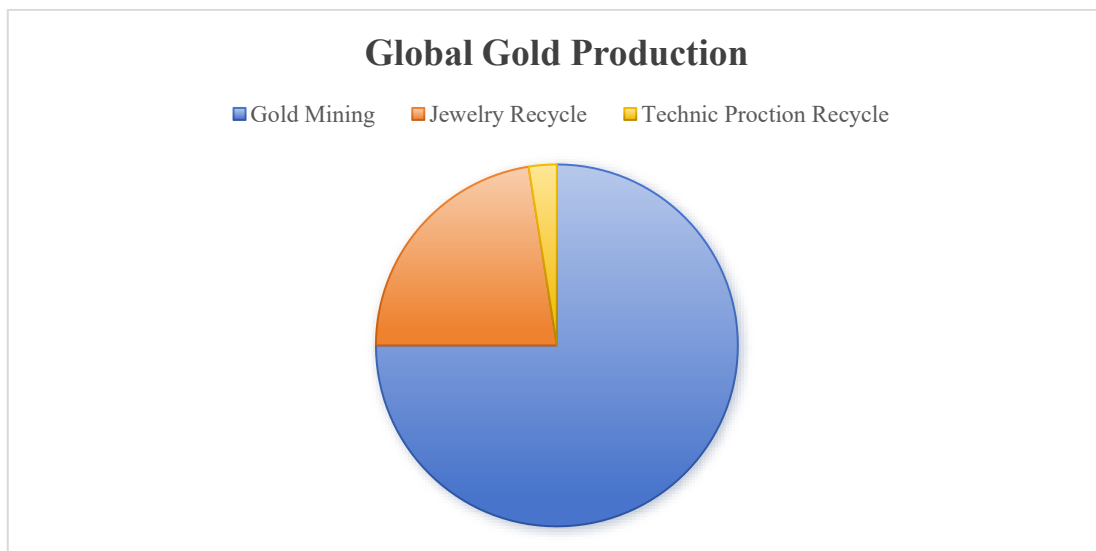


Figure 1: Global gold production

As is shown in Figure 1, most of the global supply of gold comes from mining, with a small amount coming from recycling, including jewelry and technology products (see chart on the right).

Gold mining, the largest source of gold supply, has shown geographical diversification, a large increase in total production and a slowdown in proven reserves in recent years, and the development time and life cycle of gold mining are very long. Since gold is virtually indestructible, nearly all of the gold that has been mined remains in some form, making it difficult for recycled gold to have a significant impact on the price of gold.

In conclusion, the large fluctuations in gold prices are almost never caused by the supply side. However, since the amount of new gold added each year is often limited and less than the market demand, the price of gold always rises slowly without other influences due to the factors on the supply side.

2.2. The impact on the demand side

Compared to the relatively simple supply side structure, the demand side for gold is more complex: on one hand, gold has long been favored by consumers as a store of value and a decorative item, leading to substantial demand in the jewelry industry; on the other hand, gold possesses many excellent physical properties, making it widely used in the technology sector. Additionally, its monetary credit attributes have made it highly sought after by central banks worldwide. The demand for gold from the jewelry industry, technology sector, or central banks is unlikely to experience significant fluctuations, which also makes it difficult for these demands to cause substantial price volatility. This steady demand, combined with the relatively stable production of gold, contributes to its gradual price increase.

Sharp fluctuations in gold prices can be attributed to the safe-haven nature of gold. Risk aversion is considered the direct trigger for this round of gold price increases. After the escalation of the Russia-Ukraine conflict in 2022, Western countries and Russia froze each other's foreign exchange assets, sparking concerns about the safety of the US dollar. Global investors accelerated their shift towards gold, a traditional safe-haven asset [2].

After a major international incident occurs, capital from the affected area or nearby regions may panic and flood into or exit the gold market in large numbers. This can lead to significant price increases or severe fluctuations in gold prices. Apart from the Russia-Ukraine conflict, other major international incidents such as the dissolution of the Soviet Union and the 9/11 attacks have also had a certain impact on gold prices. These events will be explored in greater detail below.

3. Mathematical modeling based on existing data

3.1. The criterion to define abnormal values: student's t-test

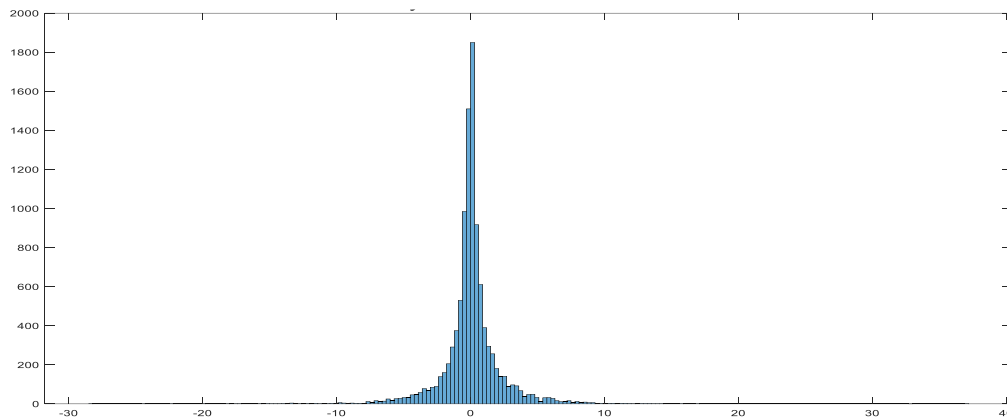


Figure 2: The daily variation of the gold price

The figure shown above is the histogram of the daily variations of the gold price, which are accumulated from January 7, 1984 to March 7, 2025.

From the histogram, it is evident that the distribution characteristics of the daily rate of change in gold prices resemble a normal distribution with an expected value of 0. A student's t-test was conducted on this database, and at the 95% confidence level, it can be concluded that, from a macro perspective, the daily rate of change in gold prices follows a normal distribution with an expected value of 0 over a long period. According to the law of large numbers, when the sample size is large, the sample standard deviation can be used instead of the population standard deviation. Therefore, for each international incident that needs to be tested, a value can be calculated using the following method:

$$R = \frac{\max_{i=1,2,\dots,7} \{v_i\}}{s} \quad (1)$$

The v_i mentioned above refers to the absolute value of daily variation of the gold price i days after the incident, and s to the standard deviation of the variations of the gold price during the two years around the incident.

According to the 3σ -principle of normal distribution, this relative rate R can be used as a criterion for judging outliers.

3.2. Quantitative analysis of international incidents: AHP

This paper focuses on the impact of international incidents on gold prices. It adapts the Analytic Hierarchy Process (AHP) to evaluate these incidents based on four criteria: location, direct impact scope, intensity, and duration. The paper applies AHP by analyzing four major international incidents: 9/11, the Collapse of the Soviet Union, the Russia-Ukraine Conflict, and Trump's first term as U.S. President.

First, construct the judgment matrix A:

Table 1: The content of the judgement matrix A

A	Location	Direct Impact Range	Intensity of The Incident	Duration of The Incident
Location	1	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{9}$
Direct Impact Range	3	1	$\frac{1}{2}$	$\frac{1}{5}$
Intensity of The Incident	3	2	1	$\frac{1}{4}$
Duration of The Incident	9	5	4	1

The matrix as the table shown in Table 1 is constructed for the following reasons: geographical factors can predict the strategic situation of the world or region and the international behavior of countries. [3] Consequently, the location where an incident occurs holds an extremely important influence, occupying the most significant part among the four factors. In the same international incident, it can be considered that the capital flowing into the gold market does not change significantly in total transfer volume, which directly determines the upper limit of transferred capital to some extent [4]. The intensity of the incident also determines the proportion of capital transfer to some degree. Both geographical factors and incident intensity are of nearly equal importance, with their impact being more substantial. The duration of the incident, while influencing the capital transfer proportion, tends to have a lower significance due to the self-regulating nature of the market. After prolonged incidents, gold prices may stabilize, reducing the impact over time. Based on these considerations, a judgment matrix can be constructed as matrix A according to the established rules.

Denote the largest eigenvalue of A as $\lambda_{\max}$, and conduct consistency test on A through the method below:

$$C.R. = \frac{C.I.}{R.I.}, C.I. = \frac{\lambda_{\max} - n}{n-1} \quad (2)$$

n mentioned above refers to the dimension of the matrix, and R.I. is abbreviation of Random Index, which will be demonstrated below:

Table 2: The Random Index (R.I.) of matrices in various dimensions

n	2	3	4	5	6	7
R.I.	0	0.58	0.90	1.12	1.24	1.32

According to Table 2, the value of C.R. can be calculated.

If $C.R. \leq 0.1$, the matrix will be considered that the consistency test is passed [5]. And the value of A mentioned above is 0.0244, which passes the consistency test. Rate the four initial examples:

Table 3 presents the initial score vectors of the four incidents.

Table 3: The initial score vectors of the four sample incidents

Incident	Location	Direct Impact Range	Intensity of The Incident	Duration of The Incident
(1) 9/11	4	5	4	3
(2) The Collapse of the Soviet Union	3	5	1	3
(3) The Russia-Ukraine Conflict	5	4	5	5
(4) Trump Being President of the United States	3	4	1	1

The final score of each incident can be calculated by the forum:

$$\text{Score}_i = \|Ax_i\|, i = 1,2,3,4 \quad (3)$$

Table 4 demonstrates the result.

Table 4: The eventual scores of each incident

incident number	(1)	(2)	(3)	(4)
grade	86.9109	64.5602	97.6474	56.9875

3.3. Correlation coefficient between international incidents scores and abnormal fluctuation value

In addition to the four international incidents mentioned above, this article also compiles fifteen significant international incidents, including the upheaval in Eastern Europe, the Rwandan genocide, the missile crisis in the Taiwan Strait, the Asian financial crisis, the Kosovo War, the Iraq War, the subprime mortgage crisis, the Wenchuan earthquake, the Libyan war, the Arab Spring, and the latest Israeli Palestinian Conflict, analyzing their impact on abnormal fluctuations in gold prices. The following image is obtained:

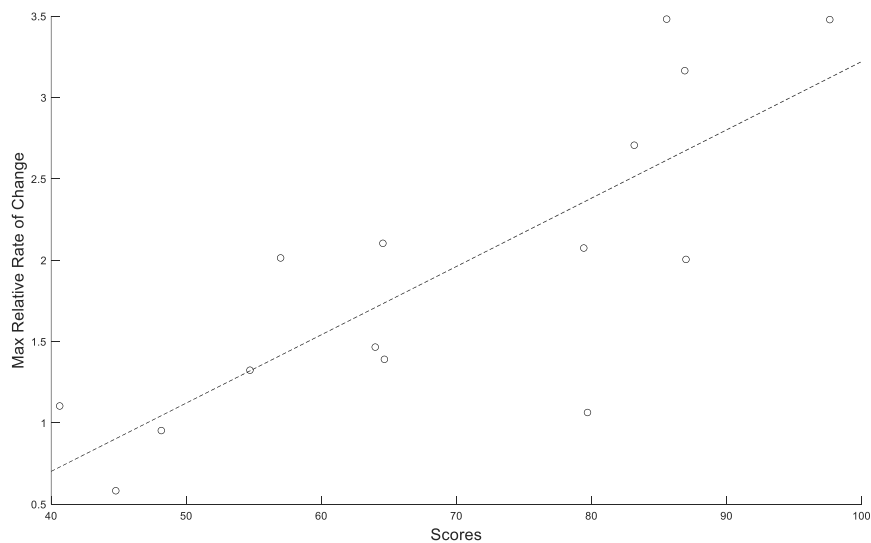


Figure 3: The correlation of incidents' scores and the value of abnormal fluctuations

According to Figure 3, the distribution of data points reveals a positive correlation between the incident rating and the maximum fluctuation in gold prices over time. [4] Upon calculation, the correlation coefficient between these two variables is approximately 0.8015, which further supports this observation.

In the end, it can be asserted that an international incident with a higher score could more possibly bring a series of uncertainty to the gold price, consequently arousing the consumers' terror, and almost eventually causing an increase in the gold price to a respective degree.[6]

The world is currently in the midst of a "great change unseen in a century", with various international incidents will continue to occur in the foreseeable future. In a couple of forthcoming years, the gold price will still arise.[7]

Using this method, the impact of an influential international incident on the subsequent gold price can be estimated, so as to make a more reasonable investment choice.

4. Conclusion

This paper primarily utilizes the Analytic Hierarchy Process (AHP) to classify international incidents, and thus, the advantages and limitations of AHP also reflect the strengths and weaknesses of this study.

The primary advantage of AHP lies in its ability to quantify and assign scores to incidents that share common characteristics, allowing for systematic comparisons. This approach, which has been less involved in previous research, offers a novel framework that can be adopted and expanded upon by future studies. By providing a structured method to evaluate and categorize complex events, AHP contributes to a more objective understanding of how international incidents might influence gold price fluctuations.

However, AHP is inherently subjective, and the final outcomes are influenced by the researcher's interpretation and expertise in assessing the relevant incidents. While this study provides valuable insights, the accuracy and reliability of the judgment matrices and scoring results depend on the researcher's understanding of the subject matter. It is anticipated that future research, building upon the foundation laid here, will offer deeper insights into the international incidents analyzed, refine the judgment matrices, and improve the precision of the scoring system, ultimately achieving a more comprehensive understanding of the relationship between international incidents and gold price fluctuations.

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