

Analysis on Gold and Silver Prices vs Geopolitical Risk (1985-2025)

Course: STAT 650A

Group Members: Section 1

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Introduction

Examining the changing connection between geopolitical risk and precious metal markets. Specifically, the prices of gold and silver between 1985 and 2025 are the aim of this investigation. The purpose of the study is to determine whether geopolitical tensions, as measured by a global geopolitical risk index, have an obvious effect on the price of gold and silver, which are typically regarded as safe-haven investments. The ultimate goal is to find out how well gold and silver protect against geopolitical unpredictability and how investors' ideas of risk and security have changed over the past four decades.

The research questions are:

- (1) Do geopolitical risk indexes and gold and silver prices have a relationship that is statistically significant (correlation or causal linkage)?
- (2) Is gold a greater "safe haven" than silver, and do they react differently to growing global tension?

Data Description

The dataset provides a thorough understanding of how global political tensions impact precious metal markets from 1985 to 2025 by combining daily gold and silver price data with the Global Geopolitical Risk Index (GPRD). We sourced the gold and silver market data from Investing.com, which contains opening, high, low, and % change numbers for both metals as well as daily spot prices. The Global Geopolitical Risk Index, developed by Matteo Iacoviello, is a globally recognized metric that measures geopolitical uncertainty by monitoring perceived threats (GPRD_THREAT) as well as real geopolitical acts (GPRD_ACT). The dataset has 15 columns (variables) and 10571 rows (data entries).

Key variables include:

- **DATE:** Daily trading date.
- **GOLD_PRICE / SILVER_PRICE:** Daily spot prices in USD.
- **GPRD:** Overall Geopolitical Risk Index (base 1985–2019 = 100).
- **GPRD_ACT:** Sub-index measuring realized geopolitical events.
- **GPRD_THREAT:** Sub-index measuring perceived geopolitical threats.

Missing and empty values were eliminated during data cleaning, and records of non-informative events were not included. Another numerical variable named "YEAR" was assigned, and it contains mean values of all dates of the same year which was later changed into the categorical variable "YEAR_GROUP" for better visualization.

- **Source: Kaggle**

<https://www.kaggle.com/datasets/shreyanshdangi/gold-silver-price-vs-geopolitical-risk-19852025/data>

Results

From 1985–2025, both gold and silver prices show long-term growth, but their reactions to geopolitical risk are very different. The prices of gold and silver both exhibit long-term rise from 1985 to 2025, but they respond to geopolitical risk in somewhat different ways. Over the years, gold has increased slowly, with noticeable spikes at high-risk times such as the early 2010s and after 2020. Gold's significant safe-haven role is confirmed by its scatter and hex plots, which indicate a positive link with the Geopolitical Risk Index (GPRD). In comparison, silver is more erratic; its prices change significantly but don't consistently react to rising GPRD. The majority of silver data clusters at moderate prices and low risk, suggesting weak safe-haven behavior. Whereas silver's trend is cyclical and transient, gold's is more steady and upward-shifting. The yearly summary also shows that higher GPRD years often align with higher gold prices, but not silver.

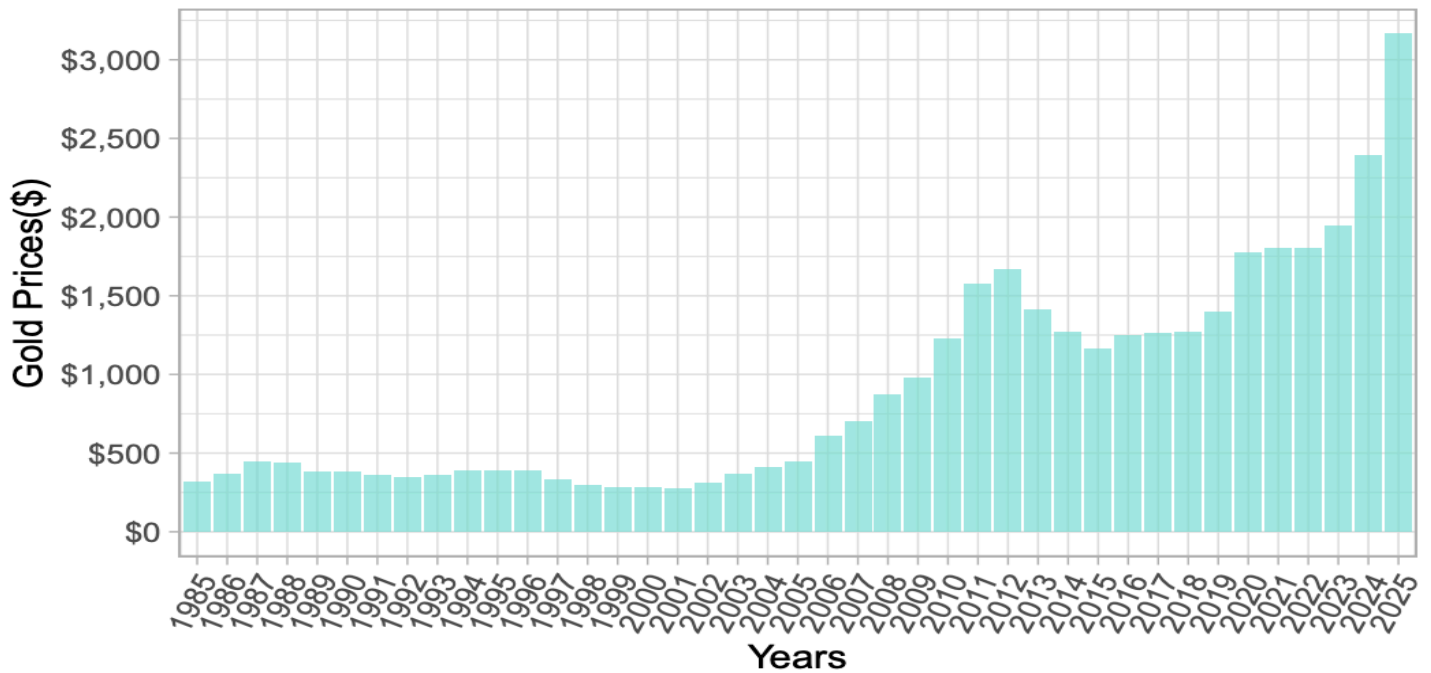
Summary Table:

A summary table provides the annual median values and quartile ranges for gold, silver, and geopolitical risk (GPRD) from 1985 to 2025. Gold prices were stable until the late 1990s but they increased significantly after 2005, increased again after the Covid era passes after 2023. On the other hand, Silver cost between \$4 and \$7 for years. From 2006 to 2012, they rose to over \$35 in 2011, then fluctuated somewhat. Reflecting significant geopolitical tensions, the GPRD index fell around 2000, rose in the early 2000s, and then rose once more in the 2020s. The GPRD index dipped around 2000, recovered in the early 2000s, and then surged again in the 2020s, reflecting substantial geopolitical tensions. Years with higher GPRD values also often have higher gold medians, confirming gold's significance as a safe haven. Nevertheless, there is a weaker and less consistent relationship between rising geopolitical risk and silver. Gold reacts more strongly to global uncertainty, according to the table, while silver is still more volatile but less sensitive to risk levels.

Characteristic	1985-1994 N = 2,577 ¹	1995-2004 N = 2,601 ¹	2005-2014 N = 2,344 ¹	2015-2025 N = 3,040 ¹
GOLD_PRICE	374 (349, 402)	321 (286, 383)	956 (661, 1,406)	1,499 (1,261, 1,899)
SILVER_PRICE	5 (4, 6)	5 (5, 5)	17 (13, 28)	19 (16, 24)
GPRD	100 (80, 127)	87 (60, 136)	92 (76, 114)	111 (84, 146)
¹ Median (Q1, Q3)				

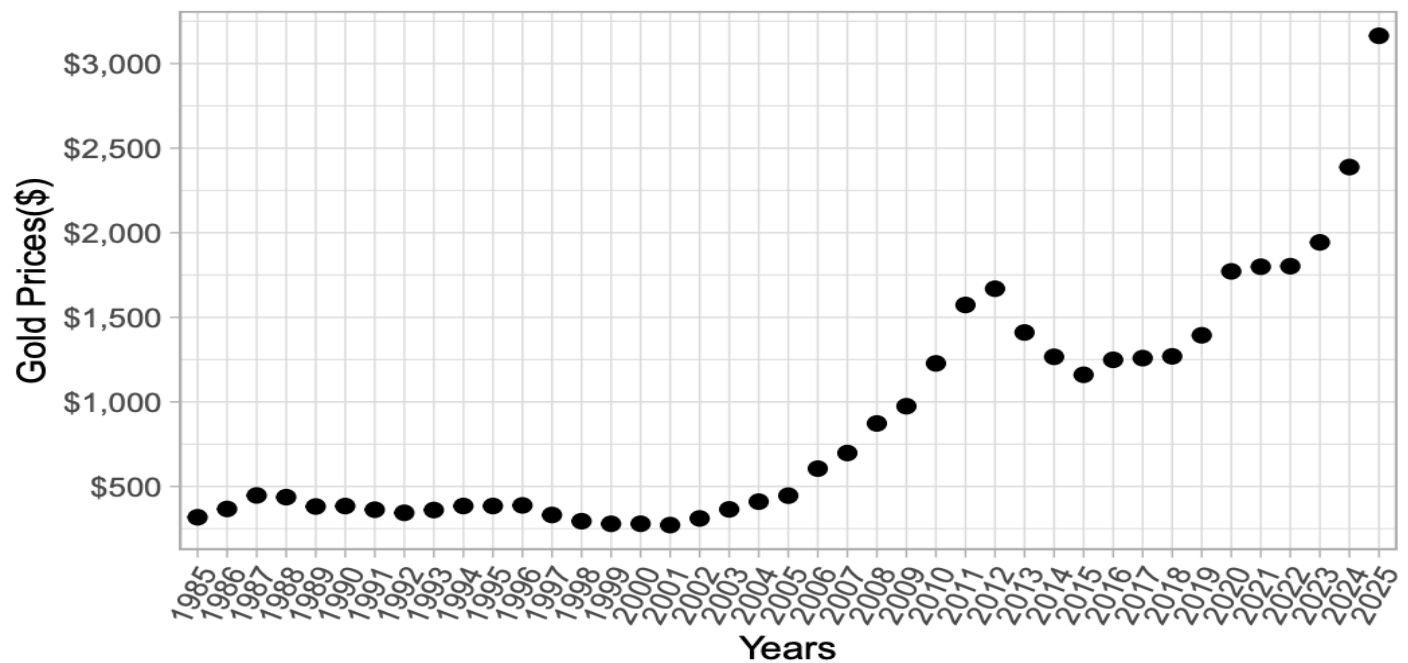
Data Visualization for Gold Prices and GPRD over Years:

Gold Prices w.r.t years(1985–2025)

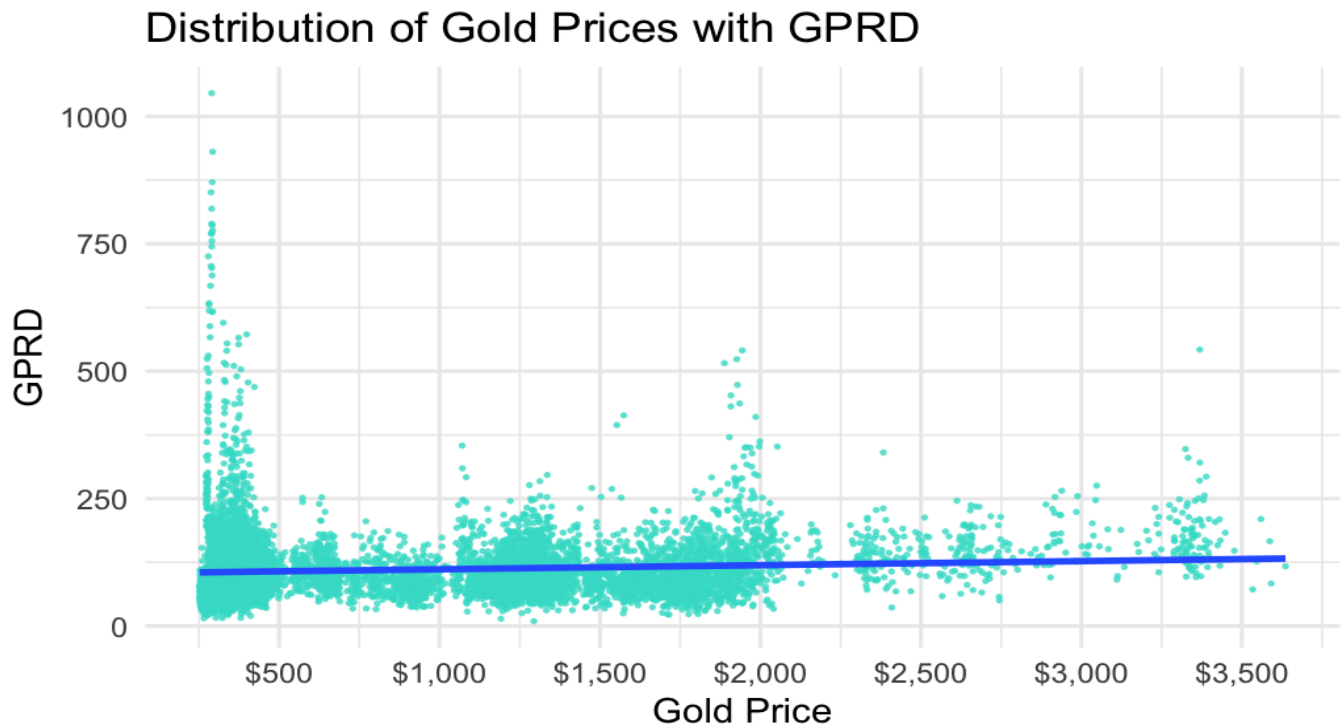


Between 1985 and 2000, gold prices were generally below \$400. Beginning in the 2000s, there was a slow increase that peaked in the post-financial crisis years of 2011–2012. Around 2020–2022, when inflation was on the rise and there was worldwide unpredictability due to the epidemic, there was another notable surge. The trend illustrates how, during periods of economic or geopolitical unrest, investors turn to gold as a "safe-haven" asset.

Gold Prices w.r.t years(1985–2025)



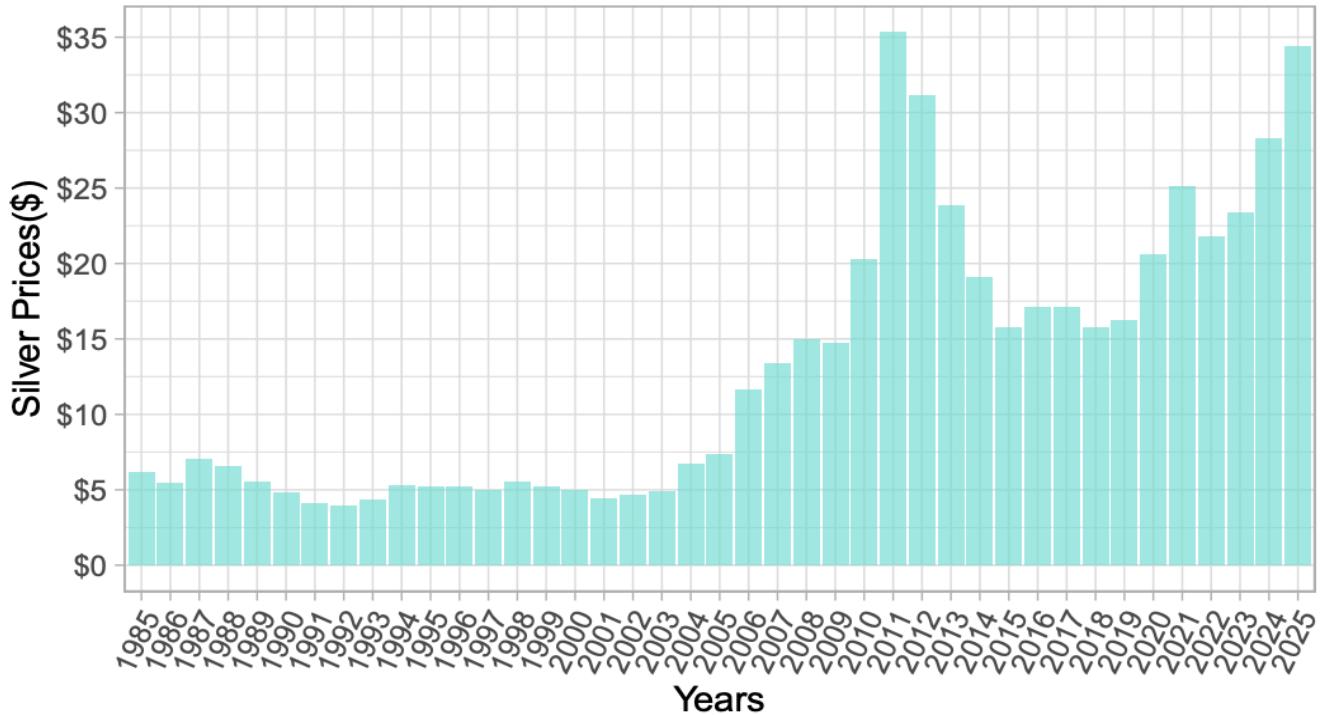
Line Plot shows that gold prices were about \$500 from 1985 to 2005.. Prices started to rise rapidly after 2006 and peaked during the financial crisis that lasted from 2008 to 2012. After a brief period (2013-2019) of stability before covid and it stabilized in Covid period after it kept increasing after 2022, took a great peak in 2025 hitting about \$3,500 by mid 2025 as a result of worldwide uncertainty.



The scatter plot below illustrates the relationship between daily gold prices and GPRD. Each dot represents a single trading day between 1985 and 2025. The fitted linear regression line shows a very weak upward trend, indicating that while gold prices are often viewed as a hedge against geopolitical uncertainty, the direct correlation with the GPRD index appears minimal. Scatter plot showing the relationship between Gold Price and GPRD.

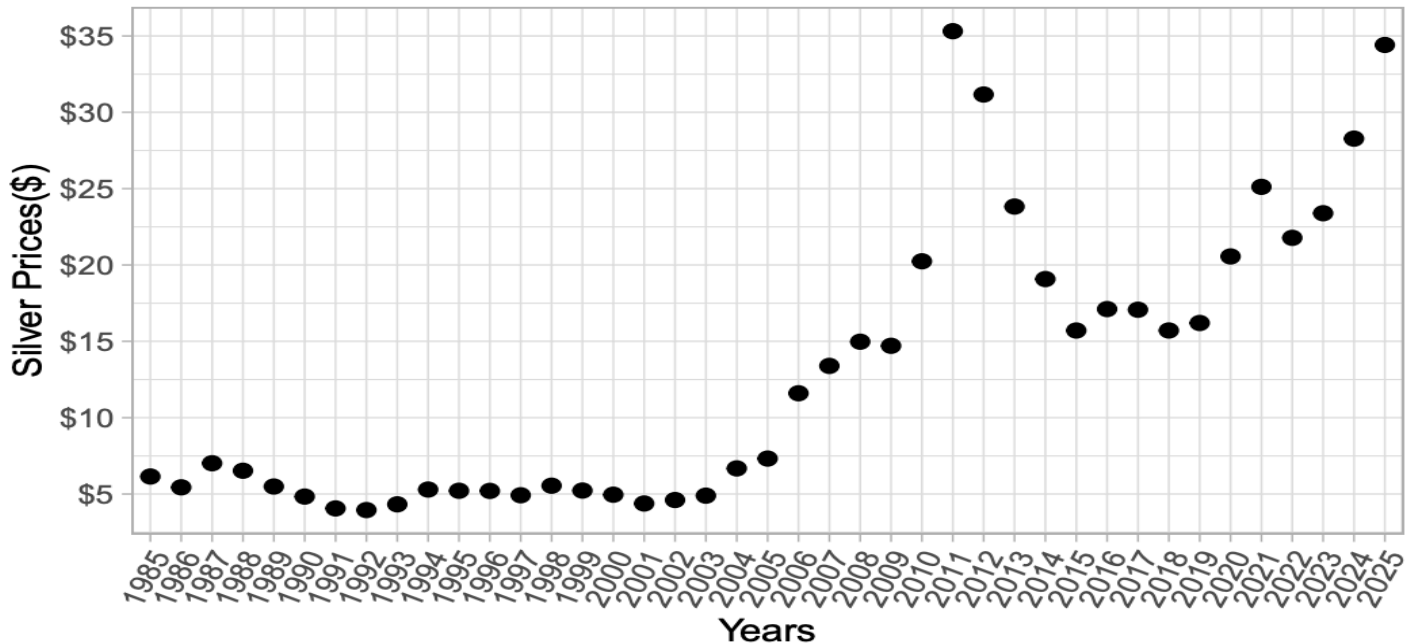
Data Visualization for Silver Prices and GPRD over years:

Silver Prices w.r.t years(1985–2025)

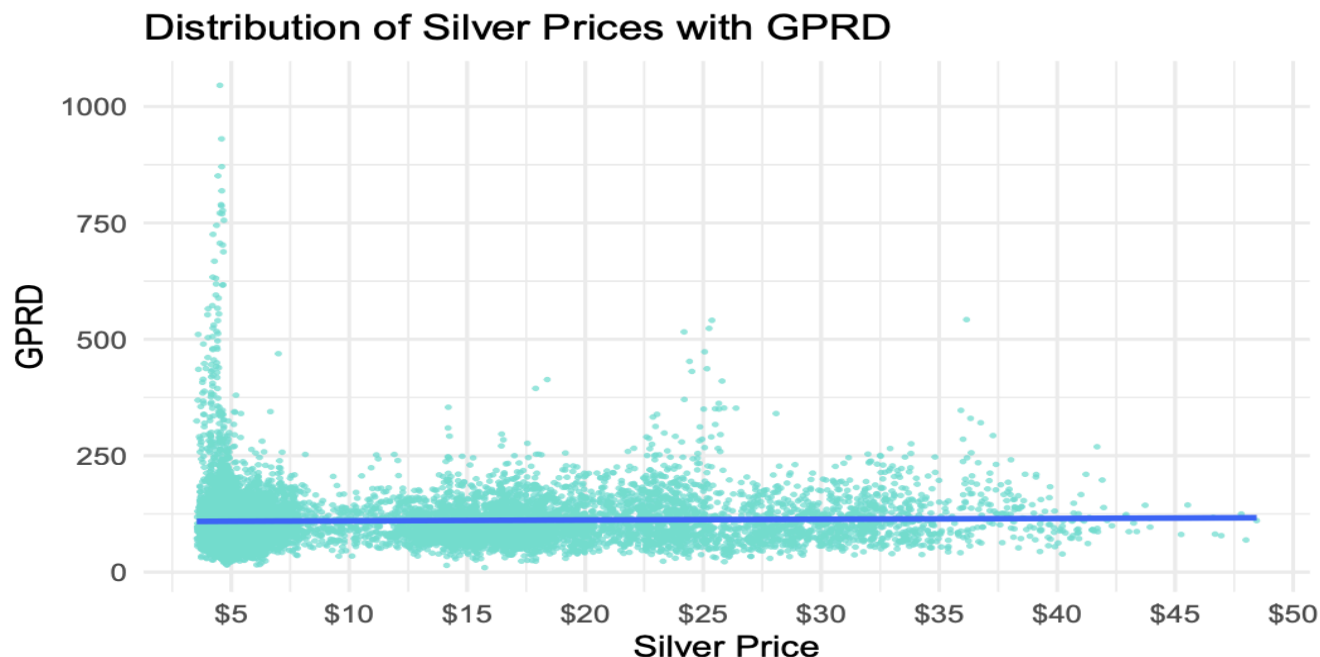


The histogram shows how average silver prices changed over time. From the mid-1980s to late 1990s, prices stayed low and steady around \$4-\$6 per ounce. They began to rise in the 2000s and reached a significant peak during the global financial and commodity boom in 2011. After a brief decline, prices soared once more after 2020, approaching \$30 by 2025 as geopolitical threats and inflation grew.

Silver Prices w.r.t years(1985–2025)

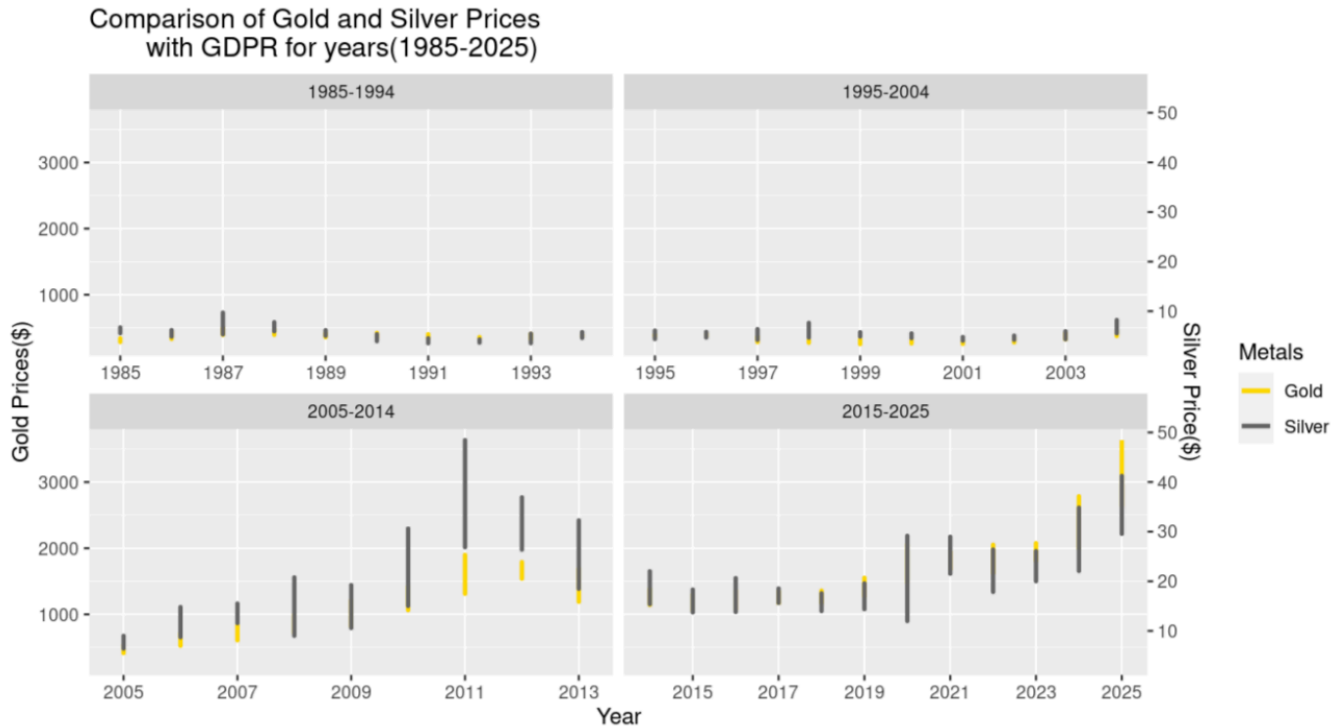


The line plot shows how silver prices have increased overall over the past 40 years. During the early years, prices remained constant but after 2000, they increased quickly reaching their peak in 2011. Silver recovered its vigor after 2020, despite a slight leveling off. This upward trend shows how silver tends to perform well when global uncertainty and inflation increase.



This scatter and hex plot shows the relationship between geopolitical risk levels and silver prices. Silver prices also tend to climb as GPRD rises, which indicates that tensions throughout the world are higher. Because silver is also impacted by industrial demand, the relationship isn't as strong as it is with gold. However, this demonstrates that in uncertain times, silver frequently serves as a semi-safe haven asset.

Comparison of Gold and Silver Prices with GPRD over years(1985-2025)



This combined plot compares **gold** and **silver** prices with the **Geopolitical Risk Index (GPRD)** over four decades. From **1985 to 2004**, both metals remained relatively low and stable, showing little reaction to global tensions. During **2005 to 2014**, gold prices surged sharply, reaching their peak around 2011 amid heightened geopolitical uncertainty, while silver also spiked but declined more rapidly. Between **2015 and 2025**, both metals rose again, with gold showing steady growth and silver displaying greater volatility. Overall, the plot highlights that **gold's upward trend is consistent and resilient during high-risk periods**, whereas **silver's movements are more irregular and short-lived**.