Analysis of the Investment Potential and Inflation-Hedging Ability of Precious Metals

July 23, 2007

James Ross McCown *
Meinders School of Business
Oklahoma City University
2501 N. Blackwelder
Oklahoma City, OK 73106

405-208-5473
Email: jmccown@okcu.edu

John R. Zimmerman
Meinders School of Business
Oklahoma City University
2501 N. Blackwelder
Oklahoma City, OK 73106

Email: jrzimmerman4@yahoo.com

Abstract:

Gold and silver show strong evidence of ability to hedge stock portfolios and inflation during the period from 1970 to 2006. However, negative betas are only observed for the 1970s, suggesting that it is the inflation-hedging ability that is the cause of the stock-hedging ability. Both metals show high correlation with expected future inflation as measured by the TIPS spreads, confirming Greenspan's (1993) conjecture that gold prices are an indicator of expected inflation.

JEL codes: E31, G11

Keywords: gold, silver, inflation
*Corresponding author.

Analysis of the Investment Potential and Inflation-Hedging Ability of Precious Metals

1. Introduction

The precious metals have been used as media of exchange and stores of value for millennia. In recent times their use as media of exchange has declined but they are still kept as stores of value as many investors have investments in gold or silver in various forms in their portfolios. This research examines the investment performance of the metals using the traditional asset pricing models used to evaluate securities, and also examines their usefulness as hedges against inflation and as indicators of expected future inflation.

Several researchers have previously examined the investment value of the precious metals. Jaffe (1989) finds that gold and silver have positive but very low betas when measured against U.S. stocks using monthly data for 1971 to 1987. Using daily returns from 1976 to 2004, Hillier, Draper, and Faff (2006) find that gold and silver have negative betas that are very small in absolute value but statistically significant when measured against U.S. stocks, thus providing hedging of an investor's stock portfolio. They also find that the betas are positive and small, but also statistically significant, when measured against foreign stocks.

Researchers have also examined the inflation-hedging ability of gold and silver.

Jaffe (1989) using monthly data finds that gold has a positive relation with inflation but that the R-squares are so low that he concludes there is "little relation between gold and consumer prices". However, Levin, MacMillan, Wright, and Ghosh (2004) find that cointegration techniques using monthly data from 1976 to 1999 show that gold can be regarded as a good long-term inflation hedge.

We test for the correlation between each of the metals and the U.S. CPI inflation rate from 1970 to 2006 using time horizons varying from one month to five years. We find that the correlation is very small at the one month horizon but becomes larger as the horizon is lengthened. These results confirm the findings of Jaffe (1989), and Levin, MacMillan, Wright, and Ghosh (2004) that the metals prices are unrelated with inflation at short time horizons and positively correlated with inflation at long time horizons.

We estimate the CAPM for gold and silver for the period from 1970 to 2006, against both U.S. and world stock portfolios, and also find that the betas are close to zero when short time horizons are examined but that they become negative and increase in absolute value and statistical significance as the time horizon is expanded. Subperiod analysis shows that the negative betas are confined to the high-inflation 1970s. During the period from 1980 to 2006 the betas are positive even for the longer time horizons. This shows that the ability of the metals to hedge against fluctuations in stock prices is primarily due to their ability to hedge against inflation.

Former Federal Reserve Board Chairman Alan Greenspan (1993) mentioned that he used gold prices as an indicator of expected future inflation. We test the ability of the metals prices to track expected inflation as computed from the yield spread between nominal U.S. Treasury securities and the U.S. Treasury Inflation Protected Securities (TIPS). We find that the prices of both metals show a large positive correlation with the expected future inflation rate, and that the correlation is highest for the time horizon over ten years. However, there were large increases in the metals prices beginning in September, 2005 that were not matched by corresponding increases in expected inflation.

Section 2 discusses the data. Section 3 looks at basic statistics for the metals prices, inflation, and stock returns. Section 4 discusses the estimation of the CAPM model for gold and silver. Section 5 examines the relation between the metals prices and expected future inflation. Section 6 concludes.

2. Data

There are several ways that an investor may take a position in gold or silver. They may purchase gold or silver bullion in the form of ingots or coins. If purchased in sufficient quantity, such items may be bought and sold for a small transaction cost. There are several companies that will store the ingots or coins for an investor and sell them when the owner desires. Investors can purchase mining stocks, whose earnings will usually rise and fall with the metals prices and perhaps provide leverage, but the profits earned by these companies are also dependent on management practices and other issues

that are not directly related to the metals prices. Derivatives based on the metals prices are available in many different varieties. The primary advantages of derivatives for an investor are to enable him to make leveraged bets on the metals or even to bet that their price might decline. Throughout this research we will assume an investor is purchasing gold or silver bullion and assume no transactions costs, since they would not be significantly higher than transactions costs for securities.

The precious metals data consist of the month-end spot prices for gold and silver. These were obtained from Datastream and various issues of the *Wall Street Journal* and begin with 1970. The continuously-compounded returns for each time horizon are computed by taking the change of the log spot prices from the beginning to the end of the period. For comparison purposes and for use in the asset pricing models, the following data are utilized:

(1) U.S. Inflation: Log change of the CPI-U, from the Federal Reserve Bank of St. Louis.

(2) Interest rates on U.S. Treasury bills: 30 day maturity, from various issues of the *Wall Street Journal*.

(3) Returns on U.S. MSCI stock portfolio, including dividends, from MSCI Barra.

(4) Returns on World MSCI stock portfolio, U.S. dollar-denominated, including dividends, from MSCI Barra. This shows the returns a U.S. investor earns if he does not hedge his foreign exchange risk.

(5) Returns on World MSCI stock portfolio, local currency – denominated, including dividends, from MSCI Barra. This shows the returns an investor living anywhere in the world earns if he completely hedges the foreign exchange risk.

3. Basic Statistics

Tables 1A, and 1B show summary statistics for the monthly log returns on the spot prices of gold and silver for 1970 to 2006. Both of the metals have returns inferior to the MSCI U.S. stock index, and higher volatility. Gold has a return that is over 2 percent less than that of stocks, and about 2 percent higher than that of U.S. Treasury bills over the same period. According to Jaffe (1989) the reason why gold has a lower return than other risky assets is due to nonpecuniary benefits. First, gold has liquidity value. It is the most liquid asset in times of catastrophe, and thus investors are willing to pay a premium price for it. Secondly, gold has consumption value as it is used in jewelry. An owner of gold jewelry receives utility that an owner of stocks or bonds does not. Finally, gold has a convenience value in production. A producer of gold jewelry holds gold in order to avoid stockouts, receiving a convenience yield. Silver has a return that is lower than Treasury bills. The low return on silver may be due to the same reasons stated by Jaffe for gold. As we shall show in this analysis, another reason for the low returns on the metals may be due to their value in hedging a portfolio.

We also looked at subperiods in tables 1A and 1B. Examination of the graph of the time series of gold and silver spot prices in figures 1 and 2 shows that the metals had

large increases in prices throughout the 1970s, reaching a maximum in January, 1980. The prices slowly decreased over the 1980s and 1990s, with a few reversals, reaching a minimum in August, 1999. This was followed by increasing prices beginning September, 1999 to the end of the sample. We have therefore looked at the summary statistics for three subperiods: (1) January, 1970 to January, 1980, (2) February, 1980 to August, 1999, and (3) September, 1999 to December, 2006.

For the first subperiod from January, 1970 to January, 1980, gold and silver had average annualized returns of over 29 percent, far in excess of stocks and inflation. During the second subperiod from February, 1980 to August, 1999, both metals had negative returns as compared with the large positive returns enjoyed by stocks. For the third subperiod from September, 1999 to December, 2006, gold and silver once again had positive returns, far in excess of inflation and the meager returns to stocks during the period.

The summary statistics, as well as figure 2, suggest a negative correlation between stocks and the metals, for which we test in table 2. We compute the correlation of the returns on the metals with each other and with inflation and each of the stock market portfolios. The correlations of the metals with the stock portfolios are close to zero for the short time horizon of one month, but as we examine larger and larger time horizons the correlation becomes increasingly negative, reaching as much as -0.643 for the correlation between gold and the U.S. stock portfolio, for the five year time horizon. The short-term movements between the metals and the stock prices appear to be independent, but over

the long-term we find strong evidence of an inverse correlation. This shows the possibility of using the metals to hedge an investment in stocks, which we examine further in the next section.

Also in table 2, the correlations between the returns on the metals and the US CPI inflation rate show considerable differences when different time horizons are examined. For a monthly time horizon, both gold and silver returns are virtually uncorrelated with inflation. Increasing the time horizon, we see higher and higher correlations, culminating in a positive correlation between gold and inflation of 0.711 and between silver and inflation of 0.530, for the five year horizon. Both metals show strong evidence of an ability to hedge inflation risk over the long term. These results confirm the findings of Jaffe (1989), who finds virtually no relation between gold prices and goods prices in the short-term, and Levin, MacMillan, Wright, and Ghosh (2004) who find that gold is a good long-term inflation hedge.

4. Estimates of the Capital Asset Pricing Model

In order to estimate the Capital Asset Pricing Model of Sharp (1964) and Lintner (1965) for the precious metals, the following ordinary least squares regression is estimated:

(1) $$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \varepsilon_t$$

where $R_{i,t}$ is the return on metal i, $R_{f,t}$ is the risk free rate (Yield on 30 day U.S. Treasury Bills), and $R_{m,t}$ is the return on the market portfolio. We use three different proxies for the market portfolio: MSCI U.S. index, MSCI World local currency – denominated index, and MSCI World U.S. dollar - denominated index.

The results for gold and silver from 1970 to 2006 are in table 3. The length of the time horizon can have a significant effect on the estimated beta coefficient. Using the one month time horizon, the estimated betas are positive and less than one (except for gold with the U.S. stock portfolio which has a negative beta that is close to zero). This result confirms the findings of Jaffe (1989) and Hillier, Draper, and Faff (2006) who find very small betas for gold and silver when measured against both U.S. and foreign stocks. Going to longer time horizons, the betas become increasingly negative, to as much as -2.086 for gold when using the World-local currency portfolio. We also ran the CAPM regressions for the three subperiods and the results are shown in tables 4, 5, and 6. We examined time horizons ranging from one month to one year. It is not practical to run the regressions for the longer time horizons of two or five years, because the samples are too small. From table 4, we see the negative betas for both gold and silver for the high-inflation 1970s. The betas generally become more negative as the horizon is increased. However in tables 5 and 6 for the subperiods from 1980 to 1999, and from 2000 to 2006, the betas are positive. The negative betas for the entire sample from 1970 to 2006 are primarily the result of the 1970s, a period of high inflation and poor stock returns. We conclude it is the inflation-hedging ability of gold and silver that is behind the stock-hedging ability seen in table 3.

We conducted an analysis (not shown) of the returns on gold and silver using the multiple-factor Arbitrage Pricing Model of Ross (1976). This provides a framework with which to evaluate an asset's exposure to multiple sources of risk simultaneously. We selected the macroeconomic factors following Chen (1991) and Chen, Roll, and Ross (1986) to include the market portfolio, default spread, term spread, change in U.S. industrial production, and change in the CPI inflation rate. The results were not informative except for the coefficients on the change in the inflation rate, which became more positive and statistically significant as the investment horizon was increased.

5. How Do Prices of the Metals Correlate with Expected Future Inflation?

Former U.S. Federal Reserve Board Chairman Alan Greenspan (1993) mentioned the price of gold as an indicator of expected inflation:

> Moreover, inflation expectations, at least by some measures, appear to have tilted upward this year, possibly contributing to price pressures. The University of Michigan survey of consumer attitudes, for example, reported an increase in the inflation rate expected to prevail over the next 12 months from about 3.75 percent in the fourth quarter of last year to nearly 4.5 percent in the second quarter of this year. Preliminary data imply some easing of such expectations earlier this month, but the sample from which those data are derived

is too small to be persuasive. Moreover, the price of gold, which can be broadly reflective of inflationary expectations, has risen sharply in recent months.

In 1993 there was no available method to directly measure expected inflation. The introduction of the U.S. Treasury Inflation Protected Securities (TIPS) beginning in 1997 gives us a method of estimating investors' expectations of future inflation by comparing the yield on a TIPS bond with that of a nominal bond of comparable maturity. The Fisher equation can then be used to estimate the expected inflation rate:

(2) $\pi^{e}_{tk} = i_{tk} - r_{tk}$

Where π^{e}_{tk} is the inflation rate that investors expect to prevail over the period t + k as of time t, i_{tk} is the yield on a nominal bond with maturity k as of time t, and r_{tk} is the yield on a TIPS bond with maturity k as of time t.

We obtained the yields of all 22 TIPS bonds from the *Wall Street Journal* as of the last business day in each month from January, 1997 when the first bond was issued up through the end of 2006. We also obtained the yield of a nominal bond with a maturity closest to the TIPS maturity to correspond with each of the TIPS bonds. The expected inflation rate was then computed from equation (2). The TIPS have been issued in maturities of 5, 10, 20, and 30 years. As each bond ages it gives us an estimate of expected inflation for a steadily decreasing time horizon. We broke down the available maturities for each month into five categories: Less than one year, one to two years, two to five years, five to ten years, and greater than ten years. There is not much coverage for the less than one year and one to two year maturity ranges for the period from 1997 to

2006, so we have left those out. There was at least one TIPS bond outstanding with a maturity from five to ten years for the entire 1997 – 2006 period. There were TIPS bonds outstanding with maturities from two to five years from July, 1997 to June, 2000 and January, 2002 to December, 2006. There were TIPS bonds outstanding with maturities greater than ten years from April 1998 to December, 2006.

The expected inflation rates extracted from the TIPS spreads are shown in figures 3, 4, and 5 alongside the corresponding end of month metals prices. Inspection of the graphs reveals co-movements between the metals prices and expected inflation from 1997 up until September, 2005 when the price of both metals increased rapidly without any corresponding increase in expected inflation. We computed the simple correlation between the metals prices and the expected inflation for each of the three time horizons. The results are shown in table 7. The correlations are positive and generally higher for gold, especially for the time horizon greater than ten years, for which we obtained a correlation coefficient of 0.679. We also computed the correlations for the time period ending August 31, 2005, which was just before the metals prices increased significantly beginning in September, 2005. In all cases but one, the correlations were higher for the period ending August 31, 2005. As Greenspan (1993) discussed, policy makers can use the price of gold (and silver) as a secondary indicator for expected future inflation. Gold has a generally higher correlation with expected inflation than silver and is most useful for indicating long-term expectations.

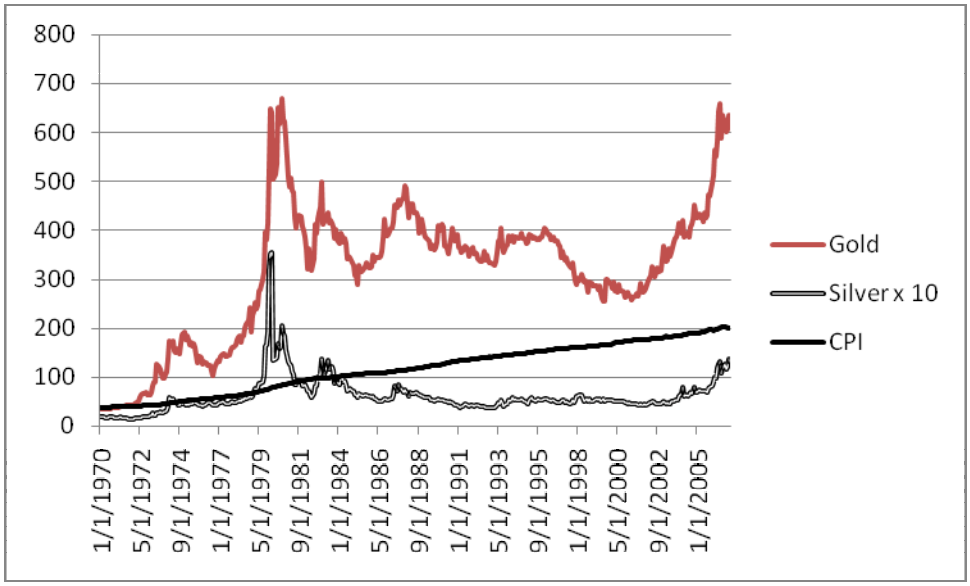
6. Conclusions

Gold and silver show evidence of ability to hedge a stock portfolio. Estimates of the CAPM result in negative betas for both metals. The negative betas are greater in absolute value at longer time horizons. Both metals also show ability to hedge inflation, which increases in effectiveness at longer time horizons. Subperiod analysis reveals that the negative betas are confined to the high-inflation 1970s, leading to the conclusion that it is the metals' abilities to hedge inflation that is the cause of the negative betas.

Confirming Greenspan's (1993) claim that the price of gold is a useful indicator of expected inflation, both gold and silver prices show high correlation with expected inflation as measured by the spread between nominal U.S. Treasury securities and TIPS yields.

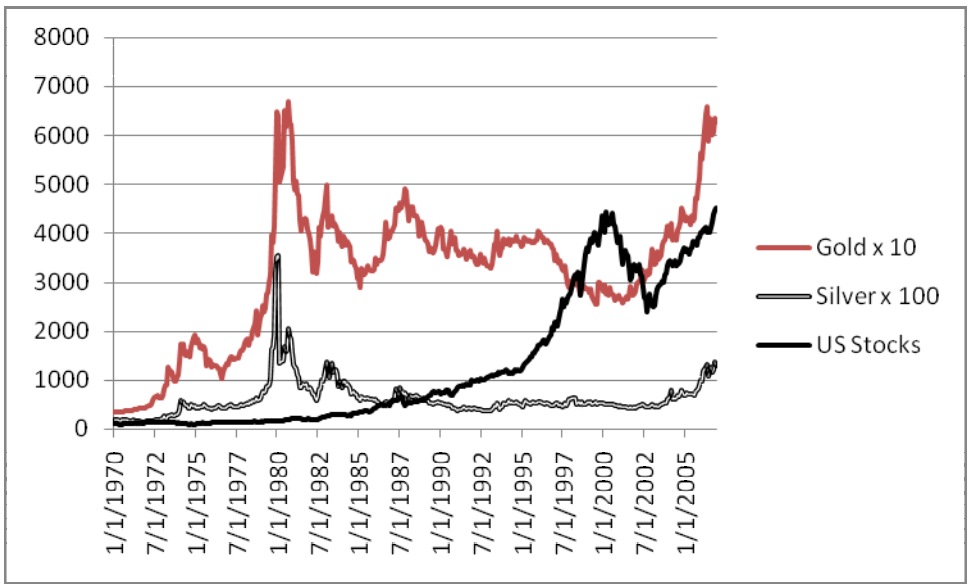
The authors wish to thank Emily Cunningham for research assistance, and to Eric Levin for helpful comments.

Figure 1
Gold and Silver Prices Compared with the Consumer Price Index
1970 - 2006



CPI-U with Index 1982 – 1984 = 100

Figure 2
Gold and Silver Prices Compared with US Stocks
1970 - 2006



US Stocks are the MSCI US Index which assumes all dividends are reinvested

Figure 3
Metals Prices and 2 – 5 Year Expected Inflation from TIPS Yields
1997 - 2006

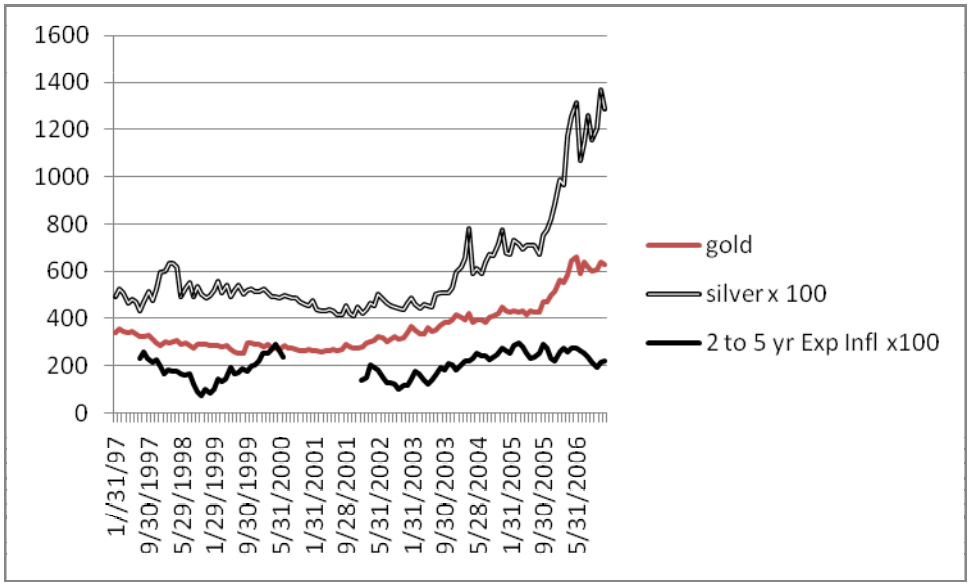


Figure 4
Metals Prices and 5 – 10 Year Expected Inflation from TIPS Yields
1997 - 2006

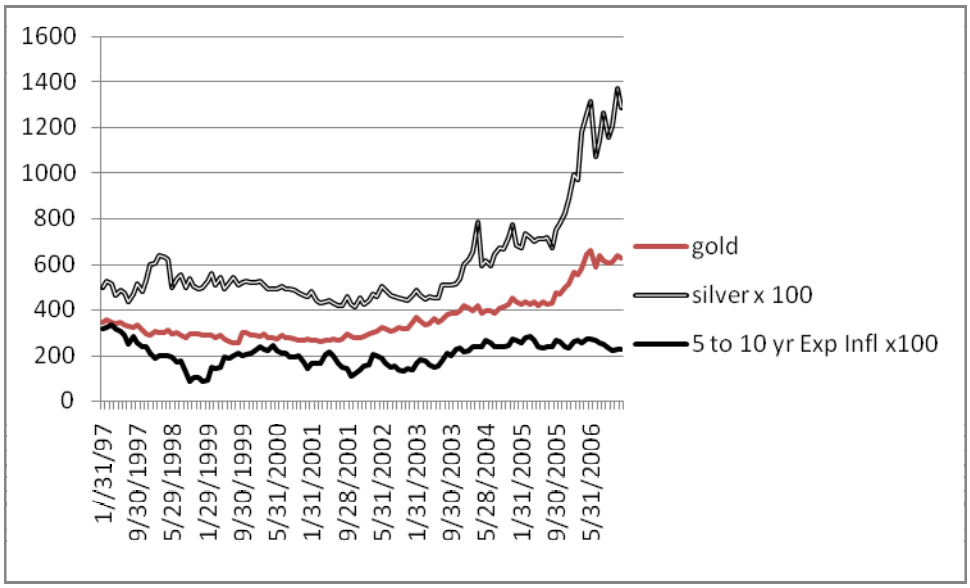


Figure 5
Metals Prices and Greater than 10 Year Expected Inflation from TIPS Yields
1997 - 2006

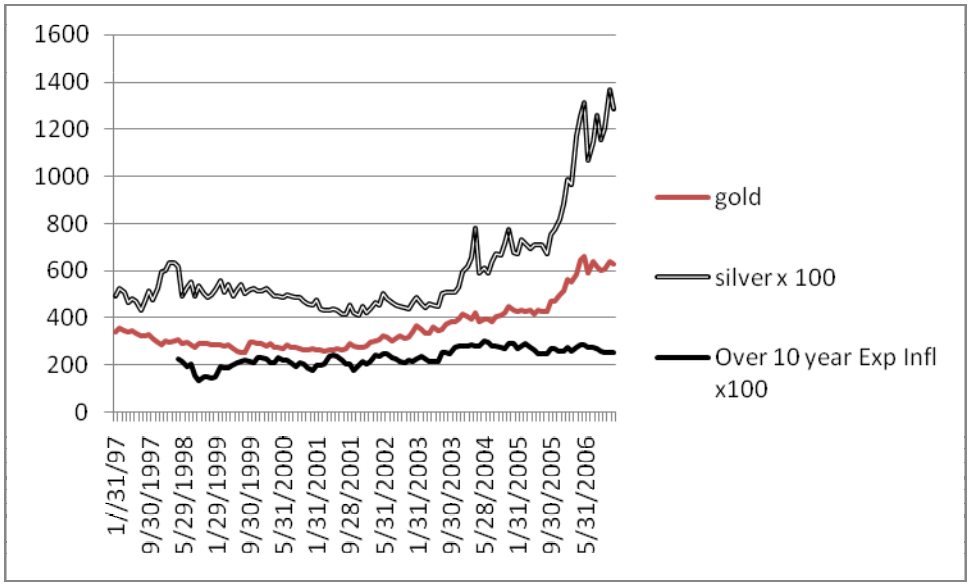


Table 1A
Summary Statistics

Monthly Data: 1970 - 2006

	Mean Annualized Return	Standard Deviation	First-order Autocorrelation
Gold	7.84%	6.06%	0.031
Silver	5.16	9.60	-0.010
US Inflation†	4.54	0.35	0.582
US TBills*	5.78	2.83	0.973
US Stocks°	10.29	4.39	0.015
World Stocks – US$ denominated°	10.27	4.12	0.073
World Stocks – Local currency denominated°	9.46	3.95	0.091

Subperiod: January, 1970 – January, 1980

	Mean Annualized Return	Standard Deviation	First-order Autocorrelation
Gold	29.26%	8.11%	0.092
Silver	29.14	9.99	0.099
US Inflation†	7.22	0.35	0.461
US TBills*	6.17	1.98	0.951
US Stocks°	5.05	4.56	0.019
World Stocks – US$ denominated°	7.26	4.06	0.156
World Stocks – Local currency denominated°	5.94	3.89	0.146

* Ask yield on 30 day U.S. Treasury Bills
† Log change of the monthly CPI-U index
° Continuously-compounded returns on the MSCI portfolios, including dividends

Table 1B
Summary Statistics {Continued}

Subperiod: February, 1980 – August, 1999

	Mean Annualized Return	Standard Deviation	First-order Autocorrelation
Gold	-4.78%	4.90%	-0.094
Silver	-9.89	10.10	-0.062
US Inflation†	3.90	0.29	0.351
US TBills*	6.59	2.93	0.965
US Stocks°	16.04	4.31	-0.006
World Stocks – US$ denominated°	13.99	4.15	0.026
World Stocks – Local currency denominated°	13.46	3.95	0.054

Subperiod: September, 1999 – December, 2006

	Mean Annualized Return	Standard Deviation	First-order Autocorrelation
Gold	12.29%	4.38%	-0.163
Silver	12.65	6.89	-0.202
US Inflation†	2.57	0.36	0.351
US TBills*	2.82	1.72	0.984
US Stocks°	2.15	4.23	-0.006
World Stocks – US$ denominated°	4.46	4.08	0.059
World Stocks – Local currency denominated°	3.62	3.99	0.081

* Ask yield on 30 day U.S. Treasury Bills
† Log change of the monthly CPI-U index
° Continuously-compounded returns on the MSCI portfolios, including dividends

Table 2
Correlations of Returns on Metals with Inflation and Stock Returns
1970 – 2006

Correlations of Gold with:

Time Horizon	Silver	Inflation	US Stocks*	World Stocks – US$ denominated*	World Stocks – Local currency denominated*
One Month	0.665	0.128	-0.028	0.119	0.021
Two Months	0.689	0.140	-0.093	0.076	-0.025
Three Months	0.615	0.247	-0.080	0.079	-0.043
Six Months	0.633	0.234	-0.189	0.038	-0.123
One Year	0.766	0.425	-0.340	-0.161	-0.276
Two Years	0.858	0.596	-0.471	-0.238	-0.369
Five Years	0.926	0.711	-0.643	-0.411	-0.598

Correlations of Silver with:

Time Horizon	Gold	Inflation	US Stocks*	World Stocks – US$ denominated*	World Stocks – Local currency denominated*
One Month	0.665	0.038	0.111	0.201	0.159
Two Months	0.689	0.025	0.097	0.194	0.166
Three Months	0.615	0.064	0.097	0.138	0.096
Six Months	0.633	0.046	0.072	0.122	0.074
One Year	0.766	0.213	-0.110	-0.047	-0.072
Two Years	0.858	0.517	-0.281	-0.098	-0.193
Five Years	0.926	0.530	-0.532	-0.458	-0.582

* Returns on MSCI indexes, including dividends

Table 3
Estimates of the CAPM for Gold and Silver
1970 – 2006

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \varepsilon_t$$

Gold: **Beta of Risk Premium against Market Proxy:**

Time Horizon	US Stocks	World Stocks – US$ denominated	World Stocks – Local currency denominated
One Month	-0.028 (-0.337)	0.184 (2.042)	0.044 (0.502)
Two Months	-0.110 (-0.158)	0.131 (1.357)	-0.017 (-0.158)
Three Months	-0.071 (-0.641)	0.125 (1.325)	-0.027 (-0.289)
Six Months	-0.242 (-0.952)	0.106 (0.420)	-0.153 (-0.657)
One Year	-0.457 (-1.462)	-0.177 (-0.524)	-0.370 (-1.199)
Two Years	-0.678 (-2.020)	-0.331 (-0.785)	-0.562 (-1.457)
Five Years	-1.628 (-3.812)	-1.616 (-2.632)	-2.086 (-3.234)

Silver:

One Month	0.260 (1.748)	0.487 (2.569)	0.406 (2.309)
Two Months	0.255 (1.637)	0.491 (2.780)	0.449 (2.517)
Three Months	0.235 (1.667)	0.336 (2.198)	0.258 (1.971)
Six Months	0.228 (0.727)	0.362 (1.099)	0.247 (0.860)
One Year	-0.161 (-0.542)	-0.002 (-0.007)	-0.076 (-0.244)
Two Years	-0.367 (-1.081)	-0.101 (-0.247)	-0.256 (-0.629)
Five Years	-1.309 (-3.472)	-1.713 (-2.810)	-1.965 (-2.946)

$R_{i,t} - R_{f,t}$ = log return on metal minus the 30 day Treasury bill yield
$R_{m,t} - R_{f,t}$ = return on the MSCI index, including dividends, minus the 30 day Treasury bill yield
Robust t-statistics in parentheses computed using the method of Newey and West (1987)

Table 4
Estimates of the CAPM for Gold and Silver
Subperiod Analysis: 1970 - 1979

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \varepsilon_t$$

Gold: **Beta of Risk Premium against Market Proxy:**

Time Horizon	US Stocks	World Stocks – US$ denominated	World Stocks – Local currency denominated
One Month	-0.130 (-0.701)	0.202 (1.038)	0.012 (0.060)
Two Months	-0.390 (-2.165)	-0.098 (-0.550)	-0.251 (-1.185)
Three Months	-0.100 (-0.486)	0.094 (0.648)	-0.052 (-0.258)
Six Months	-0.773 (-3.941)	-0.563 (-2.340)	-0.762 (-3.479)
One Year	-0.934 (-2.839)	-0.972 (-2.717)	-0.916 (-2.503)

Silver:

One Month	0.092 (0.489)	0.396 (1.844)	0.305 (1.357)
Two Months	0.068 (0.271)	0.318 (1.070)	0.278 (0.934)
Three Months	0.215 (0.868)	0.333 (1.052)	0.256 (0.921)
Six Months	-0.351 (-2.203)	-0.434 (-1.935)	-0.391 (-2.033)
One Year	-0.451 (-1.143)	-0.687 (-2.100)	-0.510 (-1.470)

$R_{i,t} - R_{f,t}$ = log return on metal minus the 30 day Treasury bill yield
$R_{m,t} - R_{f,t}$ = return on the MSCI index, including dividends, minus the 30 day Treasury bill yield
Robust t-statistics in parentheses computed using the method of Newey and West (1987)

Table 5
Estimates of the CAPM for Gold and Silver
Subperiod Analysis: 1980 - 1999

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \varepsilon_t$$

Gold: **Beta of Risk Premium against Market Proxy:**

Time Horizon	US Stocks	World Stocks – US$ denominated	World Stocks – Local currency denominated
One Month	0.088 (0.762)	0.246 (1.960)	0.131 (1.050)
Two Months	0.135 (0.861)	0.308 (2.104)	0.169 (0.999)
Three Months	0.032 (0.188)	0.234 (1.398)	0.039 (0.251)
Six Months	0.295 (0.948)	0.582 (2.375)	0.265 (0.969)
One Year	0.376 (0.870)	0.590 (1.929)	0.277 (0.867)

Silver:

One Month	0.440 (1.656)	0.631 (1.970)	0.577 (1.890)
Two Months	0.489 (1.705)	0.665 (2.227)	0.654 (2.004)
Three Months	0.384 (1.840)	0.410 (1.940)	0.319 (1.732)
Six Months	0.968 (2.312)	0.938 (2.372)	0.754 (2.092)
One Year	0.754 (1.633)	0.658 (2.336)	0.543 (1.492)

$R_{i,t} - R_{f,t}$ = log return on metal minus the 30 day Treasury bill yield
$R_{m,t} - R_{f,t}$ = return on the MSCI index, including dividends, minus the 30 day Treasury bill yield
Robust t-statistics in parentheses computed using the method of Newey and West (1987)

Table 6
Estimates of the CAPM for Gold and Silver
Subperiod Analysis: 2000 - 2006

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \varepsilon_t$$

Gold: **Beta of Risk Premium against Market Proxy:**

Time Horizon	US Stocks	World Stocks – US$ denominated	World Stocks – Local currency denominated
One Month	-0.057 (-0.565)	0.075 (0.662)	-0.043 (-0.377)
Two Months	0.074 (0.584)	0.220 (1.523)	0.126 (0.898)
Three Months	0.063 (0.504)	0.125 (0.987)	0.061 (0.473)
Six Months	0.299 (1.057)	0.381 (1.914)	0.298 (1.175)
One Year	0.245 (1.109)	0.271 (1.452)	0.216 (1.015)

Silver:

One Month	0.196 (1.550)	0.315 (2.101)	0.207 (1.397)
Two Months	0.394 (1.933)	0.542 (2.289)	0.493 (2.194)
Three Months	0.284 (1.884)	0.380 (2.444)	0.331 (1.878)
Six Months	0.713 (2.476)	0.729 (3.605)	0.703 (2.744)
One Year	0.762 (2.758)	0.726 (3.257)	0.747 (3.092)

$R_{i,t} - R_{f,t}$ = log return on metal minus the 30 day Treasury bill yield
$R_{m,t} - R_{f,t}$ = return on the MSCI index, including dividends, minus the 30 day Treasury bill yield
Robust t-statistics in parentheses computed using the method of Newey and West (1987)

Table 7
Correlations Between Metal Prices and Expected Future Inflation from TIPS Spreads

From Beginning of Sample to December 31, 2006:

	Correlation with Expected Inflation for Time Horizon		
	2 – 5 Years*	5 – 10 Years‡	Over 10 Years◦
Gold	0.522	0.509	0.679
Silver	0.492	0.429	0.542

From Beginning of Sample to August 31, 2005:

	Correlation with Expected Inflation for Time Horizon		
	2 – 5 Years*	5 – 10 Years‡	Over 10 Years◦
Gold	0.487	0.520	0.776
Silver	0.573	0.458	0.621

* July, 1997 to June, 2000 and January, 2002 to end of period
‡ January, 1997 to end of period
◦ April, 1998 to end of period

Bibliography

Chen, N., 1991. Financial investment opportunities and the macroeconomy. *Journal of Finance* 66, 529 – 554.

Chen, N., R. Roll, and S. Ross, 1986. Economic forces and the stock market. *Journal of Business* 59, 383 – 403.

Greenspan, A., 1993. The Fed aims for price stability. *Challenge* 36, Sep/Oct93 Issue 5, 4-10.

Hillier, D., P. Draper, and R. Faff, 2006. Do Precious Metals Shine? An Investment Perspective. *Financial Analysts Journal* 62, 98 – 106.

Jaffe, J., 1989. Gold and gold stocks as investments for institutional portfolios. *Financial Analysts Journal*, March – April, 53 – 59.

Levin, E., P. MacMillan, R. Wright, and D. Ghosh, 2004. Gold as an inflation hedge? *Studies in Economics and Finance* 22, 1 – 25.

Lintner, J., 1965. The valuations of risk assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics* 47, 221 – 245.

Newey, W. and K. West, 1987. A simple, positive semi-definite heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica* 55, 703 – 708.

Ross, S., 1976. The arbitrage theory of capital asset pricing. *Journal of Economic Theory* 13, 341 – 360.

Sharpe, W., 1964. Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance* 19, 425 – 442.