

by Anthony F. Herbst

Gold versus U.S. Common Stocks: Some Evidence on Inflation Hedge Performance and Cyclical Behavior

Over the very long term- that is, from 1800 to 1976-gold has proved to be inferior to the stock market both as an investment and as an inflation hedge. On the other hand, gold has exhibited a characteristic that is rare in common stocks: It has had a strongly negative beta over a span of several years. Thus gold may sometimes be used within a portfolio to reduce or eliminate systematic risk.

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An examination of the long-term relationship between the price of gold and the stock market in the United States suggests that, over the very long term, gold may be inferior to the stock market as investment and as inflation hedge, even when dividends on stock investments are excluded. Whether or not historical relationships will continue to hold in an era in which gold is no longer formally linked to the dollar is open to question, however. Furthermore, based on its characteristics in the portfolio context, gold can play an important role in portfolio investment management.

IF ONE ACCEPTS the hypothesis that the likely profit performance of an investment medium is inversely related to the promotional efforts of those attempting to sell it, then one would not have selected precious metals-gold in particular-for capital appreciation in early 1980. The financial pages of any newspaper were rife with advertisements touting the merits of gold as its price mounted to a record \$850 per ounce in January 1980. The implication, if not outright assertion, of these ads was that gold was not only the premier inflation hedge and, in the event of hyperinflation, survival insurance *par excellence*, but also an investment offering a premium over the inflation rate.

One often hears the promotion of precious metals as a counterpoint to a background chorus bewailing the overall performance of common stocks. Few would argue that, after adjustment for inflation and taxes, the U.S. stock market has performed well in recent years, particularly in comparison to its performance from the end of World War II to 1967. But has gold done any better? This article looks at the relative long-term performances of gold and the U.S. stock market after adjustment for inflation, examining the trends in the real prices of gold and common stocks, the cycles within these trends, and any comovement between them.

The Data

Our investigation covers the years from 1800 through 1976 (a period for which suitable data are available) and employs three data series-an index of the price of gold, an index of the United States wholesale commodity prices, and a stock market index (converted to annual averages to conform to the data available for gold and wholesale prices).¹ These three index time series are adjusted so that the year 1930 has the base value of 100.0. We divided the gold and stock market index series by the corresponding price index values to convert to real, or purchasing power values, and employed the logarithms of these values in the analysis.

Taxes are ignored on the basis that capital gains on gold and stock investments are affected equally. Because of lack of data, dividend returns are also ignored. It is important to recognize that any returns on investment in gold come entirely from capital appreciation. Although capital appreciation on common stocks is an important constituent of total return, dividends may be an even more important consideration to many investors. Capital appreciation in common stocks is a function of growth in company earnings, resulting either in near-term dividend growth or, through reinvestment, in the promise of still greater dividends in the future. Thus the omission of dividends tends to penalize the apparent performance of stocks relative to gold.

Anthony Herbst is Associate Professor of Finance at the University of Texas at Arlington.

1. Footnotes appear at end of article.

Figure B Cyclicalty in Stock Index and Gold

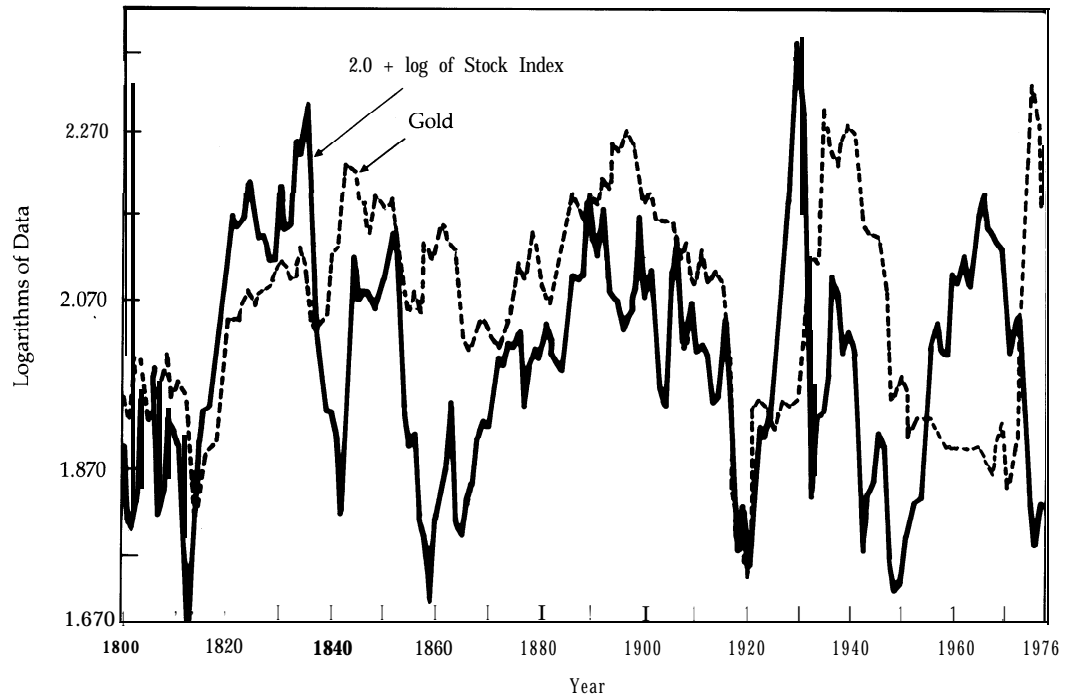
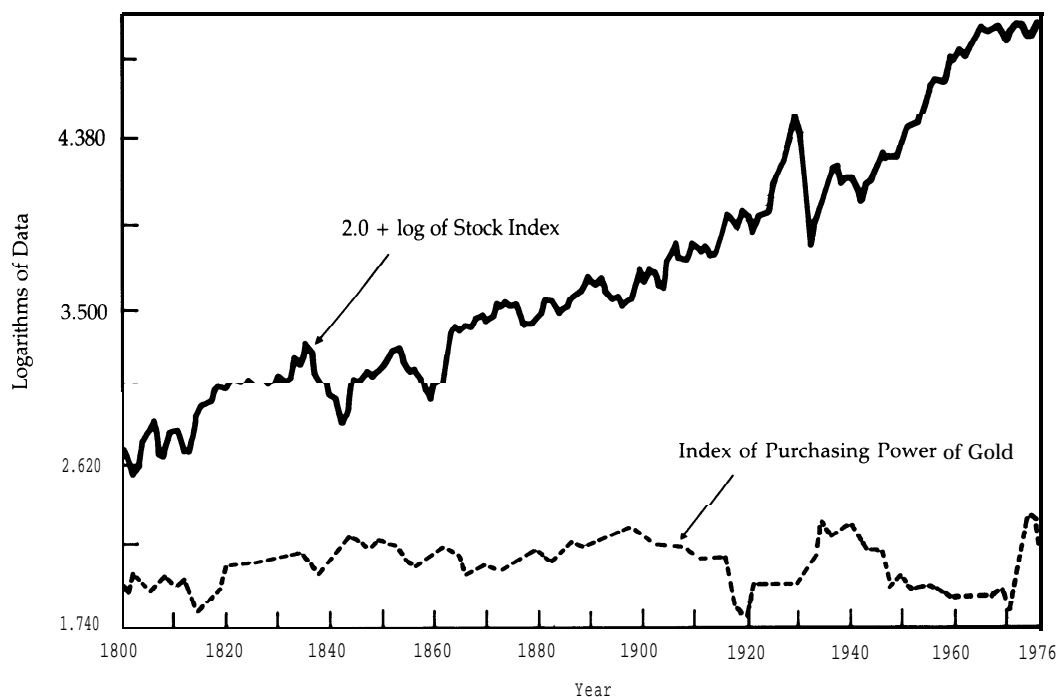


Table I U.S. Gold and Stocks in Periods of Inflation and Deflation

Time Span	Years	Prices		Gold		Stocks	
		Overall Percentage Change	Least Squares Average Rate (%)	Overall Percentage Change	Least Squares Average Rate (%)	Overall Percentage Change	Least Squares Average Rate (%)
INF 1808-1814	6	+58	+6.70	-37	-6.28	+6.15	3.95
DEF 1814-1830	16	-50	-4.01	+100	+4.18	+254.49	+6.81
INF 1843-1857	14	+48	+2.70	-33	-2.63	+5.30	-0.21
INF 1861-1864	3	+117	+29.27	-6	-1.89	+0.43	+2.06
DEF 1864-1897	33	-65	-2.91	+40	+1.68	+275.16	+4.27
INF 1897-1920	23	+232	+4.12	-70	-3.96	-18.86	-0.27
DEF 1929-1933	4	-31	-9.69	+44	+10.74	-61.13	-25.20
INF 1933-1951	18	+168	+5.34	-37	-4.27	+14.78	-1.25
INF 1951-1976	25	+101	+2.32	+80	+2.28	+88.47	+2.58
INF 1951-1971	20	+25	+1.08	-6	0.54	+174.71	+5.46
INF 1971-1976	5	+61	+11.40	+91	+16.82	-31.39	+10.46

Figure A Purchasing Power of Stock Index and Gold



Long-Term Trends and Cyclicity

Figure A plots the real prices of gold and the stock index over time. The evidence indicates a strong linear trend in the stock price index, but no apparent trend for gold.² The slope of the real stock price series translates into an annual growth rate of 2.35 per cent, versus zero growth for the gold series. At this rate of growth, the real stock index doubles approximately every 30 years. In other words, common stocks have provided price appreciation over and above what would be required of an inflation hedge, even when dividends are ignored.

The real price of gold, on the other hand, has on average remained constant. A constant real price is exactly what we should expect of a perfect inflation hedge, by definition. In the case of gold, however, the average disguises some fairly wide fluctuations in purchasing power. At its highest real price, gold would buy more than 3.8 times as much as it would at its lowest real price.³ One might argue that it would be reasonable to expect less variation of an ideal inflation hedge.

Figure B plots the purchasing power of gold and the deviations from trend of the purchasing power

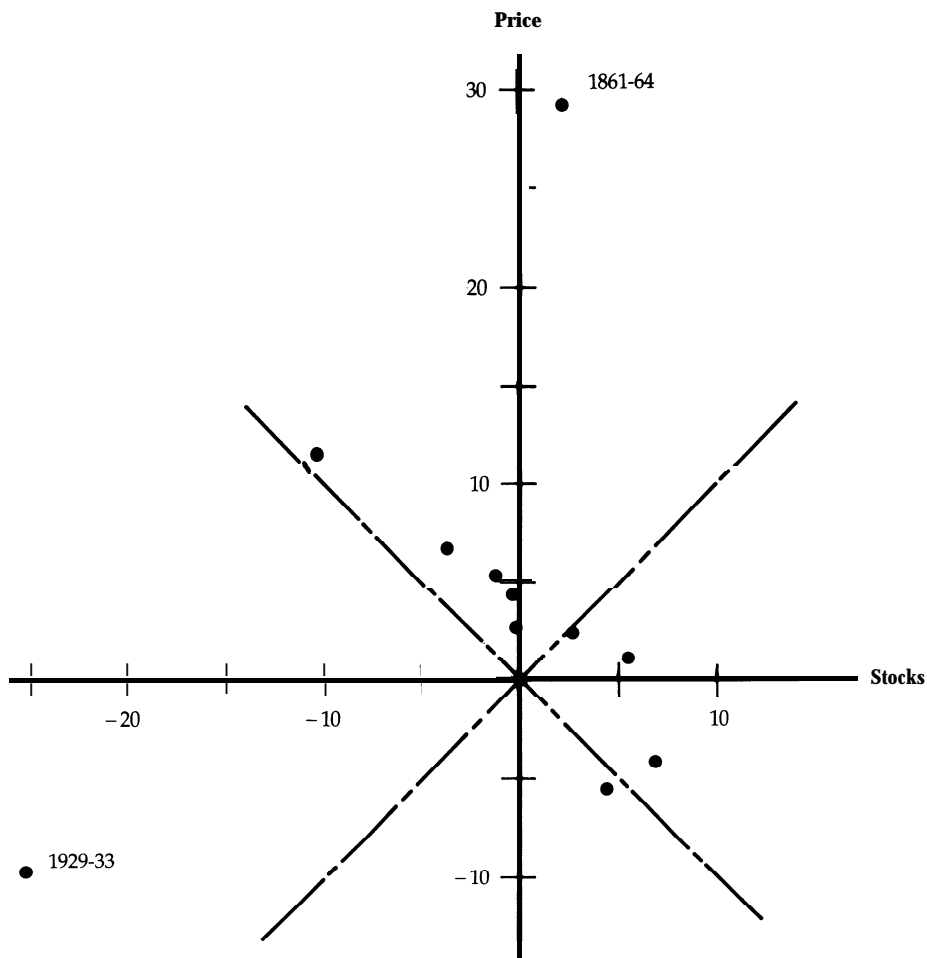
of the stock price index (the latter were augmented by 2.0 to enhance comparability with gold and to eliminate all negative values). The visual evidence suggests low frequency, long cycles in the two series and joint movement between them. The appendix to this article details the results of spectral and cross-spectral analyses employed to examine the cyclical tendencies in the data and to detect any possible lead or lag relationships between the corresponding cyclical components of the two series.

The cyclical factors present within and between the gold price and stock price series over time suggest that they are related, but not in phase. One will often be rising while the other declines. This in itself implies that an investment strategy based on accumulating gold while rejecting common stocks will be inappropriate at some times, whereas the opposite strategy will be inappropriate at other times.

Gold and Stocks in Inflation and Deflation

Table I summarizes the performance of gold and common stocks in the U.S. over periods of inflation and deflation.⁴ In the U.S., periods of war have been closely associated with inflation, whereas

Figure C Annual Average Growth Rates in U.S. Commodity Prices vs. Purchasing Power of Common Stocks for Selected Periods



postwar periods have been associated with deflation. The association is less than absolutely reliable, however, notably for the period following World War II. Furthermore, the price level effects of war are often evident in the years preceding actual military involvement, as was the case in 1808-14.

Stocks

Figure C plots average annual price level changes against changes in the purchasing power of common stock prices. The Civil War (1861-64) period lies far from the other points. The 1929-33 point is also an anomaly, because the average annual rate of decline in stock prices was far greater than the decline in the commodity price level. Most of the points lie above the downward sloping 45-degree

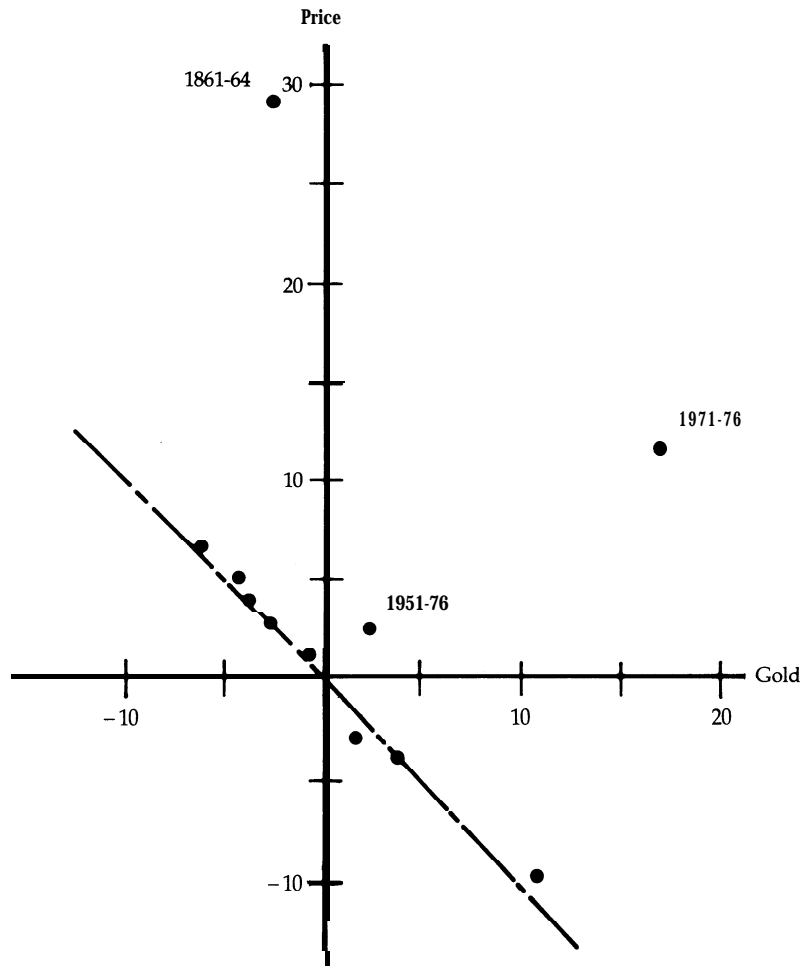
line and to the left of the price axis. This means that commodity prices have tended to rise faster than the (price-level adjusted) value of common stocks during periods of inflation.

In two of the three deflationary periods (not 1929-33), the purchasing power of stocks increased; it also increased during two periods of mild price inflation. Had we included dividends in the study, the average annual purchasing power change from stock investments would have been appreciably better, even at fairly low dividend rates.

Gold

Figure D plots the average annual rates of change for the commodity price level and for gold over selected periods from 1800 to 1976. Almost all the

Figure D Annual Average Growth Rates in U.S. Commodity Prices vs. Purchasing Power of Gold for Selected Periods



points lie along a 45-degree line through the origin. That is, in every period of rising prices from MB-14 through 1933-51, the purchasing power of gold fell, and in every period of falling prices it rose; with some exceptions, the average rate of change in the commodity price level was nearly of the same magnitude, but opposite in direction, to that of gold

This is because, when the exchange rate between dollars and gold is fixed, an increase in price level must reduce the purchasing power of gold, and a decrease in price level must increase the purchasing power of gold. In this sense, gold is money—i.e., convertible at a fixed ratio into dollars. Under these conditions, comparing gold with stocks tells

us more about the investment performance of stocks under changing price levels than about the relative performances of gold and stocks.

Two points on the chart do, however, fall appreciably off a 45-degree line—1861-64 and 1971-76. (The point for 1951-76 lies somewhat off this line because of the influence of changes in the subperiod 1971-76; 1951-71 lies along the line.) During the Civil War inflation of 1861-64, price increases averaged almost 30 per cent, but the purchasing power of gold decreased only about 2 per cent a year. This may be attributed to the suspension of specie (i. e. , gold) redemption by the U. S. Treasury in early 1862. In essence, gold no longer served as money for domestic transactions and did not

resume its role again until 1879. In the period 1971-76, of course, the official dollar price of gold was fixed, although raised from \$35 to \$38 per ounce (on December 18, 1971) and then from \$38 to \$42.22 per ounce (on February 12, 1973).

In summary, when the dollar was defined in terms of gold, and freely convertible into gold, the change in the purchasing power of gold was inversely related to the change in the price level. It was not a hedge against price inflation, because it was money; it was, however, a hedge against deflation. When the dollar is not defined in terms of gold, or freely convertible, the relationship is less clear.

Gold Today

On January 12, 1980, gold's price reached record levels, in both nominal and real terms. The nominal high of \$850 corresponds to an index value of 4,112.2 (1930 = 100.0 = \$20.67); the Bureau of Labor Statistics wholesale spot commodity index (22 commodities) on the same date stood at 287 (1967 = 100), for a commodity price index value of 643.5 (1930 = 100). Thus gold's purchasing power reached an index value of 639.0. A glance at Figure B reveals that this value is off the chart; it is far above any previous value.

In terms of the distribution of the gold purchasing power index, this value is 6.127 standard deviations above the mean. This event, in statistical terms, borders on the impossible.⁵ Was it an indication that the long-term historical relationship between gold and commodity prices had suddenly ceased to hold? Or an indication that investors temporarily viewed gold much differently, in relation to commodities in general, as speculators pushed the price to record levels with the momentum of their stampede into the market? †

There are simply not enough data to support any strong conclusions about the behavior of gold, now that it is no longer formally linked to the dollar. We might, however, expect that gold, as a scarce and desirable commodity surrounded by a mystique that has survived several millenia, will tend to follow commodity prices in general and should therefore serve as a hedge against inflation-in contrast to its role as a deflation hedge when it was officially money.

Gold in the Portfolio

At approximately the same date that gold reached its record price, the Dow Jones industrial average stood at 877.56 (on January 23, 1980). This translates into an index of 371.28 (1930 = 100) and a real or

purchasing power index of 57.697. Removing the long-term trend value from this yields a deviation from trend of -0.0635. This is only 0.473 standard deviations below the average deviation from trend.⁷ What's more, it is below the long-term trend, while gold is at its upper extreme.

It would seem obvious that to dismiss investments in gold or other tangible assets without reference to their relationships to the stock market is shortsighted and ignores important principles of modern portfolio theory. Viewed within a portfolio context, gold (and other tangibles) have a definite place? The historical evidence supports this conclusion.

Table II contains the results obtained by calculating the beta for gold for various time spans from 1930 through 1976, according to the equation detailed in the appendix. This table suggests that gold has exhibited a characteristic that is very rare in common stocks: It has had a strongly negative beta over a span of several years. Negative beta assets are particularly valuable within a portfolio,

Table II Capital Gains Betas for Gold vs. the U.S.*
Stock Market (overlapping time spans)

Five-Year Spans		1 O-Year Spans		IS-Year Spans	
Years	β	Years	β	Years	β
1972-76	- 1.283	1967-76	-0.716	1962-76	- 0.606
1971-75	- 0.601	1966-75	- 0.334	1961-75	0.430
1970-74	- 0.213	1965-74	- 0.453	1960-74	0.478
1969-73	0.240	1964-73	-0.127	1959-73	-0.179
1968-72	1.030	1963-72	0.416	1958-72	0.197
1967-71	0.776	1962-71	0.366	1957-71	0.216
1966-70	1.097	1961-70	0.263	1956-70	0.158
1965-69	0.083	1960-69	- 0.004	1955-69	- 0.000
1964-68	- 0.008	1959-68	- 0.009	1954-68	0.009
1963-67	0.114	1958-67	0.041	1953-67	0.039
1962-66	0.069	1957-66	0.058	1952-66	0.042
1961-65	0.018	1956-65	0.037	1952-65	0.037
1960-64	0.011	1955-64	0.032	1950-64	0.026
1959-63	0.002	1954-63	0.032	1949-63	0.007
1958-62	0.007	1953-62	0.022	1948-62	0.051
1957-61	0.051	1952-61	0.026	1947-61	0.231
1956-60	0.038	1951-60	0.046	1946-60	0.247
1955-59	0.067	1950-59	0.059	1945-59	0.262
1954-58	0.070	1949-58	0.015	1944-58	0.283
1953-57	0.047	1948-57	0.089	1943-57	0.263
1952-56	- 0.032	1947-56	0.296	1942-56	0.280
1951-55	0.063	1946-55	0.318	1941-55	0.273
1950-54	0.009	1945-54	0.388	1940-54	0.288
1949-53	- 0.437	1944-53	0.427	1939-53	0.309
1948-52	0.168	1943-52	0.358	1938-52	0.218
1947-51	0.385	1942-51	0.301	1937-51	0.203
1946-50	0.441	1941-50	0.299	1936-50	0.186
1945-49	0.479	1940-49	0.311	1935-49	0.179
1944-48	0.442	1939-48	0.303	1934-48	0.210
1943-47	0.377	1938-47	0.222	1933-47	0.169
1942-46	0.230	1937-46	0.110	1932-46	- 0.052
1941-45	0.211	1936-45	0.089	1931-45	-0.119
1940-44	0.193	1935-44	0.070	1930-44	-0.121

because they can reduce or eliminate systematic (i.e., beta) risk.⁹

Outside the time periods covered in Table II, there have been five periods of six or more years in which gold has exhibited a negative beta-1801-10, 1865-75, 1893-99 (strongly negative), 1907-13 and 1923-39.¹⁰ The real price of gold did not rise as rapidly as the real price of stocks in the 1920s, nor did its real price fall as fast in the 1930s. An investor could thus have profitably sold stocks and accumulated gold during the late 1920s and reversed this process during the 1930s. Similarly, after the stock market peak near the end of the 1960s, a profitable strategy would have been to sell stocks and buy gold for the 1970s.

Of course, investor psychology (particularly during the 1920s and 1930s), issues of prudence and legal restrictions have often limited investor utilization of gold, even when it may have proved profitable. In particular, until the end of 1975, U.S. citizens and institutions would have had to invest in gold through surrogates (e.g., silver and platinum) or through shares of mining companies.

Conclusions

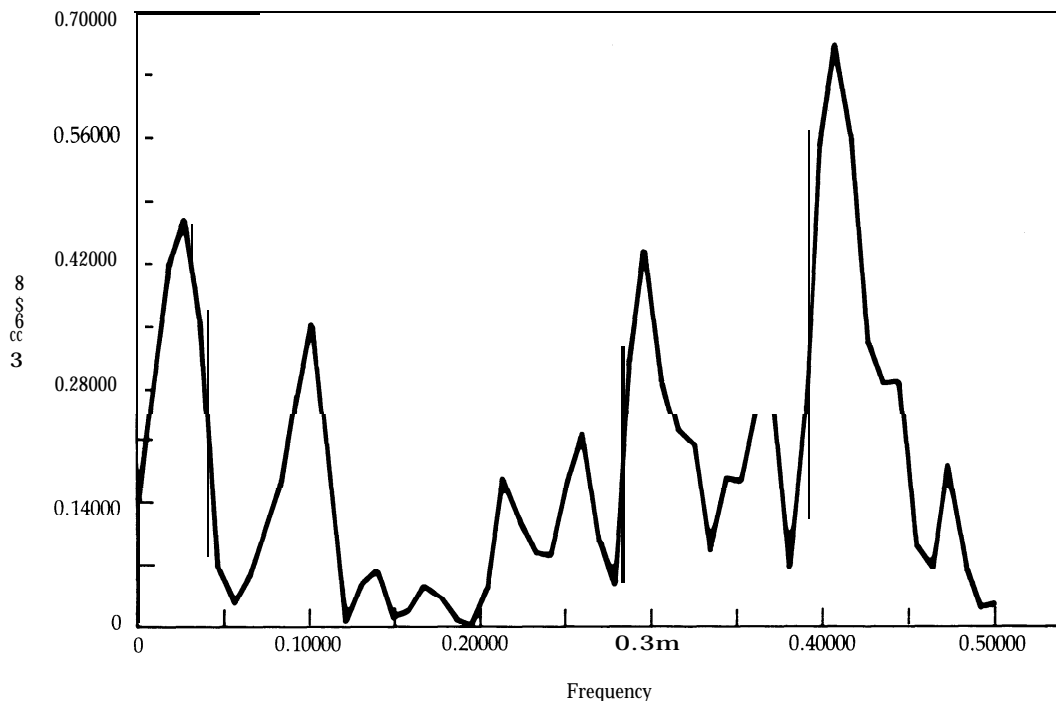
To predicate investment in gold on other than the

historical record is to rely on an implicit prophecy of continued decline or stagnation in the private sector. The historical evidence simply does not support the conclusion that, over the long run, gold is superior to common stocks as an inflation hedge. In fact, if the rising trend that has persisted in real common stock prices since the year 1800 is extrapolated, the conclusion would be to hold stocks

On the other hand, the data do suggest that investment strategies based on switching between gold and common stocks may be worth pursuing under certain conditions. For example, one might sell gold and buy common stocks (i.e., alter portfolio composition) when gold is in its upper range of real price and stocks are under their trend and in their lower range, and vice versa? Given the mass psychology prevailing at these times, the efficient market hypothesis may not adequately explain prices.¹²

Pension fund managers and other institutional investors contemplating or already embarked on a program of gold investment should, however, carefully consider the timing of their transactions. The market price of gold relative to the general commodity price level should guide and constrain their commitment to the metal; forbearance may be in

Figure AA Coherence-Gold vs. Stocks



order for certain periods of time. It would be unfortunate if the legalization of precious metals investments by several states in recent years were to be taken as a mandate to invest without reference to the real price level of gold. Furthermore, even though gold, when viewed as a negative beta security, has a useful role to play in well-managed portfolios, managers should consider the alternatives. Other commodities may perform even better, especially when they can be held as futures contracts. ■

Appendix

Technical Analysis of Cyclicity

We used spectral analysis to examine the cyclical tendencies in the data and cross-spectral analysis to detect any possible lead or lag relationships between the corresponding cyclical components of the gold and stock price series. Table AI summarizes the results. The greatest spectral density in the gold series suggests the presence of a cycle of approximately 54 years—a Kondratieff cycle. The spectral densities of the stock price series strongly suggest the presence of a cycle between 36 and 54 years in length.¹⁵ Figure AA plots the coherence between the two series.¹⁵

There appears to be strong comovement between cyclical components in each period between 36 and 54 years—for 2.45, 3.34, 9.82 and 3.86 years. The strongest coherence is for a 2.45-year cyclical component. The phase angles between the cycles at 36 and 54 years indicate that cyclical components of this period in the gold series tend to lag their counterparts of the same period in the stock price series by between 7.4 and 10.0 years? Similarly, the phase angle for a period of 2.45 years indicates that this cycle in gold tends to lag such a cycle in stock prices by about 29 days, and the phase angle for the 3.86-year cycle suggests this cycle in gold lags by about 200 days. In contrast, the 9.82-year and 3.38-year cycles in gold appear to lead those in stock prices.

Calculating the Beta for Gold

The beta for gold is calculated according to the equation:

$$R_t^G = \alpha + \beta R_t^S + \epsilon_t \quad (1)$$

where the return relatives for gold (superscript G) and for stocks (superscript S) are defined in terms of their real price changes from beginning of period to end:

Table AI Summary of Spectraland Cross-Spectral Analyses

Period (Years)	Spectral Densities			Gain: Gold/Stocks *	Phase (Degrees)
	Gold	Stocks	Coherence		
Infinite	1.3352	0.5616	0.1286	0.2580	
108.0000	1.5499	0.8072	0.2754	0.4362	-51.7470
54.0000	1.8648	1.3102	0.4178	0.6011	-66.6597
36.0000	1.5955	1.3326	0.4734	0.6976	-73.8174
27.0000	0.8490	1.0183	0.3597	0.7287	-73.0643
21.6000	0.3773	0.6369	0.0671	0.3733	-64.8651
18.0000	0.2509	0.4022	0.0231	0.2137	127.1564
15.4286	0.1909	0.3572	0.0530	0.3492	97.9912
13.5000	0.1534	0.3445	0.1086	0.5477	63.1831
12.0000	0.1397	0.2451	0.1557	0.5798	73.5448
10.8000	0.1352	0.1539	0.2639	0.6081	107.1933
9.8182	0.1308	0.1501	0.3542	0.7073	121.9588
9.0000	0.1093	0.1561	0.1572	0.5255	126.3501
8.3077	0.0775	0.1352	0.0035	0.0862	143.2307
7.7143	0.0566	0.1154	0.0454	0.3372	-37.3645
7.2000	0.0471	0.0938	0.0624	0.3911	-38.5433
6.7500	0.0409	0.0672	0.0068	0.1171	-71.7880
6.3529	0.0385	0.0615	0.0170	0.1831	102.6545
6.0000	0.0391	0.0763	0.0462	0.3333	65.4621
5.6842	0.0329	0.0813	0.0295	0.2995	24.7818
5.4000	0.0215	0.0770	0.0049	0.1473	-34.0314
5.1429	0.0177	0.0775	0.0006	0.0552	97.0316
4.9091	0.0212	0.0727	0.0420	0.4209	-22.3709
4.6957	0.0222	0.0527	0.1677	0.7003	-43.2503
4.5000	0.0188	0.0314	0.1166	0.4888	-69.2740
4.3200	0.0144	0.0214	0.0287	0.3894	-114.8269
4.1538	0.0104	0.0174	0.0767	0.3969	-88.9543
4.0000	0.0078	0.0138	0.1557	0.5817	-47.8868
3.8571	0.0065	0.0109	0.2163	0.6714	-51.2735
3.7241	0.0059	0.0106	0.0936	0.4554	-72.4479
3.6000	0.0057	0.0157	0.0486	0.4061	154.6511
3.4839	0.0063	0.0256	0.3150	1.2567	120.9217
3.3750	0.0073	0.0316	0.4367	1.5258	101.5132
3.2727	0.0073	0.0280	0.2860	1.1597	72.9985
3.1765	0.0065	0.0207	0.2164	0.9176	17.4435
3.0857	0.0054	0.0166	0.2010	0.8712	-2.7075
3.0000	0.0043	0.0159	0.0834	0.6169	47.8630
2.9189	0.0034	0.0149	0.1644	0.9423	82.4651
2.8421	0.0027	0.0132	0.1595	0.9875	90.3210
2.7692	0.0029	0.0129	0.2452	1.1544	107.3464
2.7000	0.0043	0.0125	0.2456	0.9372	107.0744
2.6341	0.0056	0.0106	0.0614	0.3787	69.6700
2.5714	0.0063	0.0105	0.2299	0.6849	-4.3833
2.5116	0.0058	0.0119	0.5498	1.1758	-9.9125
2.4545	0.0036	0.0108	0.6616	1.5726	-11.3129
2.4000	0.0016	0.0083	0.5621	1.9187	-12.4209
2.3478	0.0011	0.0080	0.3297	1.7219	-6.3142
2.2979	0.0016	0.0090	0.2839	1.3999	13.8045
2.2500	0.0024	0.0077	0.2870	1.0538	29.0466

*Gain measures the relative strength, or amplitude, of the component in one series in terms of the other.

$$R_t^G = \frac{P_t^G - P_{t-1}^G}{P_{t-1}^G} \text{ and } R_t^S = \frac{P_t^S - P_{t-1}^S}{P_{t-1}^S} \quad (2)$$

Since dividend data were not available, the capital gains relatives were used in both the regression equations defining beta.

Footnotes

1. Data for the first two series were obtained from Roy W. Jastram, *The Golden Constant* (New York: John Wiley & Sons, 1977). In addition to providing long-term gold and price data, he provides an interesting history of gold as money and commodity.
Other price index series could have been utilized, in principle. However, data availability dictated the choice, and there appears to be no compelling *a priori* reason to reject the wholesale commodity price index in favor of another.
2. Linear regression of the stock price index series against time yields an intercept of 0.3899 and a slope of 0.0101. The correlation with time is 0.968. Linear regression of the gold price series against time yields an intercept of 2.2080 and a slope of -0.0001.
3. The range between the minimum and maximum logarithmic values (1.74787 and 2.33291) represents a maximum more than 3.8 times the minimum in the original series.
4. The classification follows that of Jastram, *The Golden Constant*, p. 154, who mentions the difficulty of classifying time spans as inflationary or deflationary. The least-squares average annual rate is used because it represents the rate of inflation or deflation giving an objective fit to the data while recognizing that compound growth is an exponential, rather than a linear, process. As mentioned earlier, the time series for gold and for common stocks are converted to purchasing power series by dividing their respective index series (with 1930 = 100.0) by the price index series. Logarithms of the data are not used in this stage of the analysis.
The least-squares annual rate is based on the relationship:

$$P_t = a(1+g)^t$$
which yields:

$$\log P_t = \log a + \log(1+g)t$$
By regressing the logarithms of P_t on time we obtain the slope coefficient $\log(1+g)$, from which g is easily extracted.
5. Assuming a stable and approximately (log)normal distribution.
6. Data from 1560 for England, also contained in Jastram (*The Golden Constant*), show no index value for gold anywhere near this extreme.
7. After scaling the data by a factor of two.
8. Recent changes in U.S. tax law regarding self-administered retirement funds notwithstanding. Changes in the tax code to discourage new purchases of tangibles do **not** in themselves change portfolio diversification principles, although they affect the specific actions taken with regard to individual portfolio management.
9. Strictly speaking, gold is not part of the "system," since that is implicitly defined to be a "market" consisting of U.S. common stocks (in this case specifically the Dow Jones industrial average and its antecedents). However, the capital asset pricing model need not be constrained to contain only common stocks in the market portfolio. Empirically, this has been a pragmatic expedient necessitated by data availability and the nonhomogeneous nature of some alternative investments, such as real estate.
10. A five-year span is probably of greater practical interest than longer spans, since it is long enough to allow a strategy to work, yet not so long as to suggest a "buy and forget" policy. Since gold does not pay dividends, a strategy of buying must be followed by a strategy of selling in order to convert unrealized gains to cash flows.
11. For detailed discussion of an investment strategy employing such techniques see Robert A. Ellison, *Guidelines for Investment Management* (Seattle: Robert Ellison & Associates, 1980).
12. The markets may very well be pricing stocks and commodities properly in terms of the popular market sentiment and common wisdom, hence be efficient in the generally accepted sense of the word. Yet the psychology of the markets may well be such that they cannot anticipate the turning points. History is filled with examples of situations we are inclined to view with incredulity today—e.g., the Dutch tulip mania and the Great South Seas Bubble.
13. The Parzen data "window" was used for both the spectral and cross-spectral analyses.
14. An examination of the purchasing power of gold in England from 1560 to 1976 showed a 54-year cycle to be highly significant. Results are presented in Anthony F. Herbst, "A 54-Year Kondratieff Cycle in the Purchasing Power of Gold in England," *Cycles*, March 1981, p. 42.
15. Coherence is analogous to correlation. It provides a measure of comovement between cyclical components of the same period or frequency in the two time series. A high coherence "indicates that two cyclical components are governed by the same factors, as one might well expect." (See Phoebus J. Dhrymes, *Econometrics* (New York: Harper & Row, 1970), p. 482).
16. However, as Richard V.L. Cooper ("Efficient Capital Markets and the Quantity Theory of Money," *Journal of Finance*, June 1974, p. 898) points out, "the phase is only unique in the range 0 to 2. . . . Therefore, a priori information must be specified for a unique representation of the lead/lag spectrum." Hence gold may be considered to lag by 7.4 to 10.0 years, or to lag by 43.4 (36 + 7.4) years to 64 (54 + 10) years, etc. Or we may, in the absence of *a priori* information to the contrary, consider gold to lead the stock market by 28.6 (36 - 7.4) to 44.0 (54 - 10) years.