Are Precious Metal Investments Good for an Inflationary Hedge?

A Resampling Approach

Kazutaka KURASAWA

【Abstract】

This note takes a resampling, or bootstrap, approach to address whether precious metal investments are good for an inflationary hedge. The vector autoregressive (VAR) models are fitted to gold, silver and platinum prices, and the predicted values of the endogenous variables are simulated by resampling. The simulations indicate that long−term investments in gold and platinum can be good for an inflationary hedge.

【Key Words】

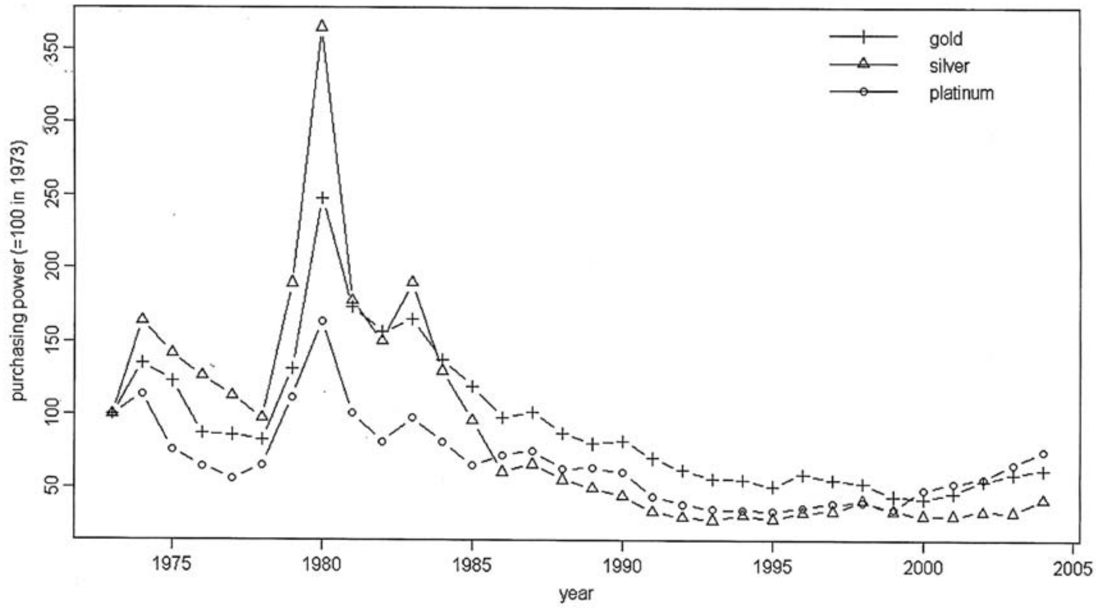
investment,inflationary hedge,vector autoregressive model,resampling,bootstrap

1. Introduction

For an inflationary hedge, investors historically have turned to gold and other precious metals, which are believed to hold their real value even in inflationary times(1). In theory, the relative prices of precious metals are determined by supply and demand; they remain unchanged unless exogenous factors, such as discoveries of uncharted mines, disturb the equilibria. The nominal prices, on the other hand, slide proportionally with the general price level. Assuming that nominal shocks are dominant disturbances, investors have put their money in precious metals as safe investments.

In practice, however, a simple look at the recent past does not provide clear−cut evidence whether benefits have accrued to investors from precious metals in their portfolios. Figure 1 plots the purchasing power of gold, silver and platinum over the period 1973−2004. Against the conventional wisdom, the precious metal prices often lagged behind the general price level. For example, gold bought in 1973 lost its purchasing power if it was sold in 1976, 1977 and 1978. On some occasions, the precious metal prices hiked more than inflation, and the metals have provided an effective inflation hedge for some investors. Given this tantalizing evidence, investors may want to address the question: What are the odds of precious metal investments successfully preserving their portfolio value against inflation?

Figure1: The Purchasing Power of Gold, Silver and Platinum, 1973-2004



This note takes a resampling, or bootstrap, approach to address this question. Standard statistical approaches gauge the variability of the quantities of interest by analytical calculations based on assumed probability distributions. The resampling method, on the other hand, repeatedly samples observations or residuals from original data to replicate new data sets; standard errors, confidence intervals and predicted values are obtained by repeating calculation procedures with replicated data sets. This method does not assume well−defined probability distributions, such as normal, Poisson, and so on; it assumes empirical distributions closely approximate underlying distributions that generate original data. Non−normality is widely observed in financial data so that a flexible line of attack, such as resampling, is a better approach(2).

In what follows, the vector autoregressive (VAR) models of the general price level with each of three precious metals, gold, silver and platinum, are fitted to the Japanese data, and residuals are constructed from the fitted models. This model−based resampling eliminates apparent dependences between the endogenous variables over time, leaving only random noises for resampling. Then, new series are generated by incorporating random samples from the residuals into the fitted models. The predictive distributions for alternative investment horizons are computed by resampling the residuals.

2. Estimation and Simulation

In our model, X_t is the log of the general price level at time t, and Y_t is the log of the price of a precious metal at time t. A vector of X_t and Y_t follows a first−order autoregressive process

$$X_t = \alpha_1 + \beta_{11} X_{t-1} + \beta_{12} Y_{t-1} + \varepsilon_t$$
$$Y_1 = \alpha_2 + \beta_{21} X_{t-1} + \beta_{22} Y_{t-1} + \nu_t$$

for $t = 1 \ldots T$, where ε_t and ν_t are random errors, and α and β are fixed coefficients.

These VAR models are fitted by ordinary least squares to the consumer price index (CPI) and the retail prices of gold, silver and platinum over the period 1973−2004(3). Table 1 summarizes estimates and other statistical results (Model 1 for gold, Model 2 for silver, and Model 3 for platinum).

Table 1 : Estimates from the VAR Models

modell	equation	variable	estimate	standard error	adjusted R−squared
Model 1	cpi	cpi	0.82291	0.012547	0.9931
		gold	−0.010233	0.007674	
		constant	0.890095	0.081225	
	gold	cpi	−0.32985	0.15192	0.7229
		gold	0.79905	0.09291	
		constant	2.96804	0.98345	
Model 2	cpi	cpi	0.810107	0.013281	0.9938
		silver	−0.011574	0.005082	
		constant	0.0911891	0.068808	
	silver	cpi	−0.68227	0.023058	0.813
		silver	0.76047	0.08823	
		constant	3.86695	1.19459	
Model 3	cpi	cpi	0.0822815	0.012814	0.9928
		platinum	−0.007805	0.009442	
		constant	0.874481	0.095252	
	platinum	cpi	−0.1218	0.1649	0.5701
		platinum	0.7706	0.1215	
		constant	2.3108	1.2255	

Figure 2: Residuals

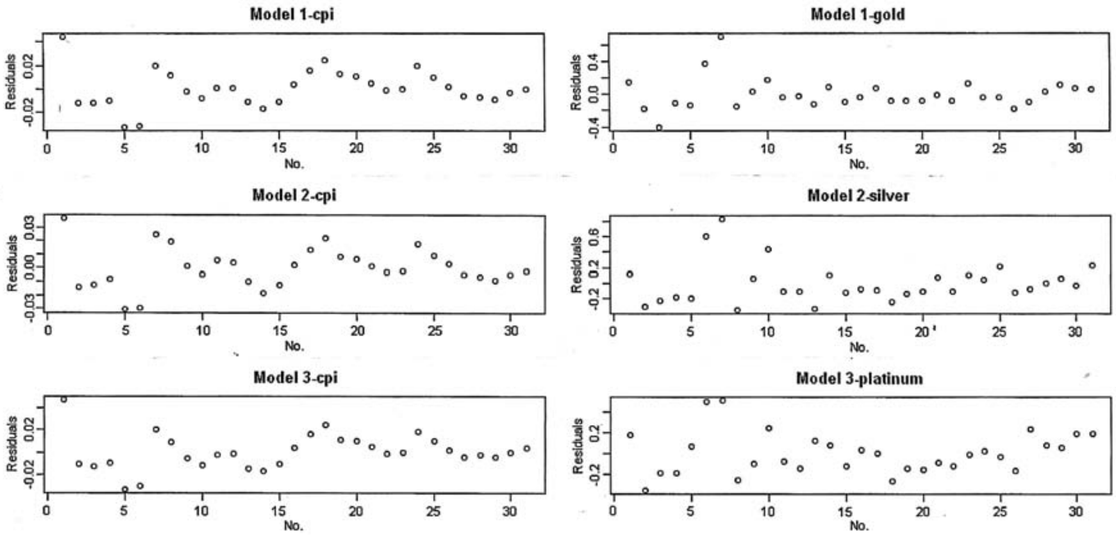


Figure 2 plots residuals constructed from the fitted models. All the residuals are positively skewed, and gold in Model 1 has "fat tails". Figures 3.1−3 are empirical autocorrelation and cross−correlation functions for the residuals; there are no strong indications of autocorrelation and cross−correlation.

The predicted values of CPI and the precious metal prices are simulated by resampling pairs of the residuals $\hat{\varepsilon}_t$ and $\hat{v}_t$ (t=1... T). The predicted values are computed as

$$\hat{X}_{T+i}=\hat{\alpha}_1+\hat{\beta}_{11}X_{T+i-1}+\hat{\beta}_{12}Y_{T+i-1}+\hat{\varepsilon}_{T+i}$$
$$\hat{Y}_{T+i}=\hat{\alpha}_2+\hat{\beta}_{21}X_{T+i-1}+\hat{\beta}_{22}Y_{T+i-1}+\hat{v}_{T+i}$$

for i=1... . Pairs of $\hat{\varepsilon}_t$ and are $\hat{v}_t$ randomly

Figure 3.1: Autocorrelation and Cross-Correlation for Model 1

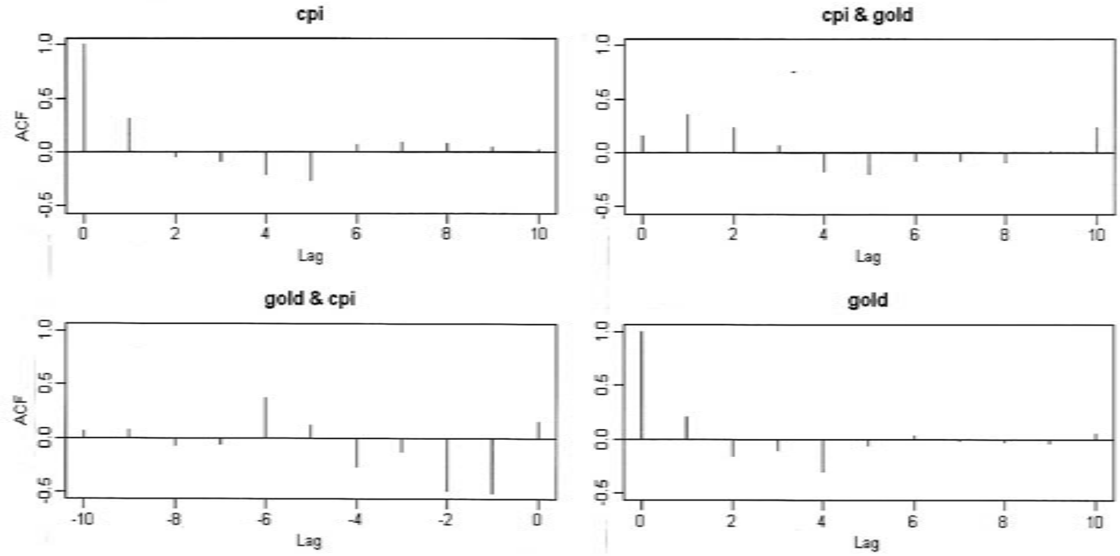


Figure 3.2: Autocorrelation and Cross-Correlation for Model 2

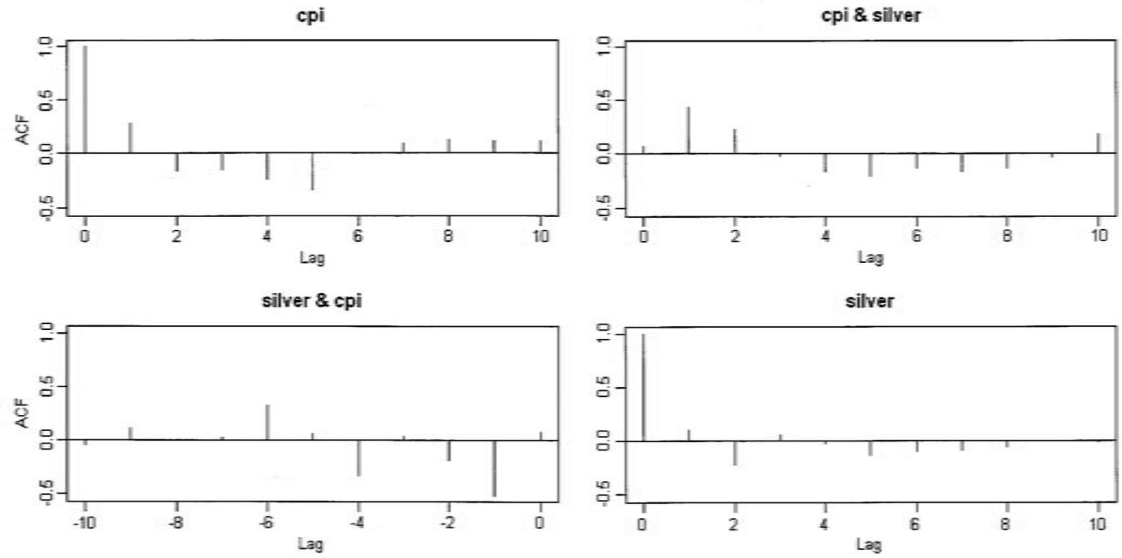
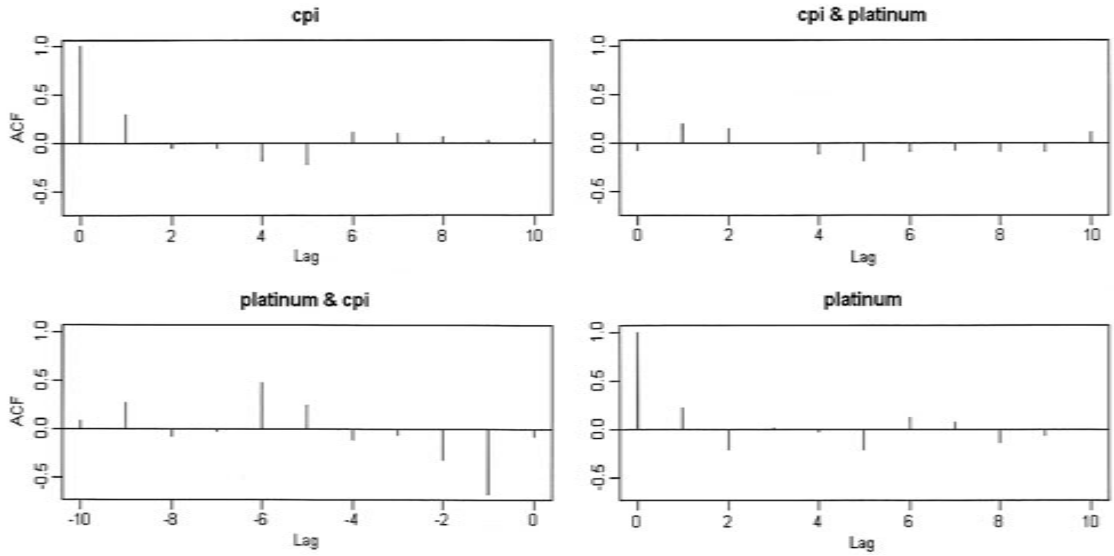


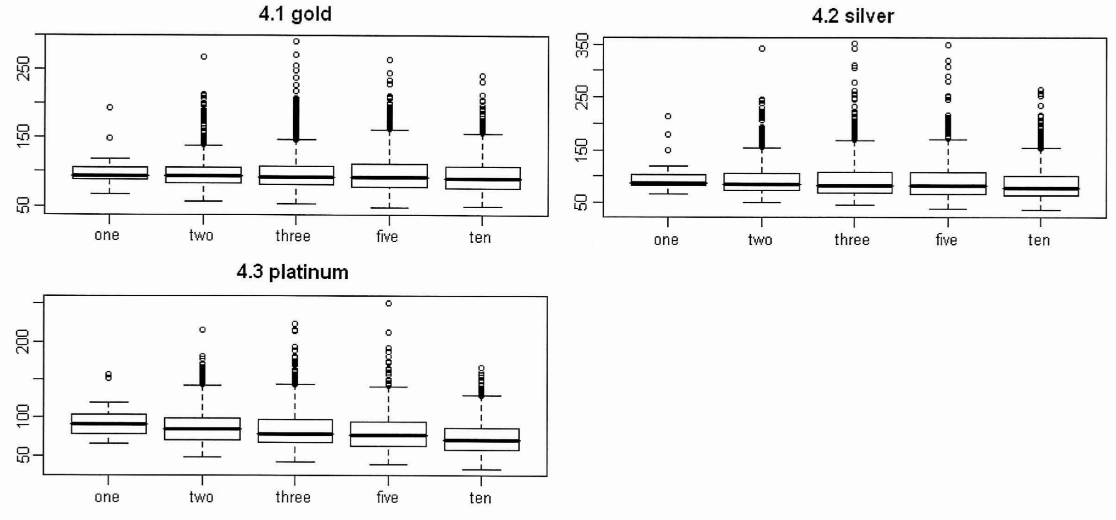
Figure 3.3: Autocorrelation and Cross-Correlation for Model 3



sampled and plugged in $\hat{\varepsilon}_{T+i}$ and $\hat{v}_{T+i}$ (i= 1...). The values in 2004 are used for X_T and Y_T (initial values). 1000 series are simulated for each model. Figures 4 are box diagrams of the predictive distributions of the purchasing power for investment horizons of 1−10 years, indicating that the odds of the three metals preserving their portfolio value against inflation are slightly less than 50−50 for all the investment horizons (the bold horizontal lines are medians).

The same models are also fit to the sample period excluding deflationary years of 1995−2004(4). The values in 1994 are used for X_T and Y_T. Tabel 2 summarizes statistical results. Figures 5.1−3 are box diagrams of the predictive distributions.

Figures 4.1-3: The Predictive Distributions



The odds of gold and platinum keeping their real value are more than 50−50 for relatively long investment horizons: gold for 10 years and platinum for 2−10 years. The odds are less than 50−50 for silver.

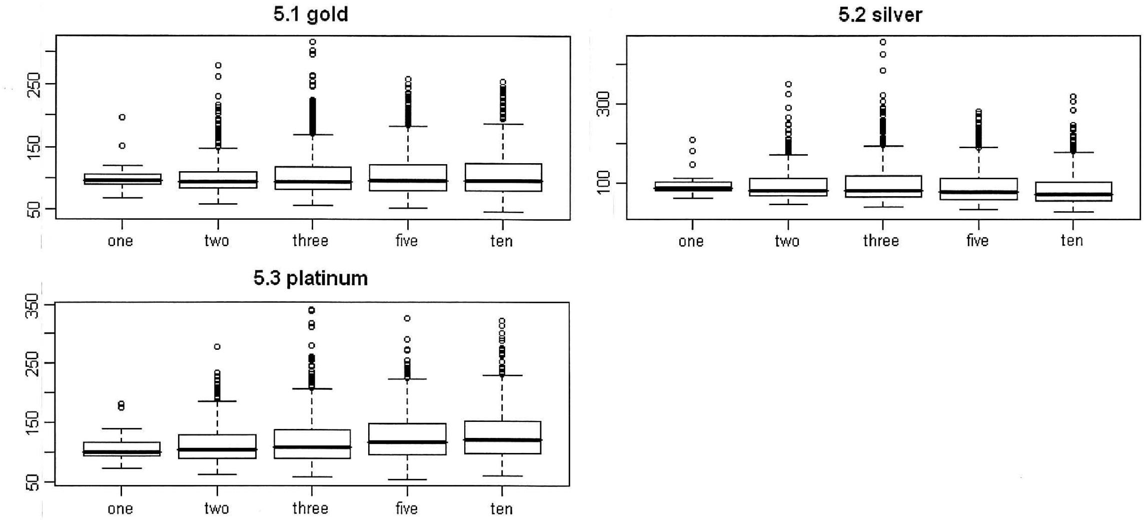
3. Concluding Remarks

This note computes the odds of precious metal investments preserving investors′ portfolio value against inflation. The simulations by resampling show that long−

Table 2: Estimates from the VAR Models, excluding Deflationary Years

modell	quation	variable	estimat	standard error	adjusted R−squared
Model 1	cpi	cpi	0.82387	0.01945	0.9905
		gold	−0.01225	0.01208	
		constant	0.90143	0.09747	
	gold	cpi	−0.3223	0.2359	0.5887
		gold	0.8015	0.1465	
		constant	2.9175	1.1821	
Model 2	cpi	cpi	0.81048	0.0173	0.9914
		silver	−0.01214	0.00685	
		constant	0.91256	0.08396	
	silver	cpi	−0.7372	0.3007	0.7389
		silver	0.7939	0.119	
		constant	3.9653	1.4592	
Model 3	cpi	cpi	0.817035	0.018709	0.9899
		platinum	−0.003353	0.013667	
		constant	0.864307	0.120764	
	platinum	cpi	−0.1239	0.2301	0.4822
		platinum	0.7632	0.1681	
		constant	2.7485	1.4853	

Figures 5.1-3: The Predictive Distributions, excluding Deflationary Years



term investments in gold and platinum can be good for an inflationary hedge.

The limitations of this analysis should be borne in mind. The equilibria of the precious metals are disturbed by real as well as nominal shocks. If real disturbances are dominant in the determination of the equilibrium prices, hedgers with these metals take unnecessarily larbe risk. Under moderate inflation, this might undermine the effectiveness of precious metal investments for an inflationary hedge.

Footnotes

(1) For a history of investments in gold and other precious metals, see Bernstein (2004).

(2) For non−normality observed in financial data, see Cont (2001) and Jondeau et al. (2000).

(3) CPI and the precious metal prices are yearly averages. The data of CPI was downloaded from Statistics Bureau of the Ministry of Internal Affairs and Communications 〈http://www.stat.g
o.jp/data/cpi/〉. The data of the precious metal prices were downloaded from Tanaka Kikinzoku Kogyo 〈http://gold.tanaka.co.jp/commodity/soub
a/index.php〉.

(4) Japan experienced deflation, measured as a rate of change in CPI, in 1995 and 1999−2003. In addition to these years, the sample periods of 1996−1998 are excluded.

References

[1] Brooks, C. (2002).Introductory Econometrics for Finance. Cambridge University Press

[2] Bernstein, P.L. (2004). The Power of Gold: The History of an Obsession. Wiley

[3] Cont, R. (2001)"Empirical Properties of Asset Returns: Stylized Facts and Statistical Issues". Quantitative Finance 1:223−236

[4] Davidson, A.C. and Hinkley, D.V. (1997). Bootstrap Methods and their Application. Cambridge University Press

[5] Hamilton, J.D. (1994). Time Series Analysis. Princeton University Press

[6] Jondeau, E., Poon, S. and Rockinger, M. (2000). Financial Modeling under Non−Gaussian Distributions. Springer

[7] Tsay, R.S. (2005). Analysis of Financial Time Series. Wiley