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On the long run relationship between gold and silver prices A note

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Abstract

This study examines the long run trend between the prices of gold and silver futures contracts traded on the Tokyo Commodity Exchange and concludes that the stable relationship between gold and silver prices has disappeared in the 1990s. The underlying causes and implications of this finding are discussed.

JEL classification: G13; G15

Keywords: Gold-silver parity; Commodity futures

1. Introduction

Throughout history, gold and silver played closely related roles as precious metals and are usually considered as substitutes to reduce similar types of risks in portfolios.[1] Hence, it can be argued that similar economic fundamentals affect the demand for these commodities and a

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[1] Historically, there were times when the gold to silver ratio was important. In the early 18th century, Isaac Newton determined that the ratio of the price of gold to that of silver should be 16 to 1. Except for periodic suspensions of the metallic monetary systems, the gold to silver ratio stood at this level until the early 20th century. For much of the time from 1945 until 1968, gold prices were fixed in dollar terms, while the US Treasury worked to maintain silver prices below the US$1.29 level at which it made sense to refine silver coins for their metal content. Since 1972, gold and silver have been free of government interference.

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rational long-run interdependency exists between the prices of gold and silver. Since prices set in efficient speculative markets contain unit roots, this argument states that gold and silver prices are cointegrated.

However, these commodities also have distinct and important uses. For example, silver has been transformed into a metal of electronics, X-rays and photography because of its unique physical and chemical properties.[2] Demand for gold, on the other hand, is largely influenced by the actions of Central Banks, as industrial nations maintain a steady proportion of gold in their foreign exchange reserves, and jewelry applications that dominate the private sector demand. Consequently, it can be argued that separate fundamentals determine the prices of gold and silver and the prices should move independently, implying that the cointegration property should be rejected.

This study examines, using the futures contracts traded on the Tokyo Commodity Exchange (TOCOM), if gold and silver prices have a common stochastic trend and can be modeled as cointegrated processes. This is important for market participants, hedgers and speculators alike. If there is a long-run stable relationship between gold and silver prices, speculators can use this information to predict returns and, hedgers can use these markets as substitutes against similar type of risks.

In prior work, Wahab, Cohn, and Lashgari (1994) apply cointegration techniques to examine the relationship between gold and silver prices. They use daily both cash and futures prices to test for cointegration between gold and silver. Their findings indicate that there is cointegration between gold and silver in both the cash and futures markets.[3] Recently, Escribano and Granger (1998) analyze monthly prices of gold and silver, from 1971 to mid-1990s. They split their sample and find evidence for cointegration between 1971 and 1990:6. Observations between 1990:7 and 1994:6 are used in an out-of-sample forecasting experiment to evaluate the stability of the estimated relationship. They argue the dependency between gold and silver is becoming less after 1990, indicating that the two markets are becoming separate.

Building on this remark, the current study investigates the interactions between gold and silver futures prices between the beginning of 1992 and the end of 1998. Contrary to previous studies, the cointegration tests do not support a stable long-run relationship between gold and silver prices in the futures markets. This finding indicates that the two markets have become separate, which is consistent with the understanding that separate economic factors determine the demand and supply forces in these markets.

In the next section, the data set and the method of analysis are discussed. The third section presents the empirical findings. Concluding remarks are offered in the final section of the study.

[2] Silver is the best conductor of electricity and heat, is the most reflective metal and the most light sensitive.

[3] They also examine if the cointegration property and error-correction models can be exploited to generate positive trading profits. They find that it is not possible to obtain positive trading profits for an ordinary market participant, after transaction costs. It should be mentioned that similar findings are reported in Ma (1985), Ma and Soenen (1988) and Chan and Mountain (1988) in the literature predating cointegration.

2. Data set and method of analysis

The data used in this study consist of daily closing prices of gold and silver futures contracts traded on the Tokyo Commodity Exchange (TOCOM). The data cover the period from the first trading day in 1992 until the last trading day in 1998, for a total of 1720 observations. The data are provided by the TOCOM and there are no missing observations. The prices are collected from the most deferred (farthest) contracts since typically, they are the most active contracts.

Johansen's (1991) full information maximum likelihood cointegration analysis is used to test for long-run interdependence. Johansen uses canonical correlation methods to estimate the number of distinct cointegration vectors within the framework of an error-correction model. He develops two likelihood ratio tests for the number of cointegration vectors between a set of variables. The *maximal eigenvalue* tests the null hypothesis r cointegration vectors against the alternative of $r+1$ cointegration vectors. The *trace* tests the null hypothesis that at most r cointegration vectors, with more than r vectors being the alternative hypothesis.

In essence, these tests examine the significance of eigenvalues in the estimated long run impact matrix in the error-correction model. Cointegration amounts to finding fewer significant eigenvalues than the number of variables in the system. Neither test has a standard asymptotic distribution but Monte Carlo simulations based critical values exist. Gonzalo (1994) shows that the finite sample properties of Johansen's method are consistent with asymptotic results even when the errors are non-Gaussian and the dynamics are unknown.

3. Empirical findings

The Augmented Dickey Fuller (ADF) tests, which are not reported, indicate the presence of unit roots in the prices of gold and silver futures contracts, which is consistent with the notion that prices determined in efficient speculative markets contain unit roots. Since the prices contain unit roots, the study proceeds to test for cointegration between gold and silver futures contracts. Johansen's (1991) *trace* and *maximal eigenvalue* test statistics are reported in Table 1. Both of the test statistics suggest that the null hypothesis of no cointegration should not be rejected. Hence, contrary to prior studies in the literature, it is established that

Table 1
Cointegration tests

	Rank	Trace	Trace (0.95)	Maximal eigenvalue	Maximal eigenvalue (0.95)
(G_t, S_t)	$r \leq 1$	1.03	3.96	1.03	3.96
	$r = 0$	9.65	15.19	8.62	14.03

G_t and S_t denote the natural logarithms of the prices of gold and silver futures where r is the cointegration rank and *trace* and *maximal eigenvalue* are the two statistics for the cointegration rank. The critical values can be found in Hamilton (1994). The lag length, which was selected by the Akaike's Information Criteria (AIC), was set at five.

there is not a stable long run relationship between the prices of gold and silver and they may drift apart arbitrarily in the long run.[4]

This is consistent with the remark in Escribano and Granger (1998) that in the 1990s the stable relationship between the prices of gold and silver has been broken. It is also implied that separate demand and supply forces affect the gold and silver markets, consistent with the separate economic uses of these commodities. A trading strategy based on the gold–silver parity will not produce positive results, on average. This implication is contrary to the arguments raised in prior studies, such as Ma (1985), Ma and Soenen (1988), and Wahab et al. (1994). However, it should be mentioned that participants in the gold and silver markets have already realized that gold and silver markets should be considered as separated markets. In a report to market participants, Simon (1996, p. 2) states the following about the gold–silver parity, which is perfectly consistent with the statistical findings of the current study:

> If you asked someone from CPM Group where we thought the gold/silver ratio would be in the future, we would develop a projection of gold prices, based on gold's supply/demand conditions and the underlying economy, then we would develop a silver price projection, based on silver's fundamentals. We would divide the gold forecast by the silver forecast, and give you our projection of the gold/silver ratio.

4. Concluding remarks

This study examines the long-term linkages between the prices of the gold and silver futures contracts traded on the TOCOM. Statistical findings indicate that the frequently cited long-term stable relationship between the prices of gold and silver has disappeared. This finding should be of relevance to participants in gold and silver markets. It is indicated that these two markets should be approached as separate markets and changes in the gold to silver ratio should not be used to predict prices in the future. Also implied is that these two markets should not be regarded as substitutes to hedge against similar types of risks. This view is consistent with the understanding that these two commodities have different economic uses and they are affected by different economic fundamentals.

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[4] It is noteworthy that additional cointegration tests proposed by Engle and Granger (1987) have also been conducted and the results are qualitatively the same.

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