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What drives gold returns? A decision tree analysis

A.G. Malliaris [a,*], Mary Malliaris [b]

[a] Departments of Economics & Finance, Loyola University Chicago, 1 East Pearson Street, Chicago, IL 60611, United States
[b] Information Systems & Operations Management, Loyola University Chicago, 1 East Pearson Street, Chicago, IL 60611, United States

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ABSTRACT

The behavior of gold as an investment asset has been researched extensively. For the very long run, that is several decades, gold does not outperform equities. However, for shorter periods, gold responds to fears of inflation, stock market corrections, currency crises and financial instabilities very vigorously. In this paper we follow a decision tree methodology to investigate the behavior of gold prices using both traditional financial variables such as equity returns, equity volatility, oil prices, and the euro. We also use the new Cleveland Financial Stress Index to investigate its effectiveness in explaining changes in gold prices. We find that gold returns depend on different determinants across various regimes.

1. Introduction

In a recent paper, Barro and Misra (2013) compute the average real rate of price change for gold in the U.S. from 1836 to 2011 and find that it is 1.1% per year with a standard deviation of 13.1%. They suggest that gold's expected real rate of return, which includes an unobserved dividend yield, would be close to the risk-free rate of return. This low average rate of return and its high volatility suggest that a very long-term passive investment in gold does not appear to be very favorable and shorter term strategies that identify economic variables that drive volatilities may be more profitable.

In this paper we give a rapid description of the general characteristics of the gold market and then propose to investigate the behavior of gold prices across the most recent business cycle which

* Corresponding author. Tel.: +1 312 915 6063.
E-mail addresses: tmallia@luc.edu (A.G. Malliaris), mmallia@luc.edu (M. Malliaris).

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includes the Global Financial Crisis. We identify on the basis of a selective review of the literature several economic and financial variables that influence the price of gold and trace the significance of these variables across the recent business cycle. To find what drives the behavior of gold returns within a business cycle and across its various phases we employ a decision tree analysis.

2. Review of the literature

Erb and Harvey (2013) report that there are about 171,300 metric tons of gold above ground. Given that there are 32,150 troy ounces per metric ton with a price of about $1400 per ounce, this yields an overall value of about $7.7 trillion. More than half of all humanity's gold has been extracted the last 50 years. The annual global gold production is about 2,500 metric tons per year and this supply is relatively price inelastic. In contrast, the demand for gold is price elastic and is driven by jewelry, industrial use, investment strategies and by inventory management in official institutions (central banks and the IMF). Supply and demand fundamentals determine gold prices and such prices have fluctuated in the past forty-five years from about $35 an ounce in 1970 to a record high of $1900 in 2010 to a relative low of $1183 in late 2013 and back up to $1400 in July of 2014. How can such large fluctuations be explained?

There is a large literature that identifies economic variables that explain the theoretical grounds that connect these variables to the fluctuations in the price of gold. Most of these studies also perform empirical tests to confirm or reject the hypothesized relationships. In particular, the set of variables used to correlate with gold returns includes inflation as measured by the Consumer Price index, various energy prices, interest rates for both the short-term 3-month Treasury Bill and the longer-term 10-year Treasury Note, foreign currencies as described in the US Dollar trade weighted exchange rate, equities as measured by the S&P 500 Index and its volatility measure by VIX. Representative such studies are listed in both Erb and Harvey (2012) and also Aggarwal et al. (2015).

Aggarwal et al. (2015) offer a detailed analysis of the world metal markets and discuss in particular the behavior of gold prices. The efficiency of gold markets is presented in Canarella and Pollard (1986) and recently in Caminschi and Heaney (2013). Cheung and Lai (1983) investigate the long cycles of gold returns. Fama and French (1988) examine the behavior of metal prices over the business cycle, and as with equities, Aggarwal and Soenen (1988) report that gold returns are leptokurtic and negatively skewed. Ciner et al. (2013) investigate the return relations between major asset classes using data from both the US and the UK to examine time variation in conditional correlations to determine when these variables act as a hedge against each other. A worth mentioning finding of this study is that gold can be regarded as a safe haven against exchange rates in both countries.

Malliaris and Malliaris (2009) observe that while gold has been an important commodity for several centuries, oil's importance grew during the 20th century, and the euro has become important during the 21st. This paper analyzes the inter-relationships among the price behavior of gold, oil and the euro using a standard time series methodology and then employs neural networks to build a forecast for each of these three variables. The authors also compare the results of the neural network to those implied by the time series tests. The statistical evidence of time series analysis demonstrates that both short-term and long-term relationships exist between the three variables. Both the time series and neural network results indicate that the series move together though they identify slightly different relationships. The time series results imply that oil adjusts to gold, the euro and oil have equal influences on each other, and the weakest relationship is between gold and the euro. The neural network methodology indicates that oil impacts gold more than gold impacts oil. Also, oil's influence on the euro is found to be greater than the euro's effect on oil and lastly, that gold's impact on the euro is greater and faster than the euro's impact on gold. Mensi et al. (2013) obtain results that show significant transmission among the S&P 500 and commodity markets. In particular, these authors show that past shocks and volatility of the S&P 500 strongly influenced the oil and gold markets.

Malliaris and Malliaris (2013) investigate inter-relationships among the price behavior of oil, gold and the euro using time series and neural network methodologies. Traditionally gold is a leading indicator of future inflation. Both the demand and supply of oil as a key global commodity are impacted by inflationary expectations and such expectations determine current spot prices. Inflation influences both short and long-term interest rates that in turn influence the value of the