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## Explanatory mining for gold: Contrasting evidence from simple and multiple regressions

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## ABSTRACT

Gold traditionally has been used as a store of value and an inflation hedge. More recently, gold is also viewed as a hedge against uncertainty and a safe haven. This paper demonstrates that many properties regularly associated with gold are only valid in a simple regression framework but significantly change in a multiple regression framework. A descriptive and econometric analysis of gold and US economic and financial variables for monthly data from 1979 to 2011 shows that gold primarily serves as a hedge against a weaker US dollar and against higher commodity prices. In contrast, gold is not a hedge against consumer price inflation. The empirical results also indicate that gold only recently evolved as a safe haven asset.

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### Introduction

The global financial crisis ignited by the subprime crisis in the United States in 2007 can be characterized by extreme negative stock returns and positive gold returns, which eventually led to an all-time high of the price of gold at the end of 2009. While the experience of this crisis period suggests a strong negative relationship of gold and stock market returns supporting the safe haven property of gold, the relationship is less clear for a longer time span than the relatively short period of a financial crisis. In addition, even within the crisis period, the correlation of gold and stock returns is not always negative prompting financial analysts and the financial media to use alternative explanations like general economic conditions, uncertainty and inflation.

This paper is motivated by the changing and possibly time-inconsistent explanations put forward by the media to explain changes in the price of gold. Consistent with the paper's title, the aim of this study is to systematically assess the relationship of gold with other variables and demonstrate that searching for relationships or "mining for explanations" is possible as there are many variables that are related to the price of gold in a simple regression or univariate framework. However, in a multivariate regression model, in which all variables potentially influencing

the price of gold are taken into consideration, only some variables remain statistically significant. More specifically, we show that around 10 out of 20 financial and economic variables are significant in a simple regression but only five are significant in a multivariate regression.

We demonstrate that the common notion of gold as a hedge against inflation does only hold in a univariate framework in which it is implicitly assumed that there is no other variable (e.g. the exchange rate) that influences the price of gold. If other variables are included in the analysis consumer price inflation becomes an insignificant factor. Theoretically, this finding is not surprising. During the gold standard, the price of gold was linked to the money supply and thus provided a hedge against inflation. With the end of the gold standard the direct link of the price of gold and inflation was eliminated.

Investors have used gold also as a hedge against a depreciating dollar. Because gold is priced in US dollars (e.g. see [Economist, 2009b](#)), if the dollar loses value, the nominal (dollar) price of gold will tend to rise, thus preserving the real value of gold. In this way, gold can act as a hedge against exchange rate risk for investors with dollar holdings (see also [Sjaastad and Scacciavillani, 1996](#); [Sjaastad, 2008](#); [Wang and Lee, 2011](#)). This issue is potentially deeper than a simple currency-of-denomination story for commodities that are likely to affect a country's exchange rate. This would be the case for countries with a relatively large mining sector such as Australia or South Africa. In this case, there could be a feedback effect from commodity prices to the value of the currency and vice versa

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(see Clements and Fry, 2008). However, in the case of gold and the US, it is reasonable to assume that the price of gold does not affect the US dollar and thus no feedback has to be modeled.

Changes in the price of gold are also linked to interest rate changes and changes in the level of uncertainty. The influence of interest rate changes on the price of gold is related to changes in expectations about future inflation and the opportunity cost of holding gold (cost of carry). Changes in uncertainty may affect the price of gold as a higher degree of uncertainty leads investors to purchase safe haven assets such as gold or US government bonds.

The academic literature offers supporting evidence for each property of gold. However, there is no study that analyzes all properties in *one* model providing evidence for the relative importance of each property and interactions among them. We speculate that the main reasons for this gap in the literature are different data frequencies and the more complex nature of a multivariate analysis in which interactions of variables have to be taken into account. The data frequency issue is relevant if the reaction of the price of gold to extreme stock market movements on a daily basis is analyzed. As macroeconomic data such as consumer price inflation is only available for lower frequencies (i.e. monthly) a joint analysis is not possible.

Many studies use the *ceteris paribus* assumption in an analysis of a specific property of gold by abstracting from the possible influence of other variables. For example, if the relationship of gold price changes and exchange rate changes is analyzed, changes in inflation or extreme stock market changes are not taken into account. Another prominent example is the safe haven effect. It states that gold does not lose value in times of extreme stock market losses, i.e. it acts as a shelter for investors. In a multivariate analysis the right question to ask is as follows “Does gold exist as a safe haven because investors buy gold in times of financial turmoil or is the real driver of the safe haven effect a lower interest rate or a depreciating US dollar occurring at the same time?”<sup>1</sup> The lack of evidence regarding the relative importance of the effects associated with gold is also evident on days when large daily changes in the price of gold occur. Commentators usually provide different, sometimes contrasting, explanations.<sup>2</sup> For example, a weaker US dollar increases the price of gold *ceteris paribus*. However, a weaker dollar also increases the likelihood of higher inflation due to rising prices of imported goods and services. Since the existing studies analyze inflation and exchange rate changes separately, there is no evidence, which of the variables is more important in influencing changes in the price of gold. Finally, the studies that analyze specific properties of gold use different sample periods, data frequencies and econometric methodologies. It is thus difficult to draw conclusions from a meta-analysis with the objective to assess the relative importance of the properties examined.

Studies which analyze the drivers of gold and its properties as a hedge are relatively scarce.<sup>3</sup> The store of value and inflation hedge property is analyzed in Ghosh et al. (2002) and Blose (2009),<sup>4</sup> the exchange rate hedge property is studied in Capie et al. (2005), Sjaastad (2008) and Wang and Lee (2011), the role of gold as a stock market diversifier is investigated in Sherman

(1982) and Davidson et al. (2003) and the safe haven hypothesis is studied in Baur and Lucey (2010).<sup>5</sup>

This paper contributes to the literature by analyzing the properties of gold in *one* model providing evidence about their relative importance and interactions among them. An assessment of the importance and the strength of these effects is useful to better understand the drivers of the price of gold and to infer how investors react to certain events. In addition, we examine the role of stock market uncertainty on gold. Uncertainty has been addressed informally by analysts and in the financial media but not formally in an econometric model. The argument is closely related to the safe haven hypothesis. If uncertainty is increasing or relatively high, investors find it more difficult to assign probabilities to future prices of securities and thus tend to buy assets that are relatively simple and traditionally viewed as a store of value. If this argument is true, there is a positive relationship of the level of uncertainty and the price of gold.<sup>6</sup> Finally, the extent to which gold co-moves with commodity prices is also an open question and can reveal when gold decouples from a basket of commodity prices potentially assuming an alternative role like the safe haven property.

The empirical analysis comprises a data set of 30-years from 1979 until 2011, with gold as a dependent variable and economic and financial variables as explanatory variables. We find that gold indeed exhibits the properties generally associated with it. However, many of these properties are only valid in a simple regression framework (i.e. when analysts “mine for explanations”) in which it is assumed that the other variables potentially affecting the price of gold do not change or even exist. If a multiple regression model is estimated, some properties disappear and others become stronger revealing the true influence of the variables on the price of gold.

The remainder of the paper is structured as follows. The Section Empirical analysis presents the data, the econometric framework and the empirical results and the Section Conclusions summarizes the findings and concludes.

## Empirical analysis

This section first introduces the data set and describes the relationships of gold and the economic and financial variables. Graphs are provided for each major economic or financial variable. The second part presents the estimation results of a simple regression model and a multivariate regression model.

### Data

The data consists of monthly prices of gold (bullion in US dollar, A.M. official), several stock market indices (the Dow Jones Industrial, the S&P 500 Composite stock market indices, the MSCI emerging stock market index, the MSCI indices of each BRIC country (Brazil, Russia, India and China) and the MSCI world stock market index), a commodity price index (S&P GSCI commodity index), a consumer price index (US CPI, all urban, seasonally adjusted), a volatility index (CBOE VIX) used as a proxy for uncertainty in the stock market, a trade-weighted US dollar exchange rate and short-term (one month, three month and six month US treasury bills and long-term interest rates (2-year, 10-year, 20-year and 30-year US treasuries at constant maturities))

<sup>1</sup> This is particularly important for lower frequency data such as weekly or monthly data where it is more likely that other variables influence the price of gold than for daily data.

<sup>2</sup> “[...]The conventional wisdom on Wall Street is that gold’s run higher is fueled by some alchemy of inflation concerns and dollar worries. [...]” (The Wall Street Journal, October 8, 2009). For other examples see also Economist (2009b).

<sup>3</sup> Gold also exhibits properties of a zero-beta asset as reported in McCown and Zimmerman (2006).

<sup>4</sup> Blose (2009) differentiates between expected and unexpected inflation and discusses the role of interest rates for the cost to hold gold (cost of carry).

<sup>5</sup> See also the Economist (2005) and the Economist (2009a).

<sup>6</sup> For example, see “Overview: inflation uncertainty bolsters gold”, Financial Times, October 7, 2009 and “Investors opt for safety amid fresh uncertainty”, Financial Times, September 5, 2009. Baur and McDermott (2010) analyze the safe haven property conditional on increased uncertainty.

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