Economic Modelling 55 (2016) 269–278

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Can consumer price index predict gold price returns?

Susan Sunila Sharma *

Centre for Economics and Financial Econometrics Research, Faculty of Business and Law, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125, Australia

ARTICLE INFO

Article history:
Accepted 12 February 2016
Available online xxxx

Keywords:
Gold price returns
CPI
In-sample
Out-of-sample
Predictability
Forecasting

ABSTRACT

In this paper using data for 54 countries we test whether consumer price index (CPI) predicts gold price returns. Our test for predictability is based on a recently developed flexible generalised least squares estimator, which most importantly accommodates the endogeneity of CPI, its persistency and any heteroskedasticity in the model. We find limited evidence that CPI predicts gold price returns in in-sample tests; however, out-of-sample tests reveal relatively strong evidence that CPI predicts gold returns. These results are robust to different forecasting horizons. On the whole, we discover reasonable evidence that consumer prices predict gold price returns.

1. Introduction

The relationship between gold and inflation (see, inter alia, Tkacz, 2007; Pierdzioch et al., 2014a; Blose, 2010[1]; Fortune, 1987; Christie-David et al., 2000; Adrangi et al., 2003; Ghosh et al., 2004; Levin et al., 2006; Mahdavi and Zhou, 1997; Tully and Lucey, 2007) has attracted significant interests because gold is regarded as an unusual asset, since it is both a commodity used, for example, in the production of jewellery and industrial applications, and also a financial asset, where it can be utilised as a store of value. Tkacz (2007) explains that as a financial asset, which represents about 12% of the gold market, the demand for gold can be seen as a function of the current and expected price of gold, the opportunity cost of holding gold, income, expected future inflation, and overall financial market stress. Theoretically, an increase in inflation expectations will reduce the perceived purchasing power of money, thus agents would divest themselves of money and can increase their holdings of gold. This literature has progressed along two lines. The first strand of the literature examines how inflation (CPI) affects gold prices (returns) (see, Pierdzioch et al., 2014a; Blose, 2010; Christie-David et al., 2000; Adrangi et al., 2003, among others). On the other hand, the other strand of the literature examines how gold prices affect CPI (inflation) (see Moore, 1990; Mahdavi and Zhou, 1997; Cui, 2009; Wherry, 2009; and Lehman, 2009). Both strands of the literature generally provide mixed results. For instance, Adrangi et al. (2003), Blose (2010), and Worthington and Pahlavani (2007) identify that the increasingly important role of gold acts as an inflation hedge. In contrast, Lawrence (2003), Jaffe (1989), Mahdavi and Zhou (1997), and TKacz (2007) document that gold is not a leading indicator of inflation or is either uncorrelated or negatively correlated with expected inflation. From these literatures it is clear that the relationship between gold and inflation is endogenous. This is a relevant statistical issue that potentially impacts on the regression results.

In this paper, we revisit the relationship between gold price returns and inflation. Our approach, however, is different from this literature in three ways. First, our approach follows a predictive regression framework: we test whether inflation (CPI) predicts gold price returns.[2] Second, we use a newly developed estimator, proposed by Westerlund and Narayan (2015a), namely the flexible generalised least squares (WN-FGLS) estimator, to examine the null hypothesis of no predictability. The key advantage of the WN-FGLS is that it allows us to control for three statistical aspects of the data and model, which directly matter for the gold price and inflation relationship. These issues relate to; (i) endogeneity, already recognised as an issue in this literature, (ii) persistency of the predictor variable such that instead of diluting the information contained in consumer prices by taking the inflation rate as a predictor we can use the actual price variable as a predictor, and (ii) heteroskedasticity—an issue that is recognised as a stylised fact in financial time-series data. Through using the WN-FGLS

* Tel.: +61 392446871.
E-mail address: s.sharma@deakin.edu.au.

[1] Blose (2010) presents a detailed survey of studies that examines the relationship between gold price and inflation.

[2] There are several studies which look at different determinants of gold returns. For instance, the common determinants of gold returns found in the literature are inflation rate (see Batten et al., 2014), the oil price (Zhang and Wei, 2010; Reboredo, 2013a), the exchange rate (Pukthuanthong and Roll, 2011 and Reboredo, 2013b), and business-cycle fluctuations (Pierdzioch et al., 2014b). However, our research question does not consider determinants of gold returns. Here, we look at the predictability of gold returns using CPI because we connect with an active strand of literature which has taken issue with the gold-CPI nexus.

http://dx.doi.org/10.1016/j.econmod.2016.02.014
0264-9993/

estimator, we account for all these statistical features that, as we will show later, characterise our data and predictive regression model.

Third, we test for both in-sample and out-of-sample predictability. This is important because the relative roles and, therefore, importance of in-sample versus out-of-sample tests have occupied interest in the literature. Basically, there is no consensus: Some studies show preference for in-sample tests (see, for example, Foster et al., 1997; Lo and MacKinlay, 1990), while others support out-of-sample tests (see, Ashley et al., 1980; Rapach and Wohar, 2006). The main conclusion is that both are important and therefore undertaking both tests are important.[3]

Our approaches lead to three main findings. First, we discover weak evidence of in-sample predictability of gold price returns using CPI; evidence of predictability is only found for 10 countries. Second, we follow the literature and consider three (25%, 50%, and 75%) out-of-sample periods for out-of-sample forecasting evaluations. We use a constant returns model as our benchmark model. Our findings from out-of-sample evaluations reveal that there is strong evidence of out-of-sample predictability when we consider a short (25%) out-of-sample period compared to middle (50%) and long (75%) out-of-sample periods. In summary, we find that out of these 10 countries (where we find evidence of in-sample predictability), only for six countries the out-of-sample statistics (namely, Theil U and OOS_R^2) for $h=1$ support our proposed CPI-based predictive regression model. In addition, we find that out-of-sample predictability tests also support our proposed predictability model in the case of an additional 25 countries, where in-sample predictability test did not reject the null of no predictability. Third, to check the robustness of out-of sample predictability test, we compute Theil U and OOS_R^2 statistics for a longer horizon ($h = 6$). From this exercise, we conclude that our results are robust.

Our findings contribute to two different literatures. Our first finding that inflation predicts gold price returns supports earlier studies showing that; (a) inflation is a determinant of gold returns (see, Sherman, 1983; Moore, 1990; Christie-David et al., 2000), and (b) there is a cointegrating relationship between gold price and inflation (CPI) (see, Ghosh et al., 2004; Worthington and Pahlavani, 2007). Our second finding that in-sample and out-of-sample tests provide conflicting results is consistent with the bulk of the studies that undertake both in-sample and out-of-sample tests. For example, Bossaerts and Hillion (1999), Goyal and Welch (2003), Brennan and Xia (2005), Butler et al. (2005), and Ang and Bekaert (2007) document that financial ratios only predict stock returns mostly in in-sample tests than out-of-sample tests. By comparison, recent studies such as Westerlund and Narayan (2012, 2015b) show that out-of-sample tests perform as well as in-sample tests. When using a different predictor as opposed to financial ratios we discover evidence that support out-of-sample tests. This finding has implications for not only the gold market literature but also in other markets where predictability and forecasting are essential. The implication has been that out-of-sample evaluations should not be ignored.

The rest of the paper is organised as follows. In the next section, we discuss the data used in this study and explain our estimation approach. Section three discusses the preliminary features of data and the main findings. The final section provides some concluding remarks.

2. Data and methodology

This section contains two objectives. The first objective is to explain the data set. The second part of this section explains the in-sample predictive regression framework.

[3] However, in this study we do not consider in-sample predictability tests for three subsample for which we have done the out-of-sample predictability tests. The reason is because the debate is about the out-of-sample predictability and not about in-sample predictability; see, for instance, Narayan et al. (2015a), Narayan and Sharma (2015), Phan et al. (2015), Narayan et al. (2014c), and Narayan et al. (2013a,b).

2.1. Data and preliminaries

The data used in this study include monthly consumer price index (CPI)[4] and London gold price for 54 countries. All data are sourced from the *Global Financial Database*. The sample size and the number of countries selected are dictated by data availability. The sample size ranges from as low as 774 observations in the case of Malta to as high as 1733 observations in the case of Germany. The gold price is measured in United States Dollars. The specific dates of data for each country are reported in the last column of Table 1.

In columns 3 and 4 of Table 1, we report the mean and standard deviation of gold price returns and CPI (in natural logarithmic form) for each country. Considering the evidence for mean, we notice that CPI ranges from as low as −24.82 in the case of Zimbabwe to as high as 5.697 in the case of Sri Lanka. By comparison, the most volatile CPI, based on the standard deviation, has been experienced by Brazil, followed by Greece, Argentina, and Germany. Tunisia, Thailand, Switzerland, Malta, and Malaysia have experienced the least volatility in CPI.

2.2. Methodology

A recent study by O'Connor et al. (2015) presents a very detailed review of the literature on gold as an investment option. The main point here is that gold acts as a hedge against inflation. According to this survey, gold has a limited stock and a relatively inelastic supply in the short run, as it takes time to boost production through the introduction of new gold mines. This means that it is impossible to increase the supply of gold over a short time period. Gold, therefore, is considered as a hard currency, which holds its value as the purchasing power of other currencies decrease when faced with inflation. Feldstein (1980) provides hypothetical reasons as to how expected inflation is related to gold. His main argument is that the gold price will rise faster than the expected rate of inflation due to the fact that capital taxes will reduce any net payoff from selling gold. Additionally, Fortune (1987) builds this on this argument by explicitly suggesting a path through which gold prices are directly affected by inflation, which in also known as the substitution effect. Fortune (1987) hypothesis is built on the idea that the expectation of increases in future prices (inflation) encourages individuals to convert their assets, which indeed have a fixed nominal return, into gold. This increases the price of gold in that currency and it protects its residents from reductions in their purchasing power which is due to inflation.

Finally, Levin et al. (1994, 2006) proposed an alternative inflation-gold price channel which is based on an arbitrage model. This model argues that gold lease rates are equivalent to the world real interest rate. These studies assume that the general rate of inflation drives changes in gold extraction costs. They argue that in the long-term the gold price will rise in order to compensate miners for their increasing costs. In other words, this implies that there exists a causal relationship where causality runs from inflation to the cost of extraction to gold prices.

Following these discussions supporting a relation between gold prices and inflation, we propose the following predictive regression model, where CPI is considered as a predictor of gold price returns, can be represented as follows:

$$GR_t = \alpha + \beta \mathrm{CPI}_{t-1} + \varepsilon_{GR,t} \quad (1)$$

Here, GR_t is gold price returns in month t, computed as $\log(GP_t/GP_{t-1}) * 100$, with GP being the gold price index. The predictor variable CPI is the natural logarithmic form of consumer price index. The null hypothesis of no predictability is tested by setting $H_0: \beta = 0$. As explained earlier, in the above specification, it is possible that CPI is endogenous. In case CPI is endogenous, a test for the null

[4] It is worth noting while CPI for some countries like India has not been historically considered as the headline price index, it nonetheless captures the price movements.