Quantile causality between gold commodity and gold stock prices

Juan C. Reboredo[a],[*], Andrea Ugolini[b]

[a] Department of Economics, Universidade de Santiago de Compostela, Spain
[b] Post-Graduate Program in Management – PPGA, Unifacs, Brazil

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ABSTRACT

We found mixed evidence regarding quantile causality from gold commodity to gold stock returns for global, regional and individual country gold stock price indices. More specifically, gold prices Granger-caused Australian gold stock returns in all quantiles, but there was no quantile causality for either gold stock returns for companies located in the Europe-Middle East-Africa regions or the upper quantiles of companies located in America. In contrast, we found consistent evidence of quantile causality from gold stock returns to gold prices. These results would indicate that gold price shocks do not translate directly into wealth shocks for gold companies and that investors and risk managers could use the information regarding gold commodity and gold stock prices to improve decision making.

1. Introduction

Gold commodity prices and the market value of gold-mining companies (hereafter, gold companies) are intrinsically related. Shocks to gold prices are transmitted to the value of gold companies, and in turn, production or financial decisions made by gold companies could impair the supply of gold and thus its price. Moel and Tufano (2002) showed that gold-mining companies open or close mines in response to changes in gold prices, which is consistent with a real options model for valuing gold mines (Savolainen, 2016). Similarly, Rockerbie (1999) and Selvanathan and Selvanathan (1999) proved that gold prices have decisive implications for gold production. Moreover, financial decisions by gold companies to hedge against gold price oscillations depend on their market value (Tufano, 1996, 1998; Brown et al., 2006; Adam et al., 2016). Therefore, identifying causal effects between the dynamics of gold prices and the market value of gold-producing firms is of interest to gold company managers making risk management decisions, for investors making portfolio decisions and for policymakers holding gold as a store of wealth.

In this paper we study the relationship between the market value of gold companies and the price of gold as a commodity by examining causality between these two variables. Borenstein and Farrell (2007) showed that the market value of gold companies is concave in the price of gold, so the impact of changes in gold prices on a company's market value is not linear but varies with the extent of the change. Also, causality may differ depending on the extent of gold price changes, given that hedging and extreme risk management decisions differ

widely depending on gold price volatility. We therefore focused on an analysis of causal relations in the conditional quantiles of gold commodity and gold stock returns by estimating quantile regressions (Koenker and Bassett, 1978; Koenker, 2005) and testing the hypothesis of Granger causality in quantiles using the sup-Wald test as introduced by Koenker and Machado (1999).

Previous empirical studies have examined the relationship between gold commodity prices and gold stock returns. For gold-mining companies in South Africa and North America, McDonald and Solnick (1977) reported evidence of significant positive dependence between gold prices and the market value of gold companies. Similarly, Blose and Shieh (1995) found that gold prices were reflected in gold stock returns and that gold price elasticity for firms primarily engaged in gold mining was greater than one. Using a multifactor model for Australian gold stock returns, Faff and Chan (1998) showed that gold price and market factors played an important role in the pricing of gold company stocks; they also demonstrated that those factors were less volatile than the price of gold. The empirical evidence reported by Borenstein and Farrell (2007) reveals that changes in gold commodity prices had an asymmetric impact on the value of gold stocks, and, furthermore, that the effect was greater when the price of gold was low. More recently, Batten et al. (2017) used quantile regression to examine the asymmetric impact of the price of gold on gold stocks, finding evidence of no asymmetric dependence. Finally, related literature has examined the relationship between gold-mining costs and gold prices (O'Connor et al., 2016) and the safe-haven benefits of investing in gold-mining firms (Areal et al., 2013).

* Correspondence to: Universidade de Santiago de Compostela. Departamento de Fundamentos del Análisis Económico, Avda. Xoán XXIII, s/n, 15782 Santiago de Compostela, Spain.
E-mail address: juancarlos.reboredo@usc.es (J.C. Reboredo).

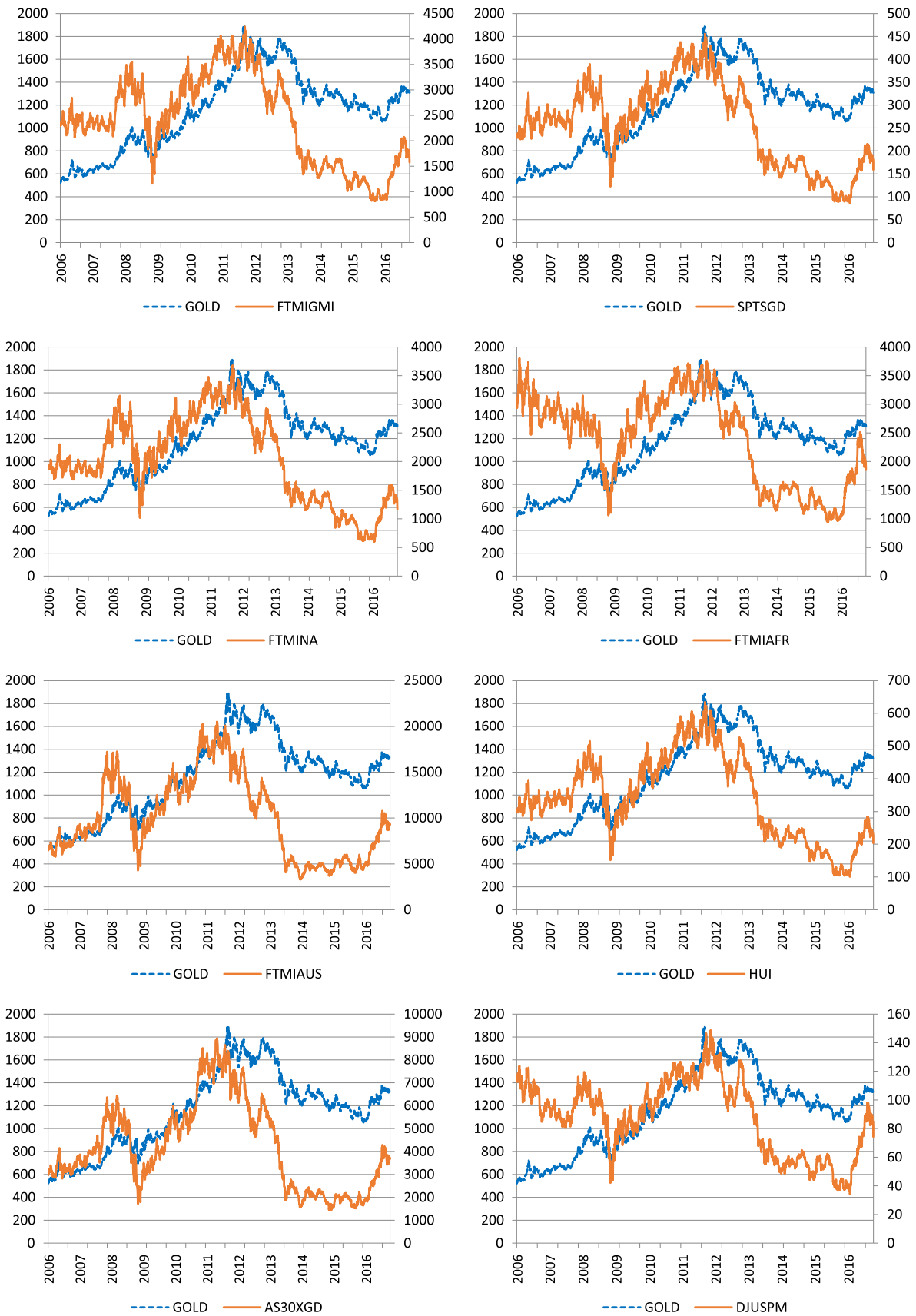**Fig. 1.** Gold commodity prices (left vertical axis) and gold stock prices (right vertical axis).