



# Is gold good for portfolio diversification? A stochastic dominance analysis of the Paris stock exchange



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## ABSTRACT

This paper aims to assess the role of gold quoted in Paris in the diversification of French portfolios from 1949 to 2012 using the stochastic dominance (SD) approach. The principal advantage of this method is that there is no restriction on the distribution of the returns. Our results show that stock portfolios including gold stochastically dominate those without gold at the second and third orders. This implies that risk-averse investors would be better off by including gold in their stock portfolios to maximize their expected utilities. The study on sub-periods shows that this result holds especially in unstable or crisis times. However, these results do not hold for bond or risk-free portfolios, for which the portfolios without gold dominate those with gold. To check the robustness of our results, our SD analysis of a mixed portfolio (50% stocks, 30% bonds and 20% the risk-free asset) provides results similar to those for portfolios with stocks only, except from 1971 to 1983. Portfolios including gold quoted in London show results similar to those from Paris. The results of mean–variance performance measures confirm the findings of previous studies that gold is good for the diversification of stock portfolios but not for bond portfolios.

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## 1. Introduction

Gold markets have been very volatile over the last several years, especially since 2007 when recent financial crises began. Gold prices have been greatly affected by financial, economic, political, and social conjunctures. On September 6, 2011, gold's price reached 1895 USD in London, the highest price in its history. This price increase has prompted the following question: Why does the price of gold increase during unstable periods or crises? Intuitively, we think that it is because gold was a currency for a very long time (e.g., Wood, 1988). Nowadays, this “precious metal” continues to be considered a real, tangible, and secure value. Thus, in periods of turmoil, investors would prefer secure assets like gold. Moreover, gold is very liquid and universal, since it can be sold easily anywhere in the world.

In order to understand the increase in gold prices during crisis times, we are particularly interested in its role in the diversification of portfolios. Indeed, if gold is good for portfolio diversification during periods of turmoil, demand for it will increase and thus so will its prices. According to the literature, gold is a good factor for diversifying portfolios because it is not positively correlated with other assets. Thus, when the price of

other assets decreases, gold prices may increase and this can maintain the portfolio's value even in crisis times. Following modern portfolio theory (Markowitz, 1952), a low or negative correlation between assets that compose a portfolio can reduce its risk. This point has already been studied by several authors such as Sherman (1982), Jaffe (1989) and Baur and Lucey (2010). However, most of these studies are only interested in gold quoted in the London Bullion Market, the biggest gold market in the world.

Our analysis focuses on the role of gold quoted in the Paris gold market in French portfolios. This choice is motivated by at least three reasons. First, our literature review shows that there are very few studies on the Paris gold market. Second, French people are known for their preferences for gold hoarding: between 3000 and 5000 tons nowadays (Hoang, 2012b). Some reports from the Bank of France<sup>1</sup> mention that the French hold the largest quantity of hoarded gold in the world. This can have an impact on the rationality of French investors' decisions to invest in gold and thus on the results of our study. Third, the Paris stock exchange is important in Europe and worldwide. For all these reasons, studying the role of gold in the diversification of French portfolios can provide interesting results not only for French investors but also international ones. Our study period, from 1949 to 2012, covers not only the recent turmoil period (from 2007 to 2012) but also previous ones.

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<sup>1</sup> Source: Archives of the Bank of France (box no. 1467200501/78).

This allows us to study how the role of gold in the diversification of portfolios changes over time.

Previous studies most commonly use the mean–variance (MV) approach. However, if the distribution of returns is not normal, the results could be misleading. That is why we recommend the stochastic dominance (SD) approach. This approach is important because it can be used to draw inferences on utility maximization for investors. Moreover, it allows them to appropriately rank portfolios without strong assumptions on the returns distribution or utility functions. Indeed, SD incorporates information on the entire distribution, rather than only the first two moments, and requires no precise assessment as to the specific form of the investors' risk preference or utility functions. In our study, to determine whether gold should be included in a portfolio, we compare the cumulative distribution functions of returns for portfolios with gold to those without gold. If the former stochastically dominates the latter, gold is preferred for expected utility maximization and/or expected wealth maximization, depending on the SD order (Wong, Phoon, & Lean, 2008). To our knowledge, this is the first paper to employ SD techniques in analyzing gold investments.

The results obtained show that stock portfolios with gold dominate the ones without gold. This suggests that French risk-averse investors should include gold in their stock portfolios in order to maximize their expected utilities. However, for bond and risk-free portfolios, including gold is not preferable except in very small proportions (from 1% to 2%). Results on a mixed portfolio (50% stocks, 30% bonds and 20% the risk-free asset) are close to those for stock portfolios (except from 1971 to 1983, when gold prices, bonds, and the risk-free asset experience a tendency to increase at the same time). However, this is not true for all percentages of gold and all orders of SD. This result implies that including gold in a mixed portfolio is also preferred but it is more restrictive than in a stocks-only portfolio regarding the proportion of gold to include in. Including gold quoted in London in French portfolios provides results similar to those for gold quoted in Paris. Moreover, using more common MV performance measures, we confirm the results of previous similar studies that gold is good for stock portfolios but not for bond portfolios. The findings of this research can help investors to design appropriate investments with gold to diversify their French portfolios.

The rest of the paper is organized as follows. Section 2 presents a literature review about the role of gold in portfolio diversification. Section 3 explains the methodology. Section 4 presents the database and its descriptive statistics. In section 5, we present and discuss our results. The robustness check of the results is detailed in Section 6. Section 7 concludes.

## 2. Gold in the diversification of portfolios: a literature review

Gold is usually assumed to be a good asset for diversifying financial portfolios, thanks to its weak correlation with other assets. This is due principally to the difference between the determinants of gold prices and those of other financial assets.<sup>2</sup> McDonald and Solnik (1977) conducted the first<sup>3</sup> empirical study of gold in the diversification of portfolios. They are interested in the relationship between gold prices quoted in London and the S&P 500 index using monthly data from 1948 to 1975. They also study the relationship between gold and gold mining stocks using a linear two-factor model. Their results show no

relationship between gold prices and stocks, but there is a positive relationship between gold and gold mining stocks. They thus conclude that both gold and gold mining stocks can be profitable for portfolio diversification.

In addition to McDonald and Solnik (1977), other authors are also interested in both “physical” gold and “paper” gold (gold mining stocks or gold mutual funds<sup>4</sup>). Jaffe (1989) studies the period from 1971 to 1987 using monthly data on gold prices in London, gold mining stocks and gold mutual funds. Using correlation coefficients, linear regressions and also the risk–return tradeoff of portfolios with and without gold, the author concludes that both physical gold and paper gold are profitable for portfolio diversification. However, physical gold is more efficient than paper gold. Chua, Sick, and Woodward (1990) use the same approach as Jaffe (1989) in calculating correlation and beta coefficients between physical gold and gold mining stocks in London. They draw the same conclusions as Jaffe (1989). Blose (1996) and Faff and Chan (1998) also examine this issue.

Other articles deal more directly with the role of gold in the diversification of portfolios. For example, Sherman (1982) studies the effect of gold on portfolios composed of stocks and bonds using monthly London data from 1976 to 1981. He uses a classical MV approach with the capital asset pricing model (CAPM) and correlation coefficients. Sherman shows that gold has a weak beta, a positive alpha, and a weak correlation with other assets. Thus, it is profitable to add gold to portfolios. Smith (2002) studies the relationship between gold prices in London and 17 European stock indices from 1991 to 2001. He finds that the correlation between gold and stock indices is very weak or even negative. Moreover, there is no cointegration between them. Smith (2002) thus concludes that gold is a good factor for portfolio diversification. Lucey, Tully, and Poti (2006) also study gold prices in London from 1980 to 2003 using the Nasdaq and FTSE indices. Instead of using the classical MV framework as in the above-cited articles, they choose the mean–variance–skewness approach. Their results show that gold is profitable for portfolio diversification. Michaud, Michaud, and Pulvermacher (2006), Ratner and Klein (2008), and Wozniak (2008) use MV methods and find the same results. Baur and McDermott (2010) use a GARCH model and conclude that gold quoted in London is good for the diversification of portfolios for major European and American stock markets. However, this is not the case for Australia, Canada and some emerging countries. Baur and Lucey (2010) use linear regressions and GARCH models. Taking into account asymmetric extreme shocks to stocks and bonds, they conclude that gold is a safe haven<sup>5</sup> for stocks but not for bonds.

Some authors compare gold with other precious metals (such as silver and platinum). Hillier, Frapper, and Faff (2006) use daily London data from 1976 to 2004 and two stock indices, the S&P 500 and the MSCI EAFE index (Europe, Australia and the Far East). They use the MV approach with correlation coefficients and the CAPM. They also measure the performance of portfolios using the reward-to-risk ratio.<sup>6</sup> Their results show that including one of these precious metals improves the portfolio's performance. Barisheff (2006) uses the New York spot precious metals index (SPMI) from 1972 to 2004 and find the same results as Hillier et al. (2006). Conover, Jensen, Johnson, and Mercer (2007) study the period from 1973 to 2006 and confirm these previous results.

To summarize, we find nearly twenty articles on the subject. Most of them use gold prices quoted in London. They study either the relationship between gold prices and other assets (stocks and bonds) or the performance of portfolios before and after including gold. Some others compare “physical gold” (ingots or coins) with paper gold (gold mining stocks or gold mutual funds), and some compare gold with other

<sup>2</sup> Some studies analyze the determining factors of gold prices, e.g., Lipschitz and Otani (1977), Jastram and Leyland (2009), Sherman (1983), Koutsoyiannis (1983), Sjaastad and Scacciavillani (1996), Cai, Cheung, and Wong (2001), Levin and Wright (2006), and Cheng, Su, and Tzou (2009). They can be summarized in three groups: political factors, monetary factors (such as inflation or the USD), and the price of other financial assets and precious metals.

<sup>3</sup> Actually, before 1971, the gold standard was still applied and gold prices were fixed at \$35 per ounce (about 31.1 g). Thus, gold was not considered a financial asset but a currency. For more information about gold under the Bretton-Woods system, see Bordo and Eichengreen (2007).

<sup>4</sup> These are mutual funds that invest in gold mining stocks.

<sup>5</sup> The authors define a safe haven as “an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil” (page 219).

<sup>6</sup> This ratio is also used to check the robustness of our results (see Section 6).

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