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Is gold a safe haven? International evidence

Dirk G. Baur [a,b,*], Thomas K. McDermott [c]

[a] Dublin City University – Business School, Ireland
[b] School of Finance and Economics, University of Technology, Sydney, Broadway, NSW 2007, Australia
[c] School of Business and Institute for International Integration Studies, Trinity College Dublin, College Green, Dublin 2, Ireland

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ABSTRACT

The aim of this paper is to examine the role of gold in the global financial system. We test the hypothesis that gold represents a safe haven against stocks of major emerging and developing countries. A descriptive and econometric analysis for a sample spanning a 30 year period from 1979 to 2009 shows that gold is both a hedge and a safe haven for major European stock markets and the US but not for Australia, Canada, Japan and large emerging markets such as the BRIC countries. We also distinguish between a weak and strong form of the safe haven and argue that gold may act as a stabilizing force for the financial system by reducing losses in the face of extreme negative market shocks. Looking at specific crisis periods, we find that gold was a strong safe haven for most developed markets during the peak of the recent financial crisis.

1. Introduction

1.1. Background

Since the beginning of the financial crisis in July of 2007, the nominal gold price has risen 42%.[1] The performance of gold is all the more impressive given the losses suffered in other asset classes during the present crisis. While the financial media regularly refer to gold as a "safe haven asset", the claim has rarely been tested in the literature. This paper aims to investigate the potential role for gold as a safe haven from losses in financial markets.

A haven is defined as a place of safety or refuge. In times of stormy weather, ships seek out the safe haven of a port or harbour to ride out the storm. A safe haven asset must therefore be some asset that holds its value in 'stormy weather' or adverse market conditions. Such an asset offers investors the opportunity to protect wealth in the event of negative market conditions. Whether or not investors will seek out a safe haven depends on a number of factors. Our analysis suggests that investors are most likely to look for a haven in response to severe market shocks suffered over a short period. We also find evidence that the haven effect is generally only present in developed markets and not in emerging markets. Losses suffered in emerging markets, even if severe, do not induce international investor movement towards the safe haven. We also test the role of uncertainty in stimulating interest in the safe haven asset.

1.2. Motivation and literature

The recent and ongoing financial crisis and the attendant strength of the gold price, presents a strong motivation to test the viability of gold as a haven from losses in financial markets. Evidence of the potential for gold to act as a safe haven asset was presented by Baur and Lucey (forthcoming). Their results show that gold tends to hold its value if stock markets experience extreme negative returns in Germany, the UK and the US. McCown and Zimmerman (2006) examine a number of characteristics of gold as a financial asset. They find evidence of the inflation-hedging ability of gold. Their analysis also suggests that gold shows the characteristics of a "zero beta asset", bearing no market risk, while they find the returns on gold over a 33 year period (1970–2003) are just slightly higher than the mean return on Treasury Bills.

* Corresponding author. Address: School of Finance and Economics, University of Technology, Sydney, Broadway, NSW 2007, Australia. Tel.: +61 2 9514 7747; fax: +61 2 9514 7722.
E-mail addresses: dirk.baur@uts.edu.au (D.G. Baur), mcdermot@tcd.ie (T.K. McDermott).

[1] Nominal gold price increased 42% from July 2007 to March 2009.

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Capie et al. (2005) analyze the role of gold as a hedge against the dollar, finding evidence of the exchange-rate hedging potential of gold. Other examples of studies that examine the financial characteristics of gold include Faugere and Van Erlach (2006), Lucey et al. (2006) and Sherman (1982).

In relation to the safe haven property and its role in financial markets, Ranaldo and Söderlind (2007) analyze the safe haven status of various currencies (see also Kaul and Sapp, 2006). Upper (2000) examines the role of a specific safe haven asset, i.e. German government bonds, during a specific period of market stress.

Various strands of investor behaviour literature are also related to our discussion of safe haven assets. The financial contagion literature examines the responses of investors to financial market shocks (e.g. Forbes and Rigobon, 2002). Investors seek diversification in their portfolios to reduce the risk of suffering heavy losses. International diversification is made possible by the less than perfect integration of international stock markets (Bai and Green, 2010; Chandar et al., 2009; Francis et al., 2008). However, in times of financial crisis, contagion effects may cause markets to co-move strongly, even where macroeconomic fundamentals would not suggest strong interdependence (Dornbusch et al., 2000; Hasman and Samartin, 2008). Thus there would appear to be limits to the potential for international diversification to reduce risks for investors (see also Ibragimov and Walden, 2007).

Markwat et al. (2009) find evidence of a domino effect that causes local crises to propagate to the regional or even global level, threatening the stability of the financial system. Such contagion dynamics present a strong motivation for investors to seek out a safe haven asset in times of financial crisis. Calvo and Mendoza (2000) find that investors faced with losses in emerging markets will tend to shift their portfolios towards the average portfolio, reflecting investors' concerns not only about returns in absolute terms, but also relative to the performance of other investors. This may explain the qualitative difference in our results for developed versus emerging markets.

A separate strand of the literature, known as the flight to quality literature, emphasizes investors' movements from stocks to bonds in response to negative market shocks (see for example Gulko, 2002; Hartmann et al., 2004). We aim to examine the role of gold as an alternative 'quality' asset in times of severe market stress.

1.3. Main contributions of paper

With the exception of Baur and Lucey (forthcoming) none of the above literature explicitly examines the role of gold as a safe haven against losses in financial markets. This paper builds on the work of Baur and Lucey (forthcoming), by extending the analysis in a number of important ways. We look at investor reactions to varying degrees of 'stormy weather'. Our dataset allows us to differentiate between 'storms' of various sizes, in terms of both the severity[2] and the duration[3] of shocks to the financial system. We also pursue a multi-country analysis, using major emerging and developed countries from a sample of 53 international stock markets, thus allowing us to test the safe haven effect across a broad cross-section of world stock markets. Our data cover a 30 year period from March 1979 to March 2009.

We also broaden the research approach, by examining two further questions related to the safe haven property and the role of gold in the global financial system: (i) to what extent does gold protect wealth during extreme market conditions, i.e. is it a weak or strong safe haven?[4] and (ii) what role do currency movements play in either driving or disguising the safe haven property of gold?

Using daily data, we find evidence of the strong-form safe haven for seven of the thirteen individual country stock indices tested: Canada, France, Germany, Italy, Switzerland, the UK and the US. The presence of a strong safe haven in these markets suggests the potential for gold to act as a stabilizing force for financial markets by reducing losses when it is most needed, i.e. during crisis periods.

An analysis of the role of exchange-rate effects also shows that a common currency denomination (US dollars) of both stock indices and gold generally increases the co-movement in all market conditions eliminating or greatly reducing the safe haven property of gold.

1.4. Organization of paper

The paper is structured as follows. Section 2 examines the performance of gold as a financial asset. Section 3 sets out the formal definitions of the hedge and safe haven properties. Section 4 contains the empirical analysis, including reported results, while Section 5 concludes.

2. The performance of gold as a financial asset

> The beauty of gold is, it loves bad news.[5]

Gold is often referred to as a store of value and a safe haven asset. In this section we examine some of the characteristics of gold that might explain the perception that it is somehow different from other assets. If gold does indeed love bad news, this would suggest *prima facie* evidence that it can act as a safe haven.

2.1. The role of gold

Gold has been used as a store of value and a means of exchange for millennia. The 17th Century British Mercantilist Sir William Petty described gold, silver and jewels as wealth "at all times and all places".[6] Gold's image as an immutable store of value has become culturally embedded, reinforced by its historic links to money. The gold standard system involved linking the value of currencies directly to gold. Central banks around the world continue to hold gold as one of the forms of reserves used to defend the value of their currencies. In India, the world's largest consumer of gold, the precious metal holds a unique socio-cultural significance as a symbol of a family's wealth and status.

And yet, the perception of gold in the financial media has wavered in recent times from "barbarous relic" to "an attractive each way bet" against risks of financial losses or inflation (The Economist, 2005, 2009).

2.2. Characteristics of gold as a financial asset

Investors have traditionally used gold as a hedge against inflation or a falling dollar. Because gold is priced in dollars, 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. Evidence of this phenomenon is presented in Capie et al. (2005).

[2] The severity of the shock is taken into account by looking at a range of lower quantiles of stock returns.

[3] The duration of the shock is represented by different frequencies of data; daily, weekly and monthly returns.

[4] A weak safe haven we define as an asset which is not correlated with the reference asset or portfolio. Therefore as the reference asset loses value, the value of the weak safe haven asset on average will remain unchanged. A strong safe haven asset is negatively correlated with the reference asset or portfolio and therefore gains value as the reference asset loses value. See formal definitions in Section 3.

[5] Harry "Rabbit" Angstrom – *Rabbit is Rich*, John Updike (as quoted in the Economist, February 26th 2009).

[6] Sir William Petty *Discourse on Political Arithmetick*, 1690 (Petty, 1690).

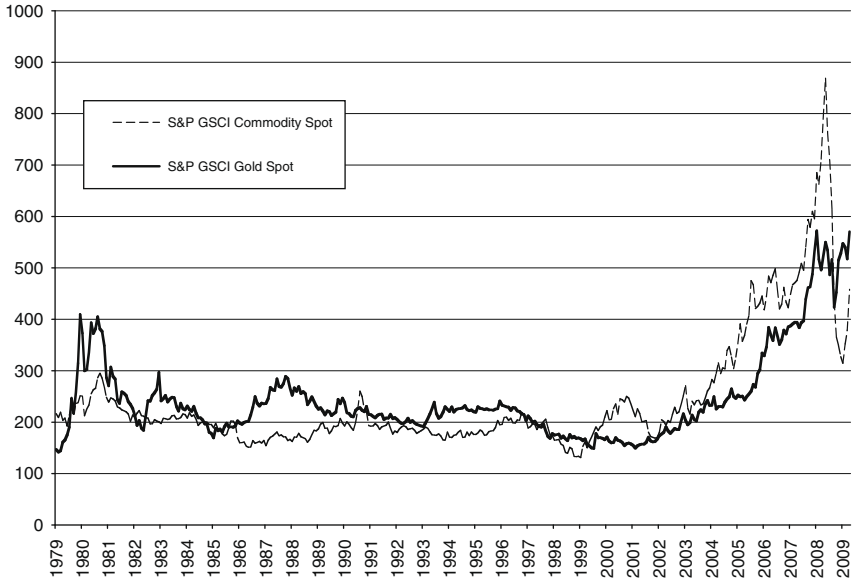

Fig. 1. The figure shows the evolution of S&P GSCI commodity and gold spot indices over a 30 year sample period from March 1979 until June 2009 (monthly data).

In times of uncertainty, when asset values become ambiguous due to investors' unwillingness to trade, the attractiveness of gold may increase due to the relative simplicity of the gold market. If the determinants of its value are easier to understand and evaluate, then gold might become an attractive alternative investment, offering investors a greater sense of certainty during periods of financial market turbulence.

As a physical asset, gold has an intrinsic value. Its main use is in jewellery but it also has dental and industrial applications. Its value is not dependent on future earnings or debt and investing in gold carries no risk of default. Other commodities may also share these properties. However, what sets gold apart is its behaviour during periods of falling asset values. Aside from its practical uses, the utility of gold may derive from this very unusual property; recent experience suggests that, unlike other financial assets, the value of gold tends to rise in response to negative market shocks.

2.3. Recent movements in the gold price

The price of gold has experienced a secular increase in recent years, in line with the boom across other commodity classes. Fig. 1 illustrates this relation. The Goldman Sachs commodities index (GSCI) increased 326% in the decade to its peak in July of last year (2008). Since then, however, the index has lost 70% of its value (July 2008 to March 2009). The equivalent index for gold rose 222% in the decade to its peak in March of last year (2008). After a brief dip in the latter half of 2008, the gold index has recommenced its upward trajectory in the first half of 2009.

Fig. 2 shows the period of the current global financial crisis. The crisis intensified in September 2008 with the collapse of Lehman Brothers. Fears of a global recession sent stock markets plummeting in October 2008.[7] Since October 2008 the gold price index has surged, indicating a positive response to the intensification of the financial crisis. This is in sharp contrast to the declining value of commodity index returns over the same period.[8]

Unlike other assets, gold prices appear to react positively to negative market shocks. The historic high in real gold prices came about in 1980 when gold surpassed $2000 an ounce (2008 dollars) against a backdrop of rampant inflation and the threat of a global recession following the oil crises of the 1970s. More recently the dramatic rise in the gold price over the past 18 months has come about during the worst financial and economic crisis to hit the global economy since the Great Depression of the 1930s.

2.4. The gold market

The composition of gold demand is rapidly changing, in the context of global economic turbulence, while gold supply remains relatively fixed.[9] The total demand for gold is made up of three categories: jewellery, industrial & dental, and investment demand. While jewellery and industrial & dental demand tend to follow the business cycle (being largely determined by consumer spending power), the demand for gold from investors would appear to be counter-cyclical, with demand from this sector rising as the global economy enters recession.[10]

Traditionally gold demand has been dominated by the demand for gold jewellery.[11] In recent months, however, the pattern of gold consumption has shifted dramatically with jewellery demand falling in response to a combination of high prices and weak consumer purchasing power. Jewellery demand for gold fell 11% (in volume terms) in 2008, while Q1 2009 saw a 24% drop in the demand for gold jewellery in year-on-year terms.[12]

By contrast, the investment demand for gold has soared with ETFs (and similar products) becoming for the first time the single

[7] On October 15th 2008 the Dow Jones index recorded its biggest one-day fall – losing 8% of its value in a single day's trading – since Black Monday in 1987.

[8] The correlation coefficient for the gold index and the GSCI went from 0.55 for our total sample period of 30 years (March 1979 to March 2009), to 0.20 for the period since August 2007 (beginning of the credit crunch), to −0.32 for the period since September 2008 (intensification of the financial crisis with the collapse of Lehman Brothers). The correlation between gold prices (in $ per Troy ounce) and the world stock market index went from 0.35 to −0.19 to −0.42 for the same intervals.

[9] Mining production, which accounts for 60% of total supply, actually fell 3% in 2008. Supply of gold, like that of other commodities, is relatively inelastic, in part due to the difficulty associated with extracting it from the ground and the long lead-in times between the establishment of a new mine and commencement of commercial production (this process can take as long as 5 years, according to the World Gold Council).

[10] This is evident from recent trends in gold prices, as well as our own analysis, which demonstrates an association between falling stock market values and rising gold prices.

[11] Jewellery consumption represented roughly 60% of "total identifiable end-use demand", excluding central banks, in 2008, down from approximately 70% in 2007. Source: World Gold Council.

[12] Source: World Gold Council.

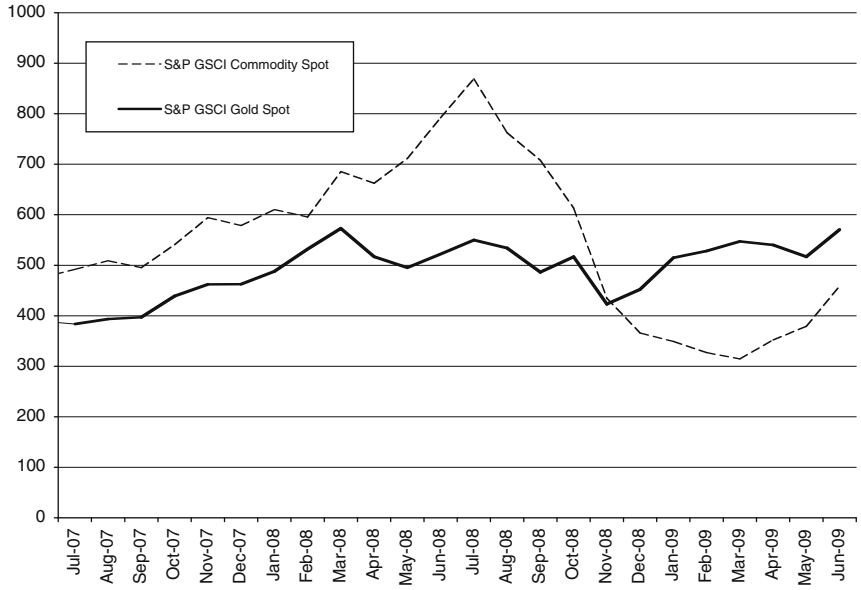

Fig. 2. The figure shows the evolution of S&P GSCI commodity and gold spot indices in the global financial crisis in 2007–2009 (monthly data).

largest category of gold demand. Investor demand for gold rose 64% in 2008. The first quarter of 2009 saw a record level of investment activity in gold, with demand from ETFs increasing 540%, in year-on-year terms, to 465 tonnes at a value of US$13.6bn.[13]

The dramatic rises in the gold price that have been witnessed in the past 18 months can therefore be explained by increased investor interest in the precious commodity. According to "The Economist" the recent surge in gold prices (since the start of 2009) has been driven by investors looking to preserve their wealth.[14] This reinforces the perception of gold as representing a secure investment for those with something to lose.

The unique characteristics of the gold market; its intrinsic value as a precious metal, the relative inelasticity of supply, and in particular the counter-cyclical elements of the demand for gold, lend weight to the theory that gold can act as a store of value, or a haven, in times of financial market turbulence and/or global uncertainty.

3. Definitions

This section defines a hedge and a safe haven to distinguish the two terms from each other. The section builds on the definitions provided in Baur and Lucey (forthcoming) but extends their work in one important respect. We differentiate between a strong hedge and a weak hedge and a strong safe haven and a weak safe haven. This distinction enables an assessment of the benefits of a safe haven asset for the financial system.

3.1. Hedge

A strong (weak) hedge is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio on average.

3.2. Safe haven

A strong (weak) safe haven is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio in certain periods only, e.g. in times of falling stock markets.

The distinguishing feature of the two types of asset described above is the length of the effect. The important property of the hedge is that it holds on average while the key property of the safe haven is that it is only required to hold in certain periods, e.g. a financial crisis.

Assets that work as a hedge against stocks might co-move with stocks in crisis periods since investors sell different types or all assets simultaneously. This can be explained by herd behaviour or contagion (e.g. see Calvo and Mendoza, 2000; Forbes and Rigobon, 2002; Boyer et al., 2006). In contrast, it is possible that there are assets that are only negatively correlated in crisis periods and co-move with the other asset on average. In this case, investors purchase the asset in these times only. The asset does not lose value in such times and thus works as a safe haven.

The distinction of a strong and weak hedge and safe haven is not only semantic but also important for investors. If an asset is negatively correlated with another asset or portfolio, investors enjoy positive returns if the other asset or portfolio exhibits (extreme) negative returns. This is not the case if the assets are uncorrelated. Since positive returns of an asset during times of financial stress or turmoil can enhance the stability of the market by reducing overall losses, a distinction of weak and strong properties of the assets is important.

4. Empirical analysis

This section contains the empirical analysis comprising an introduction to the data set, a descriptive and econometric analysis and a summary of the main findings.

4.1. Data

The data consists of daily, weekly and monthly continuously compounded stock returns of a sub-set of the 53 constituents of a world index provided by Datastream. The constituent inter-

[13] Source: World Gold Council. Increased investor activity in gold has been facilitated by the introduction of Commodity Exchange-Traded Funds (ETFs), which serve to reduce the carrying cost of gold for investors.

[14] "Haring away", February 26, 2009.

national stock indices are denominated in local currency and the weighting is based on the market capitalization. The sub-set comprises the seven largest developed countries (G7), the largest emerging markets (BRIC countries) and Australia and Switzerland. We include Australia to represent a small developed country with a large commodity market and Switzerland as a small European and non-Euro market with a strong and potentially important currency. We additionally use regional indices which represent groups of stock indices such as North America, Latin America, Europe, EU, EMU and Emerging Markets. The regional indices are denominated in US$. The price of gold is also obtained from Datastream (Gold Bullion in US$ per Troy ounce). The data cover a 30 year period from March 2, 1979 until March 2, 2009 leading to a sample size of 7826 observations for daily data, 1566 observations at the weekly frequency and 360 monthly observations. Table 1 reports summary statistics of the data for daily returns. The table contains the name of the market (country), the number of observations, the mean, the standard deviation and the minimum and maximum return for each market. The return on the world index and gold is also presented in the first two rows of the table. The average daily return of the world index is higher than the return of gold but the standard deviation is larger for gold than for the world index. This finding is also represented by the minimum and maximum values of the returns. Gold exhibits more extreme negative values (−0.1787) than the world index (−0.0976) and also more extreme positive values (0.1221 compared to 0.0817 for the world index). This pattern also holds for the returns based on weekly and monthly data.

The data also illustrate that emerging markets generally exhibit higher average returns, a higher risk (standard deviation) and more extreme values than developed markets. The values are generally also increasing with decreasing frequencies, that is, weekly data exhibit larger extreme values than daily data and monthly data show larger absolute values than weekly and daily data.

Table 1
The table presents the descriptive statistics of the world index and gold returns in US dollar and the returns of the stock market indices in local currency. The statistics are based on daily returns.

	Observations	Mean	Standard deviation	Minimum	Maximum
World index (in US$)	7826	0.0251	0.0083	−0.0976	0.0817
Gold (in US$)	7826	0.0170	0.0123	−0.1787	0.1221
Australia	7826	0.0298	0.0107	−0.2944	0.0793
Brazil	3825	0.0522	0.0173	−0.1055	0.1953
Canada	7826	0.0263	0.0094	−0.1165	0.0896
China	4070	0.0274	0.0208	−0.1429	0.1571
France	7826	0.0304	0.0118	−0.0989	0.0992
Germany	7826	0.0179	0.0110	−0.1214	0.1605
India	5000	0.0482	0.0176	−0.1825	0.2572
Italy	7826	0.0326	0.0135	−0.0984	0.1048
Japan	7826	0.0090	0.0117	−0.1574	0.1229
Russia	3835	0.0702	0.0272	−0.3062	0.3017
Switzerland	7826	0.0255	0.0096	−0.1231	0.0981
UK	7826	0.0278	0.0102	−0.1301	0.0886
US	7826	0.0269	0.0108	−0.2071	0.1090

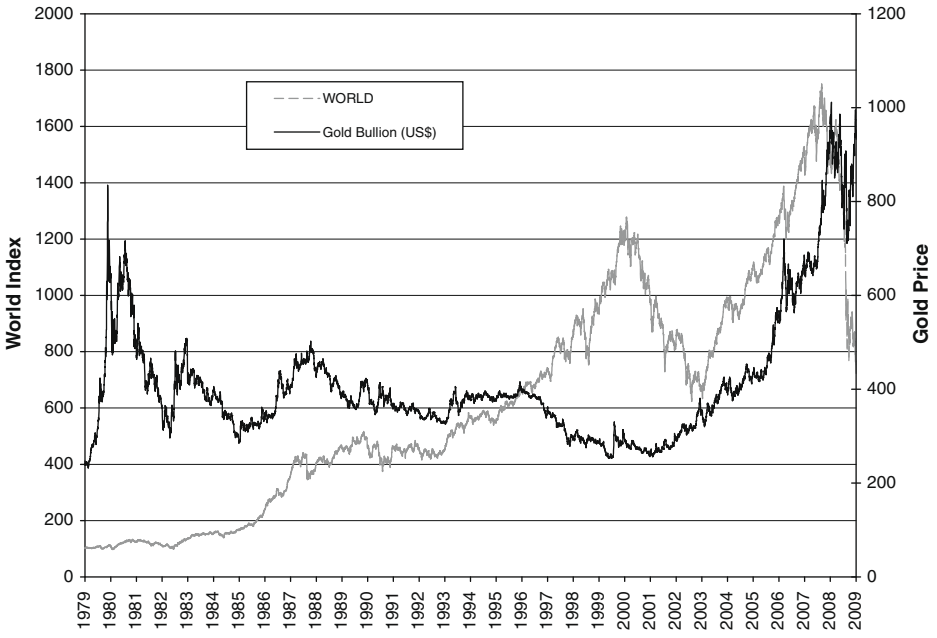

Fig. 3. The figure shows the evolution of a world stock index and the price of gold in US$ over a 30 year period from 1979 until 2009 (daily data). World index level is labelled on left vertical axis and gold price is labelled on right vertical axis.

4.2. Descriptive analysis

This section provides a descriptive analysis of the characteristics of the gold–stock market relation.

Fig. 3 presents the evolution of the world index and the price of gold through time for the 30 year sample period and Fig. 4 illustrates the time-varying volatility of the respective return series estimated with a GARCH(1,1) model.

Fig. 3 shows that the world index increased from a value of 100 in 1979 to over 1600 in 2007 before it fell to values below 800 in 2009. The price of gold increased from around 200 in 1979 to above 1000 in 2008. The graph also shows that the price of gold and the level of the world index co-move in certain periods (e.g. from 2004 to 2007) and move in opposite directions in others (e.g. from 1998 to 2003). This suggests that the relation of gold and the world equity portfolio is not constant, i.e. the beta changes over time. Obviously the period in which gold and the equity portfolio move in opposite directions is consistent with gold as a hedge against changes in the equity portfolio; gold loses value in the bull market (from 1998 to 2000) and gains value in the bear market (from 2000 to 2003). In contrast, the period from 2003 to 2007 is not consistent with a hedge since there is strong co-movement between the two assets. In this period gold is potentially driven by growth-related factors especially demand from emerging markets.

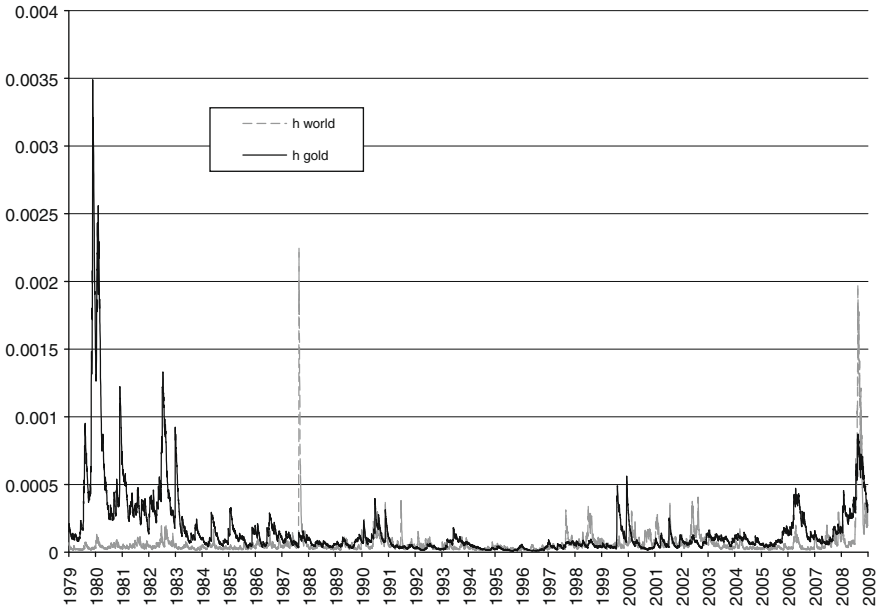

Fig. 4. The figure shows the evolution of daily conditional volatility (GARCH(1,1) estimates) of the world stock index return and the return on gold denominated in US$ over a 30 year period from 1979 until 2009.

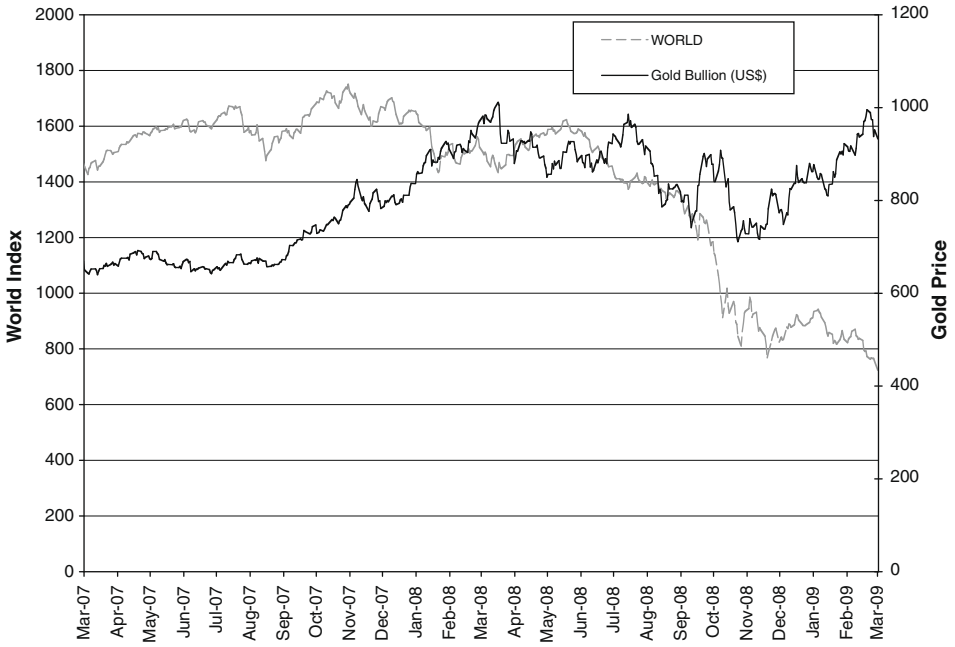

Fig. 5. The figure shows the evolution of a world stock index and the price of gold in US$ over a sub-sample period from 2007 until 2009 (daily data). World index level is labelled on left vertical axis and gold price is labelled on right vertical axis.

It is also possible that investors anticipated a crash and bought gold as a hedge against such an event. After the stock market crash in 2008, gold regained its negative correlation and thus its hedge or safe haven status.

Fig. 5 focuses on a period in which gold moves in opposite directions to the world stock market. This pattern is very clear in 2008 when stock markets fell significantly and gold increased by a similar magnitude.

This figure also shows that there is considerable noise in both the world index and the gold price.

Fig. 6 presents an even closer look and shows how the relationship changes within three months (August 20, 2008 to December 3, 2008) from a negative relation to a positive relation followed by a negative relationship. A least-squares regression of gold returns on world stock returns yields a positive and significant coefficient for the sub-sample shown in the figure. If we divide this period in two equal halves, it yields a negative and significant coefficient for the first sub-sample period and a positive coefficient for the second sub-sample period. This example shows that a positive beta on average does not exclude periods in which gold temporarily acts as a hedge or safe haven. The same is true for a negative beta on average (hedge); it would not exclude periods in which gold co-moves with other assets possibly reducing the hedge property when it is most needed.

Fig. 6. The figure shows the evolution of a world stock index and the price of gold in US$ over a short period in 2008. The figure aims to show the time-varying co-movement of gold and stocks. World index level is labelled on left vertical axis and gold price is labelled on right vertical axis.

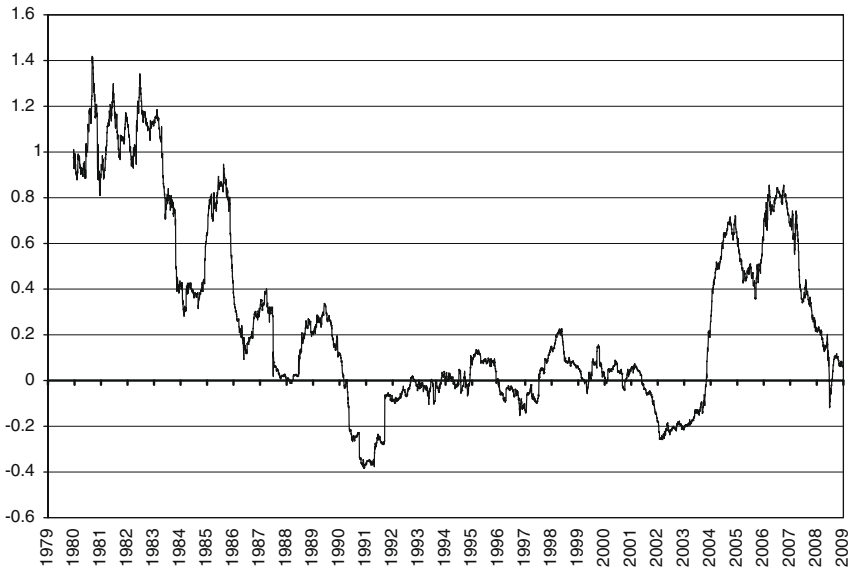

Fig. 7. The figure presents the evolution of the correlation of the global stock index with gold based on daily data. The rolling correlation estimates are based on a window length of 250 daily observations and illustrate that the correlation is changing through time. The regional indices (not displayed here for clarity of exposition) show qualitatively similar patterns through time. All indices are denominated in US$.

In order to analyze the time-varying behaviour of gold with respect to global stock markets we present coefficient estimates of a rolling window regression of the gold return on the World portfolio index. The window length is set to 250 daily observations which approximately represents one calendar year. Fig. 7 illustrates the coefficients (betas) for the World portfolio index. The time-varying betas confirm the hypothesis of a changing relationship. The results show that gold is not a hedge at all times but only in certain times. For example, gold is not a hedge in the beginning of the sample and not in the end of the sample. However, the relation is mostly around zero or even negative for more than ten years (between 1990 and 2003). The negative relationship implies that gold was a hedge for the index in that period.

Repeating this analysis revealed a qualitatively similar pattern for the regional indices (EU, EMU, North America, South America, and Emerging Markets). However, for ease of interpretation, we only present results for the World index.

Fig. 8 shows that the variation in betas is also evident in individual stock market indices. Again for the sake of clarity we only present the results for a single index – the US. However, qualitatively similar results were found for example for the UK and Germany also. The individual stock market indices are denominated in local currency in contrast to the regional indices which are denominated in US dollar.

The graphs (Figs. 7 and 8) show that the beta (i.e. the correlation of stock markets and gold) is not constant over time but changing. Since there are periods in which the beta is positive and periods in which it is negative, gold is not a hedge at all times. This justifies the separation of a hedge at all times into a hedge on average and a safe haven in specific periods.

The next section describes different models to analyze the hedge and safe haven property of gold for stock markets.

4.3. Econometric analysis

In this section, we present the econometric models to analyze the safe haven property of gold. We assume that the gold price is dependent on changes in the stock market. Moreover, we assume that the relationship is not constant but is influenced by specific, extreme, market conditions. Eqs. (1a), (1b), (1c) present the principal regression model to analyze the safe haven property of gold

$$r_{\text{Gold},t} = a + b_t r_{\text{stock},t} + e_t \tag{1a}$$

$$b_t = c_0 + c_1 D(r_{\text{stock}} q_{10}) + c_2 D(r_{\text{stock}} q_5) + c_3 D(r_{\text{stock}} q_1) \tag{1b}$$

$$h_t = \pi + \alpha e_{t-1}^2 + \beta h_{t-1} \tag{1c}$$

Eq. (1a) models the relation of gold and stock returns. The parameters to estimate are a and b_t. The error term is given by e_t.

The parameter b_t is modelled as a dynamic process given by Eq. (1b). The parameters to estimate in Eq. (1b) are c_0, c_1, c_2 and c_3. The dummy variables denoted as $D(\ldots)$ capture extreme stock market movements and are equal to one if the stock market exceeds a certain threshold given by the 10%, 5% and 1% quantile of the return distribution.

If one of the parameters c_1, c_2 or c_3 is significantly different from zero, there is evidence of a non-linear relationship between gold and the stock market. If the parameters in Eq. (1b) are non-positive (including c_0), gold acts as a weak safe haven for the market under study. If the parameters are negative and statistically different from zero, gold functions as a strong safe haven. Gold is a hedge for the market under study if the parameter c_0 is zero (weak hedge) or negative (strong hedge) and the sum of the parameters c_1 to c_3 are not jointly positive exceeding the value of c_0. Finally, Eq. (1c) presents a GARCH(1,1) model which is used to account for heteroscedasticity in the data. Eqs. (1a), (1b), (1c) are jointly estimated with Maximum Likelihood.

Eq. (1b) focuses on extreme negative returns to model potential non-linearities of the gold–stock index return relationship. If the relationship is, in fact, non-linear, this implies that investors act differently in extreme market conditions compared to normal conditions.

An alternative to this specification is to assume that the gold–stock relation changes with uncertainty of the markets. One proxy for uncertainty is the conditional volatility of the world portfolio. If uncertainty is high, the gold–stock relation is different than in periods in which uncertainty is low. If the conditional volatility of the world index is estimated with a GARCH process and different volatility levels (regimes) are chosen, an analogue to Eq. (1b) can be written as follows:

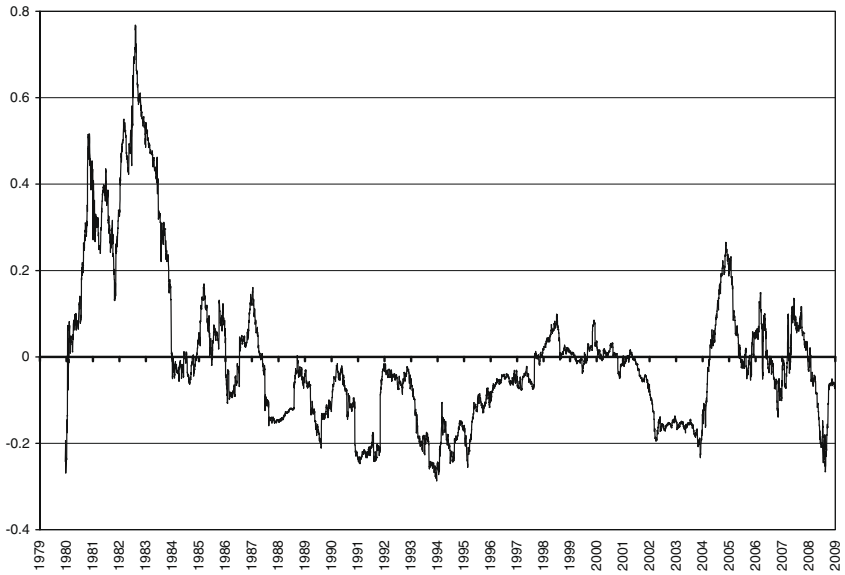

Fig. 8. The figure presents the evolution of the correlation of the US stock market index with gold based on daily data. The rolling correlation estimates are based on a window length of 250 daily observations and illustrate that the correlation is changing through time. Other individual country indices (not displayed here for clarity of exposition) also display qualitatively similar patterns through time. All individual country indices are denominated in local currency, gold is denominated in US$.

$$b_t = c_0 + c_1 D(h_{\text{stock}} q_{90,t-1}) + c_2 D(h_{\text{stock}} q_{95,t-1}) + c_3 D(h_{stock} q_{99,t-1}) \quad (2b)$$

where the dummy variable is equal to one if the lagged conditional volatility of the world portfolio lies in the 90% (95% and 99%) quantile and zero otherwise. We acknowledge the problem of generated regressors, but would argue that it is small in this case because of the use of volatility levels.

Since this approach picks up longer spells than the quantile-based approach (Eq. (1b)) the estimation results are expected to be different. For example, since volatility is highly persistent and clusters around certain periods, the dummy variables are equal to one for longer and consecutive periods than the dummy variables in Eq. (1b). While the dummy variables in Eq. (1b) can be expected to be equal to one only for one or two consecutive days or weeks, the terms in Eq. (2b) are likely to capture periods of several days or weeks.

Finally, a less statistical and more arbitrary approach would be to identify and define certain periods such as economic or financial crises, bull and bear markets and to use time dummies which are equal to one if the returns overlap with the predefined period and zero otherwise.[15] The model would be specified as in Eq. (3b) below

$$b_t = c_0 + c_1 D(\text{Asian crisis, } 1997) + \ldots + c_n D(\text{subprime crisis, } 2008) \quad (3b)$$

If the parameters c_1, c_2, … or c_n are zero or negative, gold is a safe haven in the respective crisis period. If the parameter is positive, gold co-moves with the stock market and does not meet the criteria for a safe haven. An alternative specification could utilize a dummy variable without the interaction term. Such a dummy would capture the change in the price of gold in a crisis period compared to normal periods. However, such a "pure" dummy would not indicate any relation of the gold price with stock market changes. Hence, we do not estimate such an alternative model.

The next section presents the estimation results and discusses the findings.

4.4. Estimation results

In this section, we present the estimation results of the models outlined above. Tables 2a–c show the estimates of a regression model for daily, weekly and monthly data given by Eqs. (1a), (1b), (1c). The tables contain the estimates of c_0 and the total effects for extreme market conditions, that is, the sum of c_0 and c_1 for the 10% quantile, the sum of c_0, c_1 and c_2 for the 5% quantile and the sum of all coefficient estimates for the 1% quantile.[16] The tables are structured as follows. The top panel contains the estimates for the regional indices (World, North America, Latin America, EU, EMU and Emerging Markets) and its relation with gold in normal and extreme market conditions. The bottom panel contains the estimates for the individual stock markets as listed in Table 1.

The results for the regional indices denominated in US dollar show that gold is not a hedge for most indices except North America. In fact, gold appears to strongly co-move with the regional indices, both on average and in extreme market conditions, across all frequencies of data (daily, weekly and monthly). These findings are hardly surprising. Because the regional indices are denominated in US dollar terms, the results are influenced by changes in the exchange-rate. The common currency denomination of gold and the stock market indices introduces a common feature in the data, which yields a greater degree of co-movement compared to a case in which local currency stock index returns are used. This would appear to explain the observed positive correlation between non-US stocks (denominated in US dollar) and the gold price.[17]

The North American index is the exception to the rule, as the currency effect discussed above is obviously redundant in the case of US stocks. Our results show a negative average correlation between gold prices and the North American index across all frequencies of data. However, the relationship is only significant for daily data.

In spite of the currency effect, we find highly significant negative correlations between gold and the regional indices for extreme market shocks (at the 1% quantile) for daily data. The currency effect appears to be dominated by other drivers (the safe haven effect) in the case of extreme market disturbances.

Our results suggest that gold acts as a hedge for North American stocks, and in the case of daily data, provides investors the compensating property of a strong hedge. Gold is also a (strong) safe haven in the case of extreme negative market shocks at a daily

Table 2a
The table presents the estimation results for the role of gold as a hedge and safe haven asset for daily returns. Negative coefficients in the hedge column indicate that gold is a hedge against stocks. Zero (negative) coefficients in extreme market conditions (quantile columns (0.10, 0.05 or 0.01)) indicate that gold is a weak (strong) safe haven. The results show that gold is a hedge and a strong safe haven for European countries and the US. Gold is not a hedge or a safe haven for emerging countries, Australia, Canada and Japan.

	Daily frequency			
	Hedge	0.10	0.05	0.01
Indices (in US$)				
Emerging Markets	0.057***	0.121	0.034**	0.108**
EMU	0.081***	0.142**	0.122	−0.087***
EU	0.088***	0.138	0.160	−0.088***
Latin America	0.011	0.020	0.065	−0.028***
North America	−0.064***	0.005**	−0.002	−0.070***
World	0.062***	0.126*	0.081	−0.015***
Markets (in local currency)				
Australia	0.044***	0.022	0.058	0.045
Brazil	0.005	−0.014	0.033**	0.001*
Canada	0.031**	0.076	0.071	−0.011***
China	0.011*	0.040	0.031	0.023
France	−0.047***	−0.037	−0.030	−0.096***
Germany	−0.058***	−0.040	−0.035	−0.122
India	0.004	0.038*	−0.002	0.004
Italy	−0.078***	0.015***	−0.047**	−0.147***
Japan	0.010	−0.004	−0.016	0.090***
Russia	0.003	0.016	0.010	0.011
Switzerland	−0.081***	−0.082	−0.078	−0.110*
UK	−0.067***	−0.029	−0.050	−0.094**
US	−0.071***	−0.013*	0.000	−0.073***

Model:

$$r_{\text{Gold},t} = a + b_t r_{\text{stock},t} + e_t$$

$$b_t = c_0 + c_1 D(r_{\text{stock}} q_{10}) + c_2 D(r_{\text{stock}} q_5) + c_3 D(r_{\text{stock}} q_1)$$

$$h_t = \pi + \alpha e_{t-1}^2 + \beta h_{t-1}$$

* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

[15] This approach is related to the work of Ranaldo and Söderlind (2007) who analyze the role of currencies as a safe haven in crisis periods.

[16] The dummies for the thresholds are defined to be equal to one if the stock market return exceeds a certain threshold (10%, 5% or 1% quantile) and zero otherwise. If the stock market return is below the 5% quantile threshold but above the 1% quantile threshold, the dummy variables for the 10% and the 5% thresholds are both equal to one. The total effect is then given by c_0, c_1 and c_2. If the total effect was computed as c_0 plus c_2, we would not allow for a different impact of stock returns in the interval [10%, 5%].

[17] If the dollar loses value relative to other currencies, this will cause the dollar-denominated nominal value of non-US stock markets to rise. A falling dollar is also likely to cause a rise in the nominal dollar price of gold, as discussed in the introduction. Thus movements in the dollar are likely to be driving the co-movement of non-US stocks and the gold price (both denominated in US dollar).

Table 2b
The table presents the estimation results for the role of gold as a hedge and safe haven asset for weekly returns. Negative coefficients in the hedge column indicate that gold is a hedge against stocks. Zero (negative) coefficients in extreme market conditions (quantile columns (0.10, 0.05 or 0.01)) indicate that gold is a weak (strong) safe haven. The results show that gold is a hedge and a strong safe haven for European countries and the US. Gold is not a hedge or a safe haven for emerging countries, Australia, Canada and Japan.

	Weekly frequency			
	Hedge	0.10	0.05	0.01
Indices (in US$)				
Emerging Markets	0.097***	−0.082**	0.075**	0.105
EMU	0.121***	0.186	0.049*	0.002
EU	0.136***	0.105	0.062	0.013
Latin America	0.046**	0.058	0.012	0.000
North America	−0.045	0.130***	−0.084***	−0.077
World	0.115***	0.087	0.006	−0.063
Markets (in local currency)				
Australia	0.063**	0.119	0.133	0.006*
Brazil	0.036	0.015	−0.023	0.076**
Canada	0.159***	0.050	0.124	0.049
China	0.035***	0.080	0.148	0.071
France	−0.031	−0.013	−0.062	−0.111
Germany	−0.064***	−0.045	0.026	−0.164***
India	0.010	0.116**	−0.019***	−0.041
Italy	−0.107***	−0.068	0.041*	−0.156***
Japan	0.027	0.072	−0.166***	0.059***
Russia	0.016	0.067	0.027	0.031
Switzerland	−0.127***	−0.121	−0.080	−0.042
UK	−0.083***	−0.245**	0.122***	−0.030**
US	−0.025	−0.144*	−0.153	−0.014***

Model:

$$r_{\text{Gold},t} = a + b_t r_{\text{stock},t} + e_t$$

$$b_t = c_0 + c_1 D(r_{\text{stock}} q_{10}) + c_2 D(r_{\text{stock}} q_5) + c_3 D(r_{\text{stock}} q_1)$$

$$h_t = \pi + \alpha e_{t-1}^2 + \beta h_{t-1}$$

* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

Table 2c
The table presents the estimation results for the role of gold as a hedge and safe haven asset for monthly returns. Negative coefficients in the hedge column indicate that gold is a hedge against stocks. Zero (negative) coefficients in extreme market conditions (quantile columns (0.10, 0.05 or 0.01)) indicate that gold is a weak (strong) safe haven. The results show that gold is a hedge and a strong safe haven for European countries and the US. Gold is not a hedge or a safe haven for emerging countries, Australia, Canada and Japan.

	Monthly frequency			
	Hedge	0.10	0.05	0.01
Indices (in US$)				
Emerging Markets	0.149**	0.154	0.044	0.620
EMU	0.072	0.142	−0.164*	0.330***
EU	0.108*	0.073	−0.163	0.144**
Latin America	0.145***	0.026	−0.017	0.586
North America	−0.097	−0.199	−0.074	0.093
World	0.123*	0.026	−0.014	0.238
Markets (in local currency)				
Australia	0.059	0.140	0.260	−0.057
Brazil	0.099*	0.223	0.007	0.053
Canada	0.130*	0.107	0.068	−0.103
China	0.051*	0.066	0.117	0.496
France	−0.061	0.056	−0.076	−0.073
Germany	−0.064	−0.161	−0.101	−0.234
India	0.017	−0.052	0.043	0.060
Italy	−0.105**	0.006	−0.046	−0.236
Japan	0.023	0.089	−0.187	0.347**
Russia	−0.009	−0.043	0.019	0.027
Switzerland	−0.168**	0.128*	−0.096	−0.148
UK	−0.075	0.051	−0.134	−0.098
US	−0.144**	−0.215	−0.010	−0.130

Model:

$$r_{\text{Gold},t} = a + b_t r_{\text{stock},t} + e_t$$

$$b_t = c_0 + c_1 D(r_{\text{stock}} q_{10}) + c_2 D(r_{\text{stock}} q_5) + c_3 D(r_{\text{stock}} q_1)$$

$$h_t = \pi + \alpha e_{t-1}^2 + \beta h_{t-1}$$

* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

frequency (but generally not at lower frequencies). This result is consistent across all but the Emerging Markets index, indicating that investors react differently to shocks in emerging markets as opposed to developed markets. The results also show that the relation of gold and stock returns is non-linear in many cases.

In order to control for the (possibly) distorting effects of the common currency denomination of stock market indices and gold prices, we repeat the analysis for a selection of individual stock markets quoted in local currencies.

The results for individual country indices (in local currency) for daily data are as follows. Gold is a hedge for France, Germany, Italy, Switzerland, the UK and the US. Gold is also a safe haven for these markets except for Italy at the 10% quantile. Most of the emerging markets exhibit small positive (but mostly insignificant) coefficient estimates. Australia, Canada and Japan show small but positive and significant coefficient estimates for the average relation excluding the possibility of a hedge and insignificantly positive or small negative coefficients implying a weak safe haven for extreme market conditions.

The pattern is qualitatively very similar for weekly and monthly return data. Developed markets with the exception of Australia, Canada and Japan show mostly negative coefficient estimates at all frequencies and all quantiles. The stock markets of Australia, Canada and Japan generally co-move with gold on average and show negative coefficient estimates in some extreme market conditions (e.g. 1% quantile Australia, monthly frequency).

Again the results are consistent with gold providing a safe haven for developed markets in times of extreme market conditions. Faced with heavy losses or high levels of uncertainty investors sell stocks and buy gold. However, this pattern of behaviour does not appear to carry over to emerging markets, where the observed positive correlations between stocks and gold prices across all quantiles would seem to confirm the hypothesis that investors react differently to shocks in emerging markets. They may well sell their shares in response to a negative market shock, but rather than seeking the shelter of a haven asset, they instead may be content to shift their portfolios towards the relative safety of developed world markets.

The finding that Australia, Canada and Japan prove exceptional might be explained by the nature of their stock markets. Canada and Australia both have significant mining interests in their national stock markets, which would tend to cause stocks and commodity prices (including gold) to co-move. Japan's stock market performance differs from the other countries in that stock prices rather stagnated for a long period. This causes gold to play a different role in Japan than in any other market.

The results can be summarized as follows. Gold is a strong hedge for all European markets and the US. Gold is also a safe haven in these markets. The strength of the safe haven effect varies across market conditions (quantiles) and return frequencies. Gold is generally a strong safe haven in very extreme market conditions (1%) for daily and weekly returns in European markets and the US. In contrast, gold is neither a hedge nor a safe haven for the BRIC countries, Australia, Canada and Japan.

The coefficients reported in Tables 2a–c are relatively small. That is, the coefficients generally lie in the interval [−0.1, 0.1],

Table 3
The table presents the estimation results for the role of gold as a hedge and safe haven asset in periods of increased volatility as a proxy for uncertainty. Negative coefficients imply that gold is a hedge on average (second column) or a safe haven in periods of increased or extreme volatility. The results show that gold is a hedge in European markets and the US and a safe haven in periods of increased volatility (columns 4–7) in most markets. In contrast, for the majority of markets, gold is not a safe haven in periods of extreme volatility (last two columns). The total effect is the sum of the hedge coefficient (c_0) and the marginal effect. The t-statistics refer to the marginal effect.

	Hedge		World volatility > 90%		World volatility > 95%		World volatility > 99%	
	Coefficient	*t*-Statistics	Total effect	*t*-Statistics	Total effect	*t*-Statistics	Total effect	*t*-Statistics
Australia	0.14	8.71	0.08	−1.03	−0.01	−1.31	0.11	2.24
Brazil	0.04	3.18	0.07	1.02	−0.06	−3.16	0.04	2.47
Canada	0.16	8.32	0.14	−0.48	−0.02	−2.53	0.13	2.69
China	0.04	3.97	0.04	0.03	−0.02	−1.70	−0.02	−0.01
France	−0.04	−2.85	−0.02	0.60	−0.05	−0.72	0.04	1.91
Germany	−0.05	−2.98	−0.05	−0.05	−0.06	−0.15	0.06	2.28
India	0.02	2.56	0.03	0.40	−0.02	−1.34	0.11	2.93
Italy	−0.03	−2.35	−0.06	−0.75	−0.07	−0.21	0.11	3.45
Japan	0.05	3.40	−0.03	−2.10	−0.01	0.44	0.14	3.08
Russia	0.03	4.07	0.02	−0.42	0.00	−0.75	0.10	3.70
Switzerland	−0.07	−3.73	−0.08	−0.23	−0.07	0.21	0.03	1.89
UK	0.02	1.19	0.00	−0.54	−0.05	−0.76	0.11	2.95
US	−0.01	−0.64	−0.02	−0.32	−0.09	−1.25	−0.02	1.52
Number of observations		783		391		78		

Model:

$$r_{\text{Gold},t} = a + b_t r_{\text{stock},t} + e_t$$
$$b_t = c_0 + c_1 D(h_{\text{stock}} q_{90,t-1}) + c_2 D(h_{\text{stock}} q_{95,t-1}) + c_3 D(h_{\text{stock}} q_{99,t-1})$$
$$h_t = \pi + \alpha e_{t-1}^2 + \beta h_{t-1}$$

which means that a 10% change in the stock market leads to a 1% change in the gold price. One reason for the relatively small coefficients is the time-variation in the gold–stock relationship as described and reported above. An explicit analysis of shorter periods, e.g. a strong bull or bear market would lead to larger absolute coefficients.

The plots of the time-varying beta estimates presented above show that the betas are larger in absolute terms for sub-periods of 250 trading days. These episodes also include bull and bear markets. We do not analyze such market trends in more detail since it is to some extent arbitrary to identify bull and bear markets and to distinguish such periods from each other and from other periods.

4.5. Uncertainty and the safe haven effect

In this section we present the estimation results of the regression model specified in Eq. (2b). We use a measure of extreme market conditions given by the daily conditional volatility of the world index estimated with a GARCH(1,1) model. We choose different levels of this volatility as a proxy for global financial market uncertainty. If investors buy gold in times of high volatility and thus uncertainty, the price of gold should increase in such periods.

The results are presented in Table 3 and illustrate that gold is a hedge for the Euro countries, Switzerland and the US and works as a safe haven in periods of increased volatility (90% and 95% thresholds) but does not work as a safe haven in spells of extreme volatility (99% threshold) or uncertainty except for the US and China. The marginal effect is positive and statistically significant for all markets but the total effect, despite being smaller than the marginal effect, is only negative for the US and China.

The results imply that in times of increased uncertainty, gold is a safe haven but loses this property for most markets in times of extreme uncertainty proxied by a global volatility estimate. If volatility and uncertainty exhibit extreme levels stocks and gold comove thereby eliminating the safe haven property.

Since volatility is clustered around certain periods, the results also imply that the safe haven is effective for a certain period and not confined to the days of the extreme shocks only. This also explains why the results differ between the two regression models. Since there is volatility clustering but no extreme negative shock clustering the regressions yield different results.

In the next section, we analyze certain periods of high volatility or uncertainty by focussing on three major episodes of financial crisis.

4.6. Crisis periods and the safe haven effect

The model specified in Eq. (3b) analyzes crisis periods explicitly and not implicitly as the models in Eqs. (1a), (1b), (1c) and (2b) do. The specification of the crisis periods, while more economic and less statistical, is more arbitrary than for the other two models (despite the specification of thresholds) since crisis periods have to be selected and the start date and the length have to be defined. As has been shown in the so-called contagion literature, it is not straightforward to define the outbreak of a crisis and its end (see Dungey et al., 2004). We analyze three major crisis periods: (i) the stock market crash in October 1987, (ii) the Asian crisis in October 1997 and (iii) the global financial crisis which originated as a subprime crisis in 2007 and peaked in September 2008.

We define starting dates and assume that most of the crisis and its effects occurred in the first 20 trading days (approximately one month)[18] after the start date. We define October 16, 1987, October 22, 1997 and September 10, 2008[19], respectively, as the start dates for each crisis period, and set the dummy variables in Eq. (3b) equal to one on that day and the subsequent 20 trading days. On all other days, the dummies are equal to zero.

Table 4 presents the results and shows the coefficient estimate and statistical significance for a hedge (second and third columns, respectively) and the total effects and the t-statistic for the marginal effect of the three crisis periods (following column pairs for the coefficient estimates and the t-statistics).

[18] A similar number of trading days for a crisis period is used in the contagion literature (e.g. see Forbes and Rigobon, 2002).

[19] Lehman Brothers collapsed on September 15, 2008.

Table 4
The table presents the estimation results for the role of gold as a hedge and safe haven asset in periods of financial crises (October 1987, Asian Crisis October 1997 and Financial Crisis of 2008 – Lehman Brothers bankruptcy September 2008). The results show that gold is a hedge on average and in financial crises in particular in the global financial crisis in September 2008 (last two columns). The safe haven effect of gold in October 1987 is confined to Canada and the US and the results for the Asian crisis do not clearly indicate a safe haven effect of gold. The crisis periods are modelled through a dummy variable which is set equal to one for 20 trading days after the crisis start and equal to zero for all other observations. The total effect is the sum of the hedge coefficient (c_0) and the marginal effect. The *t*-Statistics refer to the marginal effect.

	Hedge		October 1987		Asian crisis (October 1997)		Financial crisis (Lehman September 2008)	
	Coefficient	*t*-Statistics	Total effect	*t*-Statistics	Total effect	*t*-Statistics	Total effect	*t*-Statistics
Australia	0.11	5.88	0.06	−0.96	0.04	−0.64	0.77	2.87
Brazil	0.01	0.83			0.08	1.32	−0.31	−2.32
Canada	0.14	6.49	−0.03	−2.61	0.24	0.64	−0.18	−1.22
China	0.01	1.47			−0.03	−1.07	0.24	2.08
France	−0.03	−1.64	−0.07	−0.75	0.04	0.51	−0.86	−3.69
Germany	−0.03	−1.57	0.03	0.80	0.05	0.69	−1.03	−3.96
India	0.01	1.30			0.16	0.71	−0.08	−0.89
Italy	−0.03	−2.35	−0.01	0.24	0.00	0.24	−0.72	−2.93
Japan	0.04	2.67	0.09	0.68	0.06	0.08	0.42	1.78
Russia	0.02	2.48			−0.02	−1.35	0.68	2.88
Switzerland	−0.04	−1.93	−0.01	0.57	0.03	0.47	−0.90	−2.91
UK	0.04	1.94	0.03	−0.10	0.14	0.51	−0.97	−4.20
US	−0.02	−1.21	−0.15	−2.52	0.17	1.43	−0.75	−3.31

Model:

$$r_{\text{Gold},t} = a + b_t r_{\text{stock},t} + e_t$$

$$b_t = c_0 + c_1 D(\text{Asian crisis},1997) + \ldots + c_n D(\text{subprime crisis},2008)$$

$$h_t = \pi + \alpha e_{t-1}^2 + \beta h_{t-1}$$

The total effect estimates for the crash in October 1987 indicate a zero correlation of gold and stocks for all markets with the exception of Canada and the US which exhibit a negative and statistically significant coefficient estimate. This implies that gold was a weak safe haven in all markets and a strong safe haven in Canada and the US. The results for the Asian crisis are more heterogeneous and exhibit larger absolute total effect estimates. The total effects estimates are positive and relatively large for several countries including Canada and the US implying that gold was not a safe haven despite the statistical insignificance. The non-significance of the coefficient estimates must be treated with more care due to the low number of observations (20 trading days).

Finally, the third crisis period studied here shows a clear result for two groups of countries. The European countries and the US exhibit a strong safe haven effect with total effect estimates ranging from −0.72 (Italy) to −1.03 for Germany. Brazil, Canada and India also exhibit a safe haven effect. The other countries show a strong positive co-movement of gold and stocks, most notably Australia with a total effect estimate of 0.77.

Since the change in the US dollar price of gold is the same in each country within a certain period, the differences in the total effects are due to a different performance of the local stock market and changes in the exchange-rate.

The safe haven effects in high volatility and financial crisis periods differ since the financial crisis episodes are relatively short (20 trading days) compared to the high volatility spells (at least 78 observations, one percent of the total number of daily observations). Since high volatility episodes include but also extend the crisis periods specified in the regression models, the results imply that the safe haven effect holds only for a certain number of days. The safe haven asset tends to exhibit negative returns thereafter due to its hedge property against stock markets.[20]

[20] If gold is a hedge against stocks on average, gold exhibits negative returns if stock prices increase.

5. Conclusions

This paper analyzes the role of gold in the global financial system. Specifically, we test the hypothesis that gold acts as a safe haven asset, offering protection to investors against losses in financial markets. We find evidence of the safe haven effect for most developed country stock markets. However, the findings are strongest for daily data, especially for extreme shocks occurring with a probability less than one percent. These results suggest that investors react to short-lived and extreme shocks by seeking out the safe haven of gold. In this context, gold can be seen as a panic buy in the immediate aftermath of an extreme negative market shock. More gradual trends in stock markets – weekly or monthly losses – do not appear to elicit the same impulsive response from investors.

We also find evidence of a clear qualitative difference in the way investors react to shocks in developed and emerging markets. Gold is, at best, a weak safe haven for some emerging markets. This result fits with our hypothesis that the safe haven asset plays a relatively minor role in emerging markets. Investors suffering losses in emerging market stocks, rather than seeking an alternative haven asset, may simply readjust their portfolios towards the average by withdrawing from emerging markets in favour of developed market stocks. This reflects the contention of Calvo and Mendoza (2000) that investors worry not only about their absolute performance, but also about their performance relative to other investors.

Looking at specific crisis periods, we find that gold was a strong safe haven for most developed markets during the peak of the recent financial crisis. Gold was also a strong safe haven for markets in the US and Canada during the 1987 stock market crash. However, the results for the Asian crisis do not clearly indicate a safe haven effect of gold for any of the markets tested.

We also test the hypothesis that increased uncertainty not confined to specific crisis periods leads investors to seek out the safe haven. The results show that gold is a safe haven for increased levels of global uncertainty proxied by the conditional volatility of a world stock market index. However, gold is not a safe haven for extreme levels of global uncertainty. Rising uncertainty causes investors to seek out the safe haven but under extreme uncertainty

gold co-moves with stock markets establishing a market of one; that is, all assets move in the same direction.

In our analysis, we distinguish between a weak and strong form of the safe haven effect. A weak safe haven will protect investors to the extent that it does not move in tandem with other assets in response to negative market shocks. The strong safe haven, by moving against other assets during periods of market stress, reduces overall losses for investors. We find that gold is a strong safe haven for most major developed world stock markets including the larger Eurozone markets (Germany, France and Italy), Switzerland, the UK and the US. Gold thus has the potential to act as a stabilizing force for the global financial system by reducing losses when it is most needed.

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