Financial Turmoil and Safe Haven Assets

Dirk G. Baur*

&

Thomas K.J. McDermott†

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Abstract

Financial crises and contagion have highlighted the need for safe haven assets. However, their existence, role and interactions are not well understood. We analyze the two most prominent yet fundamentally different safe haven assets, US government bonds and gold. Our econometric analysis explicitly models the dynamic interaction between these assets and the global stock market. While both assets appear to act as safe havens, we find that gold, in contrast to US government bonds, becomes increasingly sensitive to large negative shocks in the stock market. Gold therefore appears to be a stronger safe haven in extreme conditions despite the fact that it is more risky and less liquid than bonds. We offer a behavioral interpretation to explain our findings.

JEL classification: D03, D81, G01, G11

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*Corresponding author. Address: UTS, Business School, Finance Discipline Group, PO Box 123 Broadway, Sydney, NSW 2007, Australia, Email: dirk.baur@uts.edu.au, Baur gratefully acknowledges financial support from the 2011 (UTS) Business School Research Grant (BRG).

†Grantham Research Institute on Climate Change and the Environment, London School of Economics.

The term "safe haven" features regularly in the financial media, where it is applied to a dizzying range of assets, including various currencies, government bonds and commodities. A search on the Financial Times website for the term "safe haven" yields 4,024 hits.[1] A google search using "Wall Street Journal safe haven" yields over three million hits displaying a vast range of "safe haven" assets.[2] The search results also reveal a dynamic inconsistency. For example, the US dollar is cited as a safe haven currency in one month but only a month later the media claims that the US dollar has lost its safe haven status. There thus appears to be some confusion with regard to the definition of a safe haven asset.

While in general, portfolio diversification may allow investors to reduce the risk of suffering large losses on their investments, during periods of financial market turmoil various asset classes tend to co-move strongly, even where macroeconomic fundamentals would not suggest strong interdependence (Dornbusch *et al.* , 2000).[3] Such contagion effects, and the increased co-movement across countries, industries and asset classes during crisis periods, motivates the search for a safe haven asset, which will not move in tandem with other assets and holds its value during these specific episodes. We can therefore define a safe haven asset empirically, as an asset that is either uncorrelated or negatively correlated with other assets during periods of financial stress, e.g. during a financial crisis (Baur & Lucey (2010) and Baur & McDermott (2010)).[4] According to this definition, many assets labelled "safe haven" in the financial media (see footnote above) are not safe haven assets.

The recent attention on safe (haven) assets can also be related to the global financial

[1]The search was performed in January 2013.

[2]An arbitrary list of article headlines in the Wall Street Journal includes "Sterling to Trade More Like a Safe Haven" (3 Oct 2012), "Australian Debt Draws Safe-Haven Crowd" (14 Aug 2012), "Gold Poised to Regain Safe-Haven Status" (28 May 2012), "Nordic Banks Gain New Status: Haven" (24 Sep 2012), "Seeking a New Safe Haven" (18 Jul 2011), "Dollar Rises on Safe-Haven Flows" (16 Nov 2012), "Singapore Dollar Higher Late, Benefits From Safe-Haven Flows" (5 Dec 2012), "Investors are seeking safety in new harbors" (1 Mar 2011).

[3]The literature on financial crises and contagion examines the responses of investors to financial market shocks, and how those shocks get transmitted across markets and across asset classes. Boyer *et al.* (2006) present evidence that crises spread through the asset holdings of investors, as opposed to changes in economic fundamentals.

[4]Note that this definition implies that assets that display such properties during a single episode of financial stress or turmoil do not qualify as safe haven assets.

crisis. In particular, the demand for alternative safe assets has been driven in part by concerns over mutually reinforcing bank and sovereign debts, particularly in the Eurozone.[5] However, the concept of a "safe asset" - defined by Gorton *et al.* (2012) as an asset whose value is insensitive to information - can be clearly distinguished from a "safe haven" asset, which, as noted above, is defined empirically by its relation to other assets during specific periods, and is therefore clearly dependent on information flows.[6] The safe haven effect, as defined above, is essentially then a short-term phenomenon. There may still be a link between the global demand for safe assets, and the safe haven effect. For example, the downgrading of what were previously seen as relatively safe investments (e.g. collateralized debt obligations (CDOs) and government bonds) may have forced investors to re-evaluate their models of risk. The associated uncertainty, at least in the short-term, would be expected to drive demand for safe haven assets. We return to these themes later in the paper. For the moment, we concentrate our discussion on the safe haven effect.

We focus our analysis on the two most prominent safe haven candidates: US Treasury bonds and gold. Despite the fact that US government (Treasury) bonds and gold are both commonly referred to as safe haven assets, they offer investors very different forms of "safety".[7] Bonds are an obvious choice as safe haven asset, given that they offer a fixed return if held to maturity. The returns to gold, on the other hand, tend to be relatively volatile. However, gold offers investors protection from additional threats to which bonds are susceptible; that is inflation, currency risk and, perhaps most importantly, default risk.[8] In addition, the cost at which the "safety" can be purchased also differs. Bid-ask spreads can be assumed to be significantly wider for gold in the spot market than for US Treasury bonds which means that investors pay a premium if they buy gold compared to

[5]Interestingly, it has been argued by the 'euro-nomics' group of economists that the global demand for safe assets has been rising as a result of impressive growth in emerging markets outstripping their financial development. Furthermore, these authors argue that this structural trend at a global level is at least partly responsible for the Eurozone's joint banking and sovereign debt crisis. See <http://post.nyssa.org/nyssa-news/2011/12/european-safe-bonds-esbies.html> for further details.

[6]Other studies on "safe assets" are Gourinchas & Jeanne (2012) and IMF (2012).

[7]The simultaneous demand for both gold and US Treasuries may constitute a puzzle given that the former is considered to be an inflation hedge and the latter is a bet against high inflation. (See for example "Safety Thirst", *The Economist*, 7 May 2011).

[8]Currency risk can be viewed as a form of default risk since a currency devaluation is similar to a partial default for an international investor.

the purchase of bonds.[9]

These distinct characteristics of bonds and gold make their joint analysis potentially more revealing with regard to what motivates investor purchases of safe haven assets. Although the existing literature has analyzed the safe haven property of specific assets individually, as far as we are aware this is the only study that jointly analyzes two safe haven assets, i.e. gold and US government bonds, and models their interaction. In our empirical analysis, we use large shocks in the stock market as a trigger of safe haven purchases. We assume that large shocks carry more information than small shocks. Hence, large shocks are more difficult to process than smaller shocks especially if the shock contains "new", i.e. unfamiliar, information. Investors thus react differently to large shocks than to smaller, and more normal, shocks.[10] We then test whether the reaction of bonds and gold differs with respect to different shock magnitudes.

We find that both bonds and gold act as "safe haven" assets during periods of market stress. However, our results also reveal a distinction between the roles of these two assets. In general gold appears to be more responsive to large shocks. Furthermore, the reaction of gold returns to stock market movements gets progressively stronger (and becomes more persistent) as we move from average stock returns to the most extremely negative returns. For bonds, if anything, the relationship is stable but weak. The distinction between bonds and gold is most clearly illustrated in our graphical analysis of specific crisis episodes. In particular, for those episodes that most closely correspond to the idea of a "black swan" event that carries a large amount of "new" information - i.e. 9/11 and September 2008 (the collapse of Lehman Brothers) - the reaction of gold is both more rapid and stronger than that of bonds. Such "black swan" events are of particular interest for our study. However, given their rarity such events may not be amenable to statistical analysis.[11] For

[9] It can also be argued that the price of "safety" increased substantially given the price of gold in 2011 (above 1,800 US dollar) compared to the price of gold in, say, 2000 (about 250 US dollar). Storage costs for physical gold are also significantly higher than for bonds which adds to the premium.

[10] Peng *et al.* (2007) argue that investors can only process a limited amount of information during a given time period. This "limited attention" may result in different reactions of investors to large shocks than to small shocks.

[11] "Black swan" events - the *unknown unknowns* that nobody predicted or foresaw - have been characterized by Nassim Taleb (Taleb, 2010) as events that carry extreme impacts. They are outliers in the sense

this reason, we give serious consideration to the observed patterns of market responses to these isolated events, in addition to our econometric analysis.

This study contributes to the existing literature with (i) the analysis and joint modelling of the most prominent safe haven assets, (ii) the treatment of all variables as endogenous in the econometric specification and the empirical analysis and (iii) the use of a theoretical model to explain the observed patterns. The use of a global stock market index (MSCI World) allows us to treat large negative shocks as evidence of contagion among at least a subset of the countries in the index. The role of the US dollar is also analyzed and the results illustrate that changes in the US dollar are particularly important for the safe haven properties of gold.[12] The econometric framework, a Vector Autoregressive model, explicitly accounts for the endogeneity possibly present between stock returns and safe haven assets. This framework can also identify feedback effects and thus the role of safe haven assets and their stabilizing or de-stabilizing function on the stock market. Hence, the empirical contribution in this study can be clearly distinguished from the existing literature in more than one respect.

We also propose a behavioral interpretation of our results. In particular, our findings are suggestive of an important role for psychological and emotional factors (e.g. ambiguity-aversion or cognitive limitations in the face of uncertain choices) in the decisions of investors during periods of market turmoil. We argue that it would be difficult to explain the observed patterns of investment in gold without reference to such phenomena, given that the high volatility of gold would not necessarily make it an "efficient" investment from a purely rational perspective. Recently, a number of authors have used insights from the literature on ambiguity-aversion in attempting to explain episodes of financial crisis (e.g. Caballero & Krishnamurthy, 2008; Epstein & Schneider, 2008). However, relatively

that they lie outside the realm of regular expectations and are essentially unpredictable *a priori*. For this reason, "black swan" events, which had never been factored in to models of risk (because nobody believed, or imagined, that such an event would ever take place), are precisely the type of events that force agents to re-evaluate their world view - thus generating large uncertainties.

[12] Since the US dollar is viewed as a safe haven currency the reaction of gold may be underestimated if investors simultaneously purchase both gold and US dollar or gold using US dollar. The empirical analysis provides strong evidence for this effect.

few studies have tested these theories empirically.[13] Our results potentially contribute to this literature also.

The rest of the paper is structured as follows. In Section I we present our data and a preliminary, descriptive analysis of the relationship between stocks, bonds and gold. This section also includes a graphical analysis of specific crisis episodes, to further motivate the study. In Section II we outline our econometric framework and present the results of a detailed, systematic empirical analysis, for both average market conditions and conditional on extreme stock market returns. The results of our analysis are discussed in more detail in Section III where we use a behavioral interpretation of our findings. Section IV concludes.

I Data and Descriptive Analysis

A Data

The data used in our empirical analysis are accessed through Datastream. We use daily returns data for all variables. The sample period for our analysis is the 31-year period from 1 January 1980 to 31 December 2010. We thus have a sample of over 8,000 daily return observations (roughly 250 observations per year over a 31-year period). Prices - for the world stock market index, US Treasury bonds and gold bullion - are denominated in US dollars. The time series that we use for movements in the US dollar is a trade weighted index from the Bank of England. The use of a global stock market index (MSCI World in US dollar) allows us to treat large negative shocks as evidence of contagion among at least a subset of the countries in the index. In addition, since gold is a global asset the use of a global stock market index seems to be an economically more sound alternative than geographically less diversified stock market indices like the S&P500 or the FTSE100.

[13]Uncertainty has been shown to affect the relationship between bonds and stocks (e.g. Connolly *et al.* , 2005), while Beber *et al.* (2009) examine the role of various Eurozone bonds with different characteristics (i.e. varying levels of liquidity risk and default risk) during periods of market stress. Another related study is Bloom (2009), who analyzes the macroeconomic - output, unemployment and investment - effects of "uncertainty shocks", as proxied by stock market volatility.

B Descriptive Analysis

Figure 1 compares movements in the main series of interest - a global stock market index, US government bonds with different maturities (2 years, 10 years and 30 years) and gold spot prices (bullion) - over the sample period (1980-2010) using quarterly observations. Gold prices have seen a secular increase over the past decade. This follows a long period of relatively steady gold prices - if anything gold had been trending down through the 1980s and '90s, following its historic high (in real terms) in the late '70s. US government bonds of various maturities have been trending gradually upwards over the 30-year sample period, albeit with a notable cyclical quality to these time series. The shorter maturity bonds - 2 year bonds in particular - exhibit a less cyclical pattern over the sample period, whereas longer maturity bonds appear to experience much larger cyclical price swings.

*** Insert Figure 1 about here ***

While the world stock market index has also been on a rising trend over the past 30 years, Figure 1 illustrates the dramatic peak-to-trough swings associated with the dot.com bubble and the recent global financial crisis, in particular. What is also clear from this graph is the strong inverse relationship between the global stock market index and the 30-year US government bonds over the past 15 years (since about the mid-90s), particularly during episodes of large movements in the stock market index. Such a pattern - exemplified by the dramatic spike in the 30-year US Treasury bond series at the height of the recent financial crisis - towards the end of 2008, around the time of the collapse of Lehman Brothers - would be consistent with the notion of bonds acting as "safe haven" assets.

Summary statistics for these variables show that on average over the sample period, the daily stock returns index significantly outperforms both bonds and gold (average daily returns of 0.03% for the world stock market index, 0.004% for 10 year US government bonds, and 0.01% for gold bullion priced in US dollars). While the volatility of bond returns is significantly lower than stock returns (standard deviation of daily returns of 0.5% for 10 year US government bonds, versus 0.9% for the global stock market index), the volatility of gold spot (bullion) and futures returns (COMEX) is higher (standard deviation of daily gold returns of 1.3%).

*** Insert Table III about here ***

Table IV contains a correlation analysis which reports the unconditional correlations between stocks, bonds and gold and the conditional correlations of bonds and gold with stocks when stock returns are in the lower quantiles of the return distribution.

*** Insert Table IV about here ***

On average over our sample period (1980-2010), there is a negative - albeit relatively weak - correlation between stocks and bonds. Stocks and gold are positively correlated on average. However, this relation may partly be explained by movements in the dollar, which is strongly negatively correlated with both stocks and gold, and to a lesser extent with bonds. Gold and bonds are only weakly correlated on average, especially for longer maturity bonds. When we look at these correlations conditional on negative stock returns, a different pattern emerges. Bonds and gold are both negatively correlated with stocks when stock returns are below the 10% (5% or 1%) quantile, indicating the potential for either of these assets to act as "safe havens" in the face of stock market losses. On the basis of these correlations, bonds appear to offer a stronger safe haven - i.e. bond returns are more negatively correlated with stocks during periods when stock markets are falling.[14]

Our data selection and analysis is based on the perspective of an international investor who holds a global portfolio of stocks represented by the MSCI World stock index, US government bonds and gold whereas all assets are denominated in US dollar. The currency

[14]This result is based on an unconditional analysis, i.e. US dollar changes are not conditioned on. The (conditional) econometric analysis will reveal a dramatically different role of gold and bonds.

effect can be well illustrated with gold which is usually quoted in US dollar. This implies that the price of gold in US dollar changes if the value of the US currency changes. When the dollar depreciates (appreciates), gold denominated in dollars tends to gain (lose) in nominal value, thus maintaining its real value.[15] This effect holds for all currencies and is thus not a specific feature of the US dollar.

Hence, gold prices can fluctuate due to exchange rate changes. That said, exchange rate movements cannot explain the larger price changes for gold, e.g. the most recent substantial increase in the price of gold.

Empirically, a similar effect may be observed for bonds but the reasons are different. US government bonds are issued and denominated in US dollars. If the US dollar depreciates or appreciates, the nominal value of a US government bond does not change. However, for an international investor whose benchmark is a foreign currency the value of the bond changes with an appreciation or depreciation of the US dollar. If international investors react to an appreciation (depreciation) with the sale (purchase) of bonds there exists a similar effect as observed for gold.

C Safe Haven Assets During Specific Financial Crisis Episodes

This section analyzes the evolution of stocks, bonds and gold during specific periods of financial turmoil or crisis to assess the performance of bonds and gold as safe haven assets. While an explicit focus on specific crisis episodes is somewhat arbitrary, due to the difficulty associated with attempting to define crisis periods, a graphical analysis avoids this problem to some degree since longer periods (some pre-crisis period and post-crisis period) can be shown and the reader can obtain her own interpretation.

The specific crisis episodes illustrated in Figure 2 are (i) the 1987 stock market crash, (ii) the September 11th, 2001 terrorist attacks and (iii) the global economic and financial crisis in 2008. The plots show that gold was a safe haven in the stock market crash in

[15] Purchasing power parity will ensure that the price of gold in US dollar is equal to the price of gold in Japanese yen for example. If P is the price of gold in US dollar, P^* is the price of gold in Japanese yen and S is the Japanese yen per US dollar exchange rate the following condition holds: $P^* = SP$

October 1987 and in September 2001 in the sense that it did not lose its value. Gold was a short-run safe haven following the October 1987 crash, but was outperformed by bonds after around 10 days. Gold performed better than bonds following the September 11 event in 2001. Finally, the turmoil in late 2008 representing the peak of the global economic and financial crisis displays a positive evolution of the gold price from mid-September 2008 until mid-October consistent with a safe haven asset, but a negative evolution of the price of gold after around mid-October. Bonds do not qualify as a safe haven prior to mid-October but then outperform gold in the subsequent two months. In mid-December both gold and bonds are in positive total return territory with respect to September 15, 2008 consistent with a long-run safe haven asset.

Gold returns appear to have risen particularly strongly in response to the September 11th attacks and the culmination of the global economic and financial crisis in September 2008, likely reflecting the uncertainty created by the occurrence of such unforeseen "black swan" type events.

*** Insert Figure 2 about here ***

The peak of the subprime or financial crisis in late 2008 demonstrates that a safe haven is short-lived as first reported in Baur and Lucey (2010). If investors buy gold as a safe haven in response to a large negative shock they will tend to sell it once the implications of the shock are fully understood.[16]

Table I summarizes the graphical analysis by displaying the aggregate returns over the specified episode of turmoil. It extends the above discussion by including the bond returns for all maturities[17] and two additional crises episodes: the Asian financial crisis in 1997 and the 1998 Russian and Long-term capital management (LTCM) crisis. The Asian financial crisis in 1997 is an important case of a regional crisis in which the safe

[16] It is also possible that increased investment demand of the safe haven asset before the outbreak of financial turmoil or a crisis reduces the duration of the safe haven effect.

[17] The graphs focussed on the 30-year bond returns to ensure that each time-series can be easily identified.

haven property of international investors was not required and thus not evident in the evolution of the price of gold.

*** Insert Table I about here ***

While the graphical analysis is indicative of the relationship we expect to find, the analysis focusses on specific events. In the next section we present the results of a systematic analysis.

II Econometric Analysis

A Econometric Framework

This part of the study describes the econometric framework to analyze the behavior of investors with respect to safe haven assets. We proceed as follows. First, we analyze how gold and bonds react to shocks in the stock market on average, that is what we call a "systematic analysis". The findings do not necessarily provide evidence for a safe haven but only a hedge.[18] In a second step, we analyze the reaction of these assets to shocks under extreme conditions, i.e. what we call a 'conditional analysis'. Since we condition on extreme events, the framework tests for the existence of a safe haven property.[19]

B Systematic Analysis

This section presents a vector autoregressive model (VAR) with stocks, bonds and gold as endogenous variables. The VAR only models lagged effects and therefore does not reveal contemporaneous safe haven effects. While this poses a restriction on the empirical analysis the advantages of a VAR potentially outweigh frameworks which do not explicitly account for endogeneity or do not allow the estimation of feedback effects between stocks,

[18]The difference between a hedge and a safe haven is defined and analyzed in Baur and Lucey (2010).

[19]We focus on financial safe haven assets, i.e. save havens against extreme financial losses in the stock market.

bonds and gold.[20]

Feedback effects, to the best of our knowledge, have not been analyzed in the literature despite its importance. For example, the model can reveal whether an increasing price of a safe haven asset at t has a positive effect on the stock market (which triggered the safe haven purchases) at $t+1$. If there is indeed a positive feedback effect from gold to the stock market, the safe haven effect plays a stabilizing role in the financial system. The opposite effect is also possible and equally intuitive, that is an increasing price of gold signals market participants safe haven purchases and thus exacerbates the turmoil.

The VAR model estimates the linkages among stock, bond and gold returns by treating them as endogenous. Since the focus is on safe haven assets and not currencies, the change of the US dollar can influence all assets both contemporaneously and with a delay (lags).

The VAR can be written as follows

$$\begin{pmatrix} r_{G,t} \\ r_{B,t} \\ r_{S,t} \end{pmatrix} = \boldsymbol{\alpha} + \mathbf{\Pi}_1 \begin{pmatrix} r_{G,t-1} \\ r_{B,t-1} \\ r_{S,t-1} \end{pmatrix} + \mathbf{\Pi}_2 \begin{pmatrix} r_{G,t-2} \\ r_{B,t-2} \\ r_{S,t-2} \end{pmatrix} + \sum_{i=0}^{i=2} \mathbf{\Phi}_i X_{t-i} + \begin{pmatrix} e_{G,t} \\ e_{B,t} \\ e_{S,t} \end{pmatrix} \tag{1}$$

where $\mathbf{\Pi}_i$ are (3×3) parameter matrices and $\mathbf{\Phi}_i$ are (3×1) parameter vectors to control for changes in the US dollar denoted by X. The model is written with two lags as indicated by the majority of the commonly used information criteria.

Table V presents the estimation results for the "systematic analysis" that does not condition on extreme shocks in the stock market. The table presents the coefficient estimates for three equations (stock return equation, gold return equation and bond return equation) separated in three panels ordered vertically. The results show strong return autocorrelation for the stock index returns (e.g. the coefficient estimate is 0.1582 for lag 1), a strong negative return autocorrelation for gold and a small positive return autocorrelation for bonds. The different autocorrelation coefficients suggest different levels of market efficiency and liquidity. US government bonds are very liquid and efficient while gold can

[20] We consider the inclusion of contemporaneous effects in a single-equation alternative to the VAR in the section "Specification Issues".

be better characterized by overreaction and reversals. The positive autocorrelation for the stock index returns (MSCI World) is possibly due to non-synchronous trading and the inclusion of countries with less developed and less liquid stock markets.

The influence of the stock returns is positive on gold and negative on bonds but all coefficients are statistically insignificant. Hence, the hypothesis that global stock returns do not influence gold or bond returns cannot be rejected. The influence of the US dollar is very strong for all assets but it is most pronounced for gold followed by stocks and bonds.

*** Insert Table V about here ***

C Conditional Analysis

The conditional analysis is based on the model utilized for the systematic analysis but only uses observations on days when the stock market return exceeds a certain (lower tail) threshold. We use the 10, 5 and 1 percent quantiles for the conditional return analysis.

The estimation results are presented in Table VI. The table is separated in three panels (stock, gold and bond equations) vertically and in three panels (10%, 5% and 1% quantile) horizontally. The results are very different compared to the "systematic analysis". The return autocorrelations increase strongly for stocks and bonds for more extreme quantiles. A similar effect can be observed for gold turning the negative autocorrelation into a positive autocorrelation for the most extreme quantile.

The results also reveal a positive feedback effect from gold at $t-1$ on the stock market, increasing the stock market index level at t for positive gold returns. A similar feedback effect is found for bonds but only for the most extreme shocks (1% quantile). The feedback effect is negative for less extreme shocks (10% and 5% quantiles).

The safe haven effect is given by the estimates for the stock market in the gold equation (2nd panel) and the bond equation (3rd panel) and show that the sensitivity of gold with respect to extreme shocks in the stock market is negative and increases dramatically with more extreme shocks (the coefficient estimate for the 1% quantile is -0.3880 indicating that an extreme negative shock affecting global stock markets increases the price of gold). The sensitivity of the bond prices with respect to extreme stock market shocks is relatively stable and not significantly different from zero. This is in stark contrast to the effects observed for gold.

The effect of the US dollar is negligible for stocks and bonds but highly significant for gold. The specific role of the US dollar on gold may be one reason for the differences between the unconditional correlation analysis and the conditional analysis.

*** Insert Table VI about here ***

Finally, the results also show that bonds exert a strong negative influence on gold while no such effect is present from gold on bonds. More specifically, negative bond returns at $t-1$ have a positive influence on gold at t but negative or positive gold returns at $t-1$ have no significant influence on bond returns at t. This finding indicates that gold is also a safe haven for bonds or an ultimate safe haven. In other words, when both stocks and bonds fall, gold tends to exhibit positive returns. These feedback effects appear to be very important and cannot be identified with the usual, and very popular, dynamic correlation analyses.

D Specification Issues

The VAR models estimated and reported above, in particular the conditional VAR, are not standard in the finance literature. The lag length for all variables was selected according to standard information criteria (AIC and BIC) and the standard errors were bootstrapped with 10,000 replications to account for the non-normality of the returns. Indeed the bootstrapped standard errors are slightly larger than the standard errors assuming normally-distributed errors. We also considered the inclusion of the contemporaneous variables in a single-equation alternative of the VAR, i.e. we estimated each equation separately and included the two contemporaneous variables of the triple (stocks, gold, bonds). For example, for the stock market equation, contemporaneous gold and bond returns were added as regressors. The main findings regarding the dynamics (lagged effects) between stocks, gold and bonds do not change and the coefficient estimates of the contemporaneous effect are consistent with the contemporaneous unconditional correlations. The regression-based contemporaneous effect of bonds is -0.5255 on stocks and 0.2030 on gold, of gold on stocks and on bonds is around 0.04 but not statistically significant and of stocks is 0.0725 on gold (not statistically significant) and -0.2238 on bonds (all estimates conditional on the 1% quantiles). These results show large differences between the contemporaneous effect and the lagged effects regarding the conditional stock-bond relationship. While the regression-based conditional contemporaneous stock-bond correlation is negative and relatively strong, the lagged conditional correlations are rather weak. These results indicate that government bonds are the immediate choice of investors when they consider safe haven assets while the safe haven of gold appears to be only relevant with a lag but is then more important.

Finally, we analyzed the stability of the coefficient estimates and separated the sample period in two sub-samples from 1980 to 1995 and from 1996 to 2010. The results reveal qualitatively similar coefficient estimates across the two samples. For example, the coefficient estimates of lagged stock returns on gold (in the gold equation) are -0.1053 for the 10% quantile, -0.1636 for the 5% quantile and -0.3669 for the 1% quantile for the 1996 - 2010 sample compared with the corresponding estimates for the full sample, i.e. -0.0790, -0.1263 and -0.3831, respectively. Detailed estimation results can be obtained from the authors upon request.

E Summary of empirical results

We find that both bonds and gold act as “safe haven” assets during periods of market stress. However, our results also reveal a distinction between the roles of these two assets. Contemporaneous correlations indicate that bonds are more responsive and the more immediate safe haven while a dynamic analysis shows that gold appears to be more responsive to large shocks with a one-day lag. More precisely, the reaction of gold returns to lagged stock market movements gets progressively stronger and becomes more persistent as we move from average stock returns to the most extremely negative returns. For bonds, if anything, the dynamic relationship is stable but significantly weaker. We also detect significant differences and asymmetries in the feedback effects. For example, gold is negatively influenced by lagged bond returns but there is no significant influence of lagged gold returns on bond returns.

Furthermore, the impact of the lagged returns at $t-1$ on time t indicates a very liquid bond market and a less liquid gold market characterized by an overreaction to shocks. This pattern significantly changes in extreme market conditions: bond returns exhibit strong positive autocorrelation while gold returns exhibit weaker negative autocorrelation compared to the unconditional VAR estimates.

The results also show that safe haven purchases of gold tend to positively influence the stock market in the next period while such an effect is non-existent for bonds. The strong negative coefficients for bonds at t-2 are in stark contrast to the positive effect of gold. Hence, safe haven effects of bonds (i.e. positive bond returns) exhibit a negative influence on future stock prices while safe haven effects of gold (i.e. positive gold returns) exhibit a positive influence on future stock prices. These effects illustrate the importance of an econometric framework that fully models the dynamic interactions among the variables and provide more evidence that bonds and gold are fundamentally different safe haven assets.[21]

III A Behavioral Interpretation

The results presented above confirm that both gold and US government bonds are safe haven assets. However, as noted in the introduction, the simultaneous demand for bonds and gold represents something of a puzzle, given the distinct forms of "safety" offered by

[21]The results further suggest that a flight to quality using bonds tends to exacerbate a large shock in the stock market while a flight to quality using gold does not exacerbate a large shock.

these assets. Indeed our analysis reveals an interesting distinction in the patterns of price movements for bonds and gold following market shocks. In particular, gold is increasingly responsive to changes in the stock market for the most extreme stock market movements (losses), whereas this is not the case for bonds. We also find evidence of some movement from bonds to gold, following large stock market losses, indicating that gold represents the ultimate safe haven asset, during periods of financial market turmoil.

This apparent preference for gold, in particular during periods of financial turmoil, is difficult to reconcile with the fact that US government bonds are fixed income securities and highly liquid while gold does not yield a fixed income, is relatively volatile and less liquid than bonds. Investors in gold may also face additional costs, i.e. storage, associated with holding physical gold.

Instead, the preference for gold (despite the apparent superiority of government bonds) seems to indicate a special role of gold which cannot be explained within a mean-variance portfolio maximization framework with constant expected returns, risk and correlations.[22] We thus rely on a behavioral explanation based on Ellsberg (1961)'s ambiguity-aversion. The Ellsberg decision rule and its implications are described and discussed in the next section.

A The Ellsberg Paradox

In his famous paradox, Ellsberg (1961) demonstrated that seemingly rational people tend to "irrationally" avoid ambiguity. Ellsberg conducted the following hypothetical experiment: You are faced with two urns. The first contains 100 red and black balls but in unknown proportions. The second, you can verify, contains exactly 50 red and 50 black balls. Whether betting on red or black, Ellsberg reports that the majority of people will choose to draw at random from urn two (where probabilities are known). From a probability viewpoint, such preferences are inconsistent, as they indicate the simultaneous belief

[22] Under the assumption that investors change their portfolio allocation dynamically the preference for gold following large stock market losses or elevated levels of volatility can be easily explained with changing stock-gold correlations and lower required portfolio returns.

that the probability of drawing either red or black from urn two is greater than from urn one. Thus, such behavior may be (mis-)interpreted as "irrational". Once we allow for ambiguity-aversion, however, we can reinterpret the results as follows: Rather than revealing a seemingly irrational belief about the probability of drawing a particular ball from a particular urn, participants in the Ellsberg experiments are in fact revealing their preference for avoiding ambiguity.

Based on his insights regarding ambiguity-aversion, Ellsberg (1961) presents a simple decision rule, which emphasizes the degree of ambiguity of the available information:

$$max : \rho.est_x + (1 - \rho)min_x \tag{2}$$

where est_x is the expected pay-off to asset x corresponding to a single estimated probability distribution, min_x is the minimum expected pay-off to x over a range of probability distributions, while ρ represents the degree of confidence in available information.[23]

The decision rule is essentially a weighting scheme. Investors choose their optimal level of investment in each asset, x - which, for our current purposes, we can think of as representing either stocks, bonds or gold - in order to maximize the weighted sum of the expected pay-off from x and the minimum expected pay-off from x. The confidence parameter ρ decreases in proportion to the ambiguity associated with available information. Thus, when ambiguity is high, investors give greater weight to their "worst case scenario" (min_x) in choosing their optimal portfolio of assets.[24]

In times of financial turmoil and elevated market uncertainty, therefore, investors withdraw from risk, favoring relatively "safe" assets; i.e. those to which the minimum expected pay-off - even in periods of market stress - will not be excessively negative. This is illustrated in the next section.

[23] It is important to distinguish here between expectations - be they optimistic or pessimistic - and the degree of confidence associated with those expectations. Confidence - as represented by the parameter ρ in the above decision rule - is a *characteristic* of expectations relating to the certainty or conviction underlying an investor's optimism or pessimism with regard to the future (Dow, 2011).

[24] Coates & Herbert (2008) demonstrate the neuro-scientific basis for this relationship between uncertainty and a greater degree of caution.

B A preference ordering among assets

To demonstrate how the inclusion of ambiguity-aversion might be expected to affect investor choices in relation to the three asset classes we are interested in - i.e. stocks, bonds and gold - we assign values for est_x and min_x for each asset and consider how the relative preference ordering between these assets would change for different degrees of ambiguity (i.e. for different values of the confidence parameter ρ). We assign values for est_x consistent with a typical portfolio allocation in which stocks dominate bonds which dominate cash or other assets.

The min_x values represent the worst case scenario for each asset. For stocks, the worst case scenario would obviously be a total wipeout of shareholder value.[25] For bonds, in theory the worst case scenario would also be a total loss of value, in the case of a default - although a partial default or "haircut", might be more likely. For gold, given that it is a physical asset, it is unlikely ever to see its value completely destroyed - certainly not over the short time scales we are interested in. We therefore assign the largest negative value for min_x to stocks, then bonds, with gold assumed to have the least negative worst case scenario.

Figure 3 illustrates the relative preference ordering among stocks, bonds and gold for different values of the ambiguity parameter, based on the assigned est_x and min_x values. Under "normal" circumstances, i.e. when ambiguity is low, stocks are preferred to bonds or gold. As ambiguity rises, the relative "safety" of bonds and gold make them more attractive. For moderate levels of ambiguity bonds remain superior to gold. Eventually, for very high levels of ambiguity, gold is the dominant choice.

*** Insert Figure 3 about here ***

[25] We note that a total loss of investment in stocks might be possible for a specific stock or portfolio, but not for the entire global stock market.

C Dynamics - Ambiguous Signals

The Ellsberg decision rule has been extended to a dynamic context by Epstein & Schneider (2008), using a model based on investors processing ambiguous news signals. For every market-related event, agents must assess the relevant information against the criteria listed by Ellsberg - the amount, type, reliability and unanimity of information - in order to inform their degree of confidence in estimates of expected returns. The degree of ambiguity, and investor responses to it, therefore depend on the quality of the observed news signal.

Using Epstein and Schneider's terminology we can distinguish between tangible and intangible news signals. Tangible news signals are those for which investors have the experience or expertise necessary to be confident in their interpretation of the signal. Such events might include the release of financial or economic data, the outcome of political elections, earnings announcements etc. Following tangible news signals investors will update their beliefs in standard Bayesian fashion - gaining confidence from good news and losing confidence following bad news.

Intangible signals, on the other hand, generate ambiguity as a result of some combination of the novelty of the observation, or the investor's lack of expertise in processing that type of news. Such events might include speculation about a particular company, or political developments that are likely to have an impact on economic or financial activities. Unanticipated, or "black swan" events, could also be considered sources of intangible signals. By their nature, such events are rare in the extreme, with the result that investors have little experience to draw on in interpreting the implications of the event's occurrence.[26] The generation of ambiguity associated with extreme or unanticipated events, and investor aversion to that ambiguity, could explain the particularly strong findings in

[26]These events are unpredictable precisely because they are unfamiliar or difficult to imagine. In psychology, the *availability bias* refers to the human tendency to overestimate the probability of events that can easily be imagined. Thus, shark attacks are far more terrifying to the average person than the idea of being hit by a falling piece of aircraft - even though the latter is, apparently, 30 times more likely (Oliver Burkeman, "Is the easy option simply mental laziness", *The Guardian*, 20 February 2010). Similarly, in a tendency known as *cognitive fluency*, we inherently give precedence to ideas that are relatively easy to think about.

relation to the specific crisis episodes illustrated in our graphical analysis.

There is also a link between tangible and intangible signals and tangible and intangible assets. Our results suggest that intangible signals lead to the purchase of tangible assets (gold) while tangible signals lead to the purchase of intangible assets (bonds or stocks). In other words, using the urn analogy, a tangible signal changes the proportions of balls in an urn but does not make those proportions unknown. In contrast, an intangible signal renders the proportions unknown. Only the latter, according to the model, leads to a reaction of the price of gold.

This section emphasized the role of information flows in driving the safe haven effect. This contrasts with the definition of "safe assets", from Gorton *et al.* (2012), as assets that are information-insensitive.

D The Psychology of a Safe Haven

This stylized illustration demonstrates how the inclusion of ambiguity-aversion in the decision rule of investors could explain our observed findings in relation to the safe haven characteristics of bonds and gold. However, the above preference ordering is based on the assumption that min_x - the worst case scenario - is least negative for gold. This characterization is plausible given that gold offers investors protection from threats for which bonds do not provide shelter, including inflation, currency risk and default risk. Gold is also an uncontingent asset, in the sense that its supply is not controlled by any single government or central bank. For this reason, investors may view gold as having fewer downsides, and less associated uncertainty, during periods of market turmoil. However, no asset is risk-free and there is no reason to believe that gold is immune from losses.[27] One could even make the opposite case that gold is a relatively risky asset, based on the volatility of gold returns.

The perceived "safety" of gold could instead be based on psychological factors.

[27] We agree with John Plender ("There is no such thing as a risk-free asset", Financial Times, July 8, 2012) that there is no such thing as a risk-free asset and that the term is an oxymoron.

Gennaioli & Shleifer (2010)'s "local thinking" model of investor decision-making emphasises the inherent cognitive limitations of individuals faced with complex and uncertain choices (see also Peng *et al.* (2007)). Initially at least, only some decision-relevant data come to mind, with the most representative scenarios tending to dominate. Gold has a unique cultural status, given its historic links to the value of currencies and its role as a symbol of durability and high achievement. Gold is also a physical and tangible asset and arguably easier to understand than bonds and stocks.[28] Thus, during periods of market stress, when investors consider gold as a potential investment, "what comes to mind" - based on what gold represents - is likely to be a secure and solid store of value.

IV Conclusions

This paper is motivated by the relative scarcity of research on safe haven assets and the lack of understanding of their importance for investors and the financial system. We analyze the two most prominent safe haven assets - US Treasury bonds and gold - their dynamic response to large shocks, interaction among them and feedback effects. Bonds and gold offer investors distinct forms of "safety", thus offering insights about what motivates investor purchases of safe haven assets.

We begin with a graphical analysis of a small number of specific crisis events. This analysis suggests that both bonds and gold tend to act as safe haven assets following stock market crises. However, these assets appear to differ in the timing of their responses to crisis events. Interestingly, for those events that most closely fit the description of "black swan" events - i.e. the 9/11 terrorist attacks and the recent global financial crisis - gold is the stronger safe haven. The econometric analysis confirms this result and also shows that the general dynamics between the assets are different. US Treasury bonds are the more immediate safe haven assets while the importance of gold relative to bonds significantly increases in the days following an extreme event.

The stronger effect for gold, following extreme stock market shocks, is difficult to

[28] The historical and cultural status of gold is discussed in more detail in Baur & McDermott (2010).

explain under a standard "mean-variance efficient" investment framework. In other words, why do investors buy an asset that is more volatile and thus more risky than bonds? We argue that the safe haven demand for gold is driven by investors' ambiguity-aversion. Based on the Ellsberg (1961) decision rule, we illustrate how investor preferences among stocks, bonds and gold might be expected to vary for different degrees of shock magnitudes and the associated uncertainty. Essentially, under this decision rule, as the shocks become more extreme and uncertainty increases investors give greater weight to their "worst case scenario". Since gold is a physical asset, and its value is uncontingent on the decisions of a single government or central bank, it is plausible that investors view gold as the best alternative in a "worst case scenario".

The safe haven preference for gold could also be the result of the cognitive limitations of investors and the nature of decision-making under stressful conditions. If shocks are large and the implications difficult to assess, investors turn to an asset that is literally "solid", tangible and that has been used as a store of value for centuries. Our findings therefore represent an illustration of the "local thinking" type models of Gennaioli & Shleifer (2010).

Future research could analyze the question whether investors' awareness of the existence of safe haven assets either makes them bear more risk or leads to an increased demand for safe haven assets inflating the price and thus depriving the system from safe (haven) assets.

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Figure 1: Performance of stock market and safe haven assets

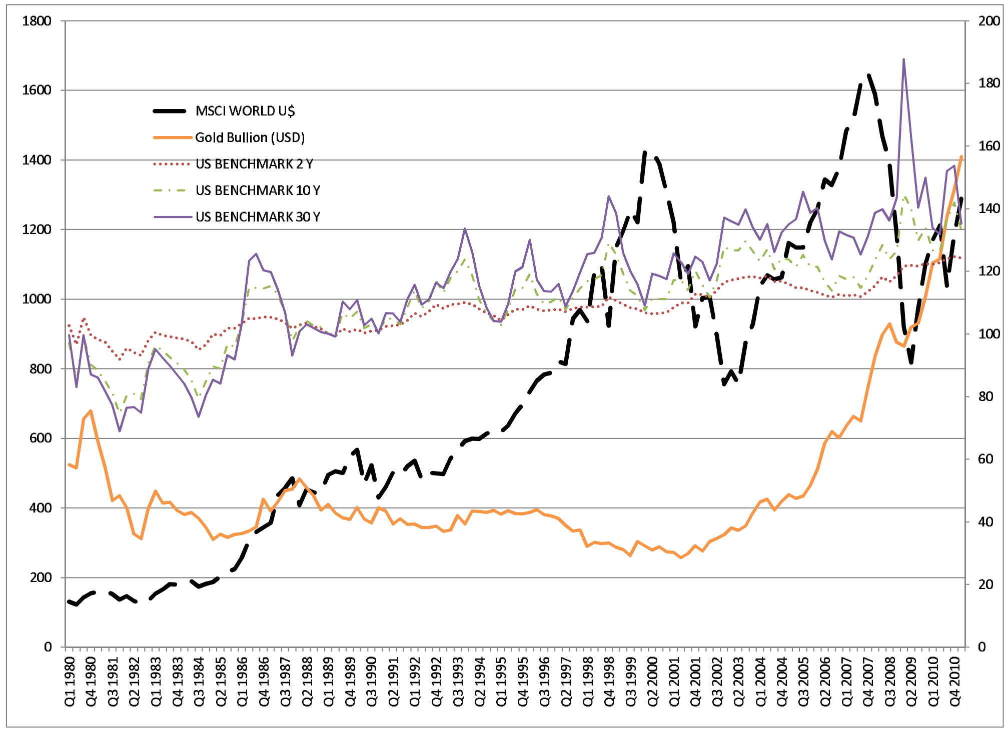
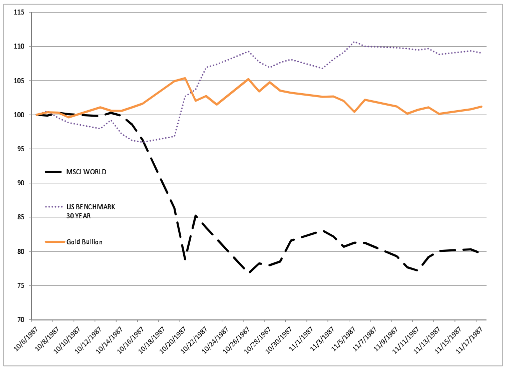
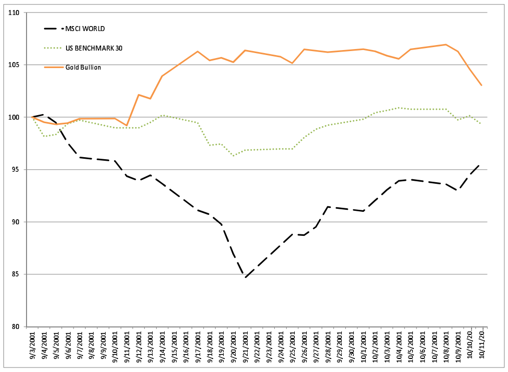


Figure 2: Graphical analysis of crash/ period of uncertainty: October 1987, September 11, 2001 and Global financial and economic crisis 2008





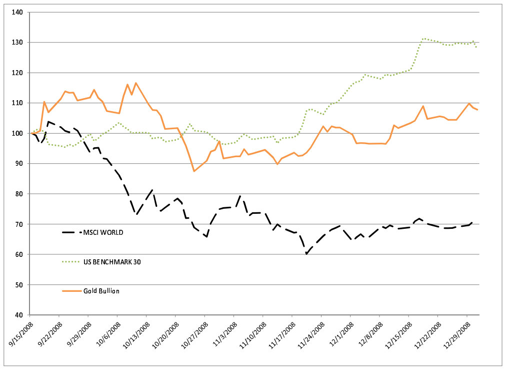


Figure 3: Ellsberg Model: Index values and confidence parameter for stocks, bonds and gold

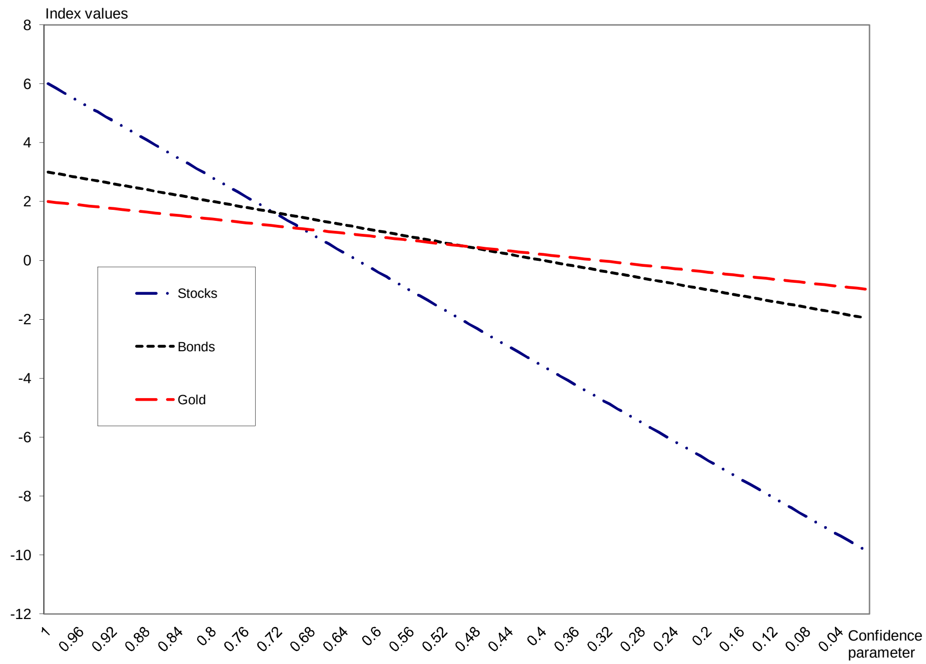


Table I: **Summary: aggregate returns for specific crisis episodes**

	MSCI WORLD	US BM 2 Y	US BM 10 Y	US BM 30 Y	Gold Bullion
1987 crash: Oct and Nov	-0.2074	0.0128	0.0395	0.0696	0.0821
1997 Asian financial crisis: Oct and Nov	-0.0465	-0.0019	0.0112	0.0304	-0.1200
1998 crisis: Aug and Sep	-0.1133	0.0197	0.0795	0.0908	0.0238
2001 September 11 attacks: Sep and Oct	-0.0140	0.0141	0.0190	0.0115	0.0473
2001 September 11 attacks: Sep (only)	-0.0458	0.0127	0.0201	0.0025	0.0634
2008 Financial crisis: Sep	-0.1211	0.0078	-0.0021	0.0172	0.0677
2008 Financial crisis: Oct	-0.2361	0.0061	-0.0098	-0.0041	-0.1538

Table II: **Descriptive Statistics and Correlation Matrix**

Descriptive Statistics	**MSCI World**	**US bond (2y)**	**US bond (10y)**	**US bond (30y)**	**Gold Bullion**	**Gold (COMEX)**
mean (x 100)	0.0282	0.0024	0.0039	0.0038	0.0122	0.0121
std. dev. (x 100)	0.8922	0.1560	0.5211	0.7861	1.2760	1.2030
min (x 100)	-10.3633	-1.4596	-3.8043	-4.1468	-16.0286	-10.0856
max (x 100)	9.0967	1.4183	4.0608	6.0263	12.5414	9.7448
skewness	-0.5154	0.3807	0.1252	0.0097	-0.0378	-0.0958
kurtosis	12.0700	13.8759	4.7931	3.2281	15.0640	8.5853

Correlations	**MSCI World**	**US bond (2y)**	**US bond (10y)**	**US bond (30y)**	**Gold Bullion**	**Gold (COMEX)**
MSCI World	1					
US bond (2y)	-0.0146	1				
US bond (10y)	-0.0235	0.7692	1			
US bond (30y)	-0.0419	0.6776	0.9168	1		
Gold Bullion	0.0705	0.0304	0.0041	-0.0092	1	
Gold (COMEX)	0.0883	0.0661	0.0192	0.0096	0.2788	

Table III: **Descriptive statistics conditional on extreme stock market returns (MSCI World)**

		Obs	Mean	Std. Dev.	Min	Max
Panel A						
MSCI World return < 10% quantile	**MSCI World**	808	-0.0159	0.0093	-0.1036	-0.0091
	US bond (2y)	808	0.0001	0.0020	-0.0146	0.0090
	US bond (10y)	808	0.0004	0.0070	-0.0288	0.0406
	US bond (30y)	808	0.0007	0.0107	-0.0388	0.0603
	Gold Bullion	808	-0.0021	0.0160	-0.1332	0.0647
	Gold (COMEX)	808	-0.0024	0.0167	-0.1009	0.0862
Panel B						
MSCI World return < 5% quantile	**MSCI World**	405	-0.0209	0.0111	-0.1036	-0.0131
	US bond (2y)	405	0.0004	0.0021	-0.0107	0.0090
	US bond (10y)	405	0.0015	0.0078	-0.0249	0.0406
	US bond (30y)	405	0.0022	0.0123	-0.0338	0.0603
	Gold Bullion	405	-0.0016	0.0155	-0.0772	0.0576
	Gold (COMEX)	405	-0.0028	0.0179	-0.0991	0.0862
Panel C:						
MSCI World return < 1% quantile	**MSCI World**	81	-0.0376	0.0153	-0.1036	-0.0246
	US bond (2y)	81	0.0015	0.0023	-0.0040	0.0090
	US bond (10y)	81	0.0051	0.0094	-0.0170	0.0406
	US bond (30y)	81	0.0089	0.0162	-0.0251	0.0603
	Gold Bullion	81	-0.0004	0.0201	-0.0472	0.0576
	Gold (COMEX)	81	-0.0015	0.0241	-0.0991	0.0862

Table IV: **Conditional correlation analysis** (conditional on extreme stock market returns)

Panel A: MSCI World return < 10% quantile

	MSCI World	**US bond (2y)**	**US bond (10y)**	**US bond (30y)**	**Gold Bullion**	**Gold (COMEX)**
MSCI World	1					
US bond (2y)	-0.3100	1				
US bond (10y)	-0.3027	0.7949	1			
US bond (30y)	-0.3184	0.7119	0.9367	1		
Gold Bullion	-0.0650	0.0882	0.0417	0.0174	1	
Gold (COMEX)	-0.0122	0.1481	0.0545	0.0422	0.3578	1

Panel B: MSCI World return < 5% quantile

	MSCI World	**US bond (2y)**	**US bond (10y)**	**US bond (30y)**	**Gold Bullion**	**Gold (COMEX)**
MSCI World	1					
US bond (2y)	-0.3615	1				
US bond (10y)	-0.3309	0.7960	1			
US bond (30y)	-0.3556	0.7074	0.9454	1		
Gold Bullion	-0.0873	0.1042	0.0456	0.0323	1	
Gold (COMEX)	-0.0412	0.2159	0.0849	0.0554	0.4137	1

Panel C: MSCI World return < 1% quantile

	MSCI World	**US bond (2y)**	**US bond (10y)**	**US bond (30y)**	**Gold Bullion**	**Gold (COMEX)**
MSCI World	1					
US bond (2y)	-0.4258	1				
US bond (10y)	-0.3507	0.7168	1			
US bond (30y)	-0.3274	0.5779	0.9419	1		
Gold Bullion	-0.0770	0.1969	0.0809	0.0579	1	
Gold (COMEX)	0.0319	0.1749	0.0139	-0.0218	0.3713	1

Table V: **VAR - Systematic Analysis** The table presents the systematic results (not conditioning on extreme shocks) for three equations, i.e. stock return equation, gold return equation and bond return equation) separated in three panels ordered vertically. The results show strong return autocorrelation for the stock index returns, a strong negative return autocorrelation for gold and no significant return autocorrelation for bonds. The influence of the stock returns on gold is positive and negative on bonds but all coefficients are statistically insignificant. Hence, the hypothesis that global stock returns do not influence gold or bond returns cannot be rejected. The influence of the US dollar is very strong for all assets but it is most pronounced for gold followed by stocks and bonds. Standard errors are bootstrapped with 10,000 repetitions.

equation: Stocks		**Coef.**	**Std.Err.**	**z-stat.**	**p-value**	**R-squared**
stock m.	t-1	0.1582	0.0246	6.42	0.00	0.108
	t-2	-0.0755	0.0267	-2.83	0.01	
gold	t-1	0.0178	0.0106	1.68	0.09	
	t-2	0.0034	0.0098	0.35	0.73	
10y bonds	t-1	0.1147	0.0255	4.50	0.00	
	t-2	-0.0135	0.0237	-0.57	0.57	
US dollar	t	-0.5294	0.0279	-18.96	0.00	
	t-1	0.0521	0.0281	1.86	0.06	
	t-2	-0.0275	0.0312	-0.88	0.38	
const.		0.0002	0.0001	2.41	0.02	
equation: Gold		**Coef.**	**Std.Err.**	**z-stat.**	**p-value**	**R-squared**
stock m.	t-1	0.0047	0.0226	0.21	0.83	0.082
	t-2	0.0210	0.0214	0.98	0.33	
gold	t-1	-0.1259	0.0286	-4.39	0.00	
	t-2	-0.0088	0.0261	-0.34	0.74	
10y bonds	t-1	0.0225	0.0361	0.62	0.53	
	t-2	0.0168	0.0332	0.51	0.61	
US dollar	t	-0.6483	0.0379	-17.11	0.00	
	t-1	-0.3893	0.0383	-10.17	0.00	
	t-2	-0.0611	0.0367	-1.66	0.10	
const.		0.0001	0.0001	0.49	0.63	
equation: 10y Bonds		**Coef.**	**Std.Err.**	**z-stat.**	**p-value**	**R-squared**
stock m.	t-1	-0.0039	0.0117	-0.33	0.74	0.0132
	t-2	-0.0019	0.0084	-0.22	0.82	
gold	t-1	-0.0072	0.0069	-1.04	0.30	
	t-2	-0.0089	0.0059	-1.51	0.13	
10y bonds	t-1	0.0251	0.0144	1.74	0.08	
	t-2	-0.0055	0.0158	-0.35	0.73	
US dollar	t	-0.1295	0.0166	-7.82	0.00	
	t-1	0.0058	0.0160	0.36	0.72	
	t-2	-0.0051	0.0149	-0.34	0.73	
const.		0.0000	0.0001	0.68	0.50	

Table VI: **VAR - Conditional Analysis** The table presents the estimation results conditioned on extreme negative stock index returns and thus test for the safe haven effect. The safe haven effect is given by the estimates for the stock market in the gold equation (2nd panel) and the bond equation (3rd panel) and shows that the sensitivity of gold with respect to extreme shocks in the stock market is negative and increases dramatically with more extreme shocks. The sensitivity of the bond prices with respect to extreme stock market shocks is relatively stable and not significantly different from zero. Standard errors are bootstrapped with 10,000 repetitions.

		10% quantile				**5% quantile**				**1% quantile**			
equation: Stocks		**Coef.**	**Std.Err.**	**z-stat.**	**p-value**	**Coef.**	**Std.Err.**	**z-stat.**	**p-value**	**Coef.**	**Std.Err.**	**z-stat.**	**p-value**
stock m.	t-1	0.1871	0.0618	3.03	0.00	0.2051	0.0711	2.88	0.00	0.3358	0.1280	2.62	0.01
	t-2	-0.0076	0.0624	-0.12	0.90	-0.0432	0.0787	-0.55	0.58	-0.1586	0.1152	-1.38	0.17
gold	t-1	0.0719	0.0301	2.39	0.02	0.0657	0.0485	1.35	0.18	0.0047	0.0847	0.06	0.96
	t-2	0.0240	0.0336	0.71	0.48	0.0227	0.0509	0.45	0.66	0.0558	0.1016	0.55	0.58
10y bonds	t-1	-0.0060	0.0719	-0.08	0.93	-0.0270	0.1132	-0.24	0.81	0.0248	0.2821	0.09	0.93
	t-2	-0.1053	0.0779	-1.35	0.18	-0.1881	0.1163	-1.62	0.11	0.0600	0.2921	0.21	0.84
US dollar	t	-0.1125	0.0860	-1.31	0.19	-0.0964	0.1317	-0.73	0.46	0.0764	0.4014	0.19	0.85
	t-1	0.0743	0.0792	0.94	0.35	0.0830	0.1119	0.74	0.46	0.0729	0.2871	0.25	0.80
	t-2	0.0192	0.0817	0.23	0.81	-0.1372	0.1232	-1.11	0.27	-0.0626	0.3259	-0.19	0.85
const.		-0.0151	0.0004	-39.91	0.00	-0.0198	0.0006	-33.71	0.00	-0.0351	0.0021	-16.94	0.00
equation: Gold		**Coef.**	**Std.Err.**	**z-stat.**	**p-value**	**Coef.**	**Std.Err.**	**z-stat.**	**p-value**	**Coef.**	**Std.Err.**	**z-stat.**	**p-value**
stock m.	t-1	-0.0790	0.0592	-1.33	0.18	-0.1263	0.0718	-1.76	0.08	-0.3831	0.1630	-2.35	0.02
	t-2	0.0254	0.0547	0.47	0.64	-0.0062	0.0714	-0.09	0.93	-0.0122	0.1592	-0.08	0.94
gold	t-1	-0.0700	0.0710	-0.99	0.32	-0.0576	0.1068	-0.54	0.59	0.0291	0.1829	0.16	0.87
	t-2	0.0086	0.0589	0.15	0.88	-0.0304	0.0770	-0.40	0.69	-0.1504	0.1586	-0.95	0.34
10y bonds	t-1	-0.2302	0.1311	-1.76	0.08	-0.2173	0.1842	-1.18	0.24	-0.2060	0.4541	-0.45	0.65
	t-2	0.0705	0.1156	0.61	0.54	0.0287	0.1381	0.21	0.84	-0.0309	0.3432	-0.09	0.93
US dollar	t	-0.8100	0.1214	-6.67	0.00	-0.8660	0.1686	-5.14	0.00	-1.0177	0.4249	-2.40	0.02
	t-1	-0.5339	0.1221	-4.37	0.00	-0.4622	0.1620	-2.85	0.00	-0.5312	0.5190	-1.02	0.31
	t-2	-0.2280	0.1256	-1.81	0.07	-0.2604	0.1653	-1.58	0.12	-0.4487	0.4041	-1.11	0.27
const.		-0.0007	0.0005	-1.38	0.17	-0.0003	0.0007	-0.46	0.65	-0.0006	0.0026	-0.21	0.83
equation: 10y Bonds		**Coef.**	**Std.Err.**	**z-stat.**	**p-value**	**Coef.**	**Std.Err.**	**z-stat.**	**p-value**	**Coef.**	**Std.Err.**	**z-stat.**	**p-value**
stock m.	t-1	-0.0180	0.0443	-0.41	0.69	-0.0011	0.0560	-0.02	0.98	-0.0444	0.1144	-0.39	0.70
	t-2	-0.0108	0.0270	-0.40	0.69	-0.0052	0.0346	-0.15	0.88	0.0742	0.0696	1.07	0.29
gold	t-1	-0.0109	0.0248	-0.44	0.66	-0.0004	0.0330	-0.01	0.99	0.0139	0.0706	0.20	0.84
	t-2	-0.0356	0.0250	-1.42	0.15	-0.0226	0.0341	-0.66	0.51	-0.0076	0.0807	-0.09	0.93
10y bonds	t-1	0.1242	0.0491	2.53	0.01	0.1999	0.0714	2.80	0.01	0.2676	0.2000	1.34	0.18
	t-2	0.0384	0.0536	0.72	0.47	0.0675	0.0773	0.87	0.38	0.0014	0.1824	0.01	0.99
US dollar	t	-0.2150	0.0529	-4.07	0.00	-0.1896	0.0771	-2.46	0.01	-0.0589	0.1847	-0.32	0.75
	t-1	0.0300	0.0715	0.42	0.68	0.0964	0.1038	0.93	0.35	-0.0444	0.2573	-0.17	0.86
	t-2	0.0257	0.0607	0.42	0.67	0.0525	0.0896	0.59	0.56	0.1073	0.2431	0.44	0.66
const.		0.0007	0.0003	2.58	0.01	0.0019	0.0004	4.20	0.00	0.0049	0.0013	3.95	0.00