Is Gold a Hedge or a Safe Haven? An Analysis of Stocks, Bonds and Gold

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Is gold a hedge, defined as a security that is uncorrelated with stocks or bonds on average, or is it a safe haven, defined as a security that is uncorrelated with stocks and bonds in a market crash? We study constant and time-varying relations between US, UK and German stock and bond returns and gold returns to investigate gold as a hedge and a safe haven. We find that gold is a hedge against stocks on average and a safe haven in extreme stock market conditions. A portfolio analysis further shows that the safe haven property is short-lived.

JEL: G10, G11, G14, G15
Keywords: safe haven, hedge, gold, stock-bond correlation, flight-to-quality

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1. Introduction

Financial markets and the variety of financial instruments have grown steadily in both volume and value in recent decades. This growth has raised the risks of the financial system and potentially established the need for a safe haven for investors. While gold has often been associated with the existence of a safe haven, we are not aware of any study actually testing this hypothesis.

After a definition and clear distinction of a safe haven, a hedge and a diversifier, it is tested whether gold is a (safe) haven asset. Gold is chosen as a candidate since anecdotal evidence and the financial media suggest that gold serves as a safe haven in financial markets. While there is no theoretical model which explains why gold is usually referred to as a safe haven asset, one major explanation could be that it was among the first forms of money and was traditionally used as an inflation-hedge. Furthermore, gold is said to be uncorrelated with other types of assets, which is an important feature in an era of globalization in which correlations increased dramatically among most asset types. These components might have contributed significantly to the role of gold.

The econometric approach is based on a regression model in which gold returns are regressed on stock and bond returns and two interaction terms that test whether gold indeed serves as a safe haven if stock or bond markets fall or exhibit extreme negative returns. The empirical analysis focuses on three large financial markets (the US, the UK and Germany) with different currencies (US dollar, UK pound and the Euro) to examine the differences and similarities of the role of gold in these markets. Daily returns are used to analyze whether investors react to extreme negative shocks relatively fast and use gold as a safe haven asset. Finally, a portfolio analysis evaluates the evolution of all assets in periods in which gold

potentially serves as a haven asset. Such an analysis illustrates how profitable it is for investors to buy and sell gold in periods of stock market turmoil.

Our empirical analysis shows that gold is a safe haven for stocks in the US, in the UK and in Germany. Gold is also a hedge for stocks in the US and the UK. However, gold is nowhere a safe haven for bonds; nor is it a bond hedge in the US or UK. Furthermore, gold is not a safe haven for stocks at all times but only after extreme negative stock market shocks. In addition, the safe haven property is short-lived. In other words, gold is a safe haven when it is needed most but is not a safe haven, and is not supposed to be, in periods of rising stock markets.

Studies relevant to this issue are relatively scarce. One strand examines the nature and influences of the gold market, (e.g. see Sherman, 1982; Faff and Hillier, 2004; Capie, Mills and Wood, 2005; Faugere and Van Erlach, 2005; Faff and Hillier, 2006; Lucey, Poti and Tully, 2006 and Tully and Lucey, 2007) and another examines safe havens (see Upper, 2000 and Kaul and Sapp, 2007). There appears to be only one paper that explicitly analyzes the role of gold as a hedge, that being against the US dollar (see Capie, Mills and Wood, 2005). The authors do not distinguish between average and extreme shocks as they analyze the role of gold as a hedge for exchange rate risk. We are unaware of any paper that analyzes the role of gold as a safe haven for both stocks and bonds. This present paper is also related to the flight to quality literature, that is, studies analyzing the question of whether investors flee from stocks into bonds when stock markets exhibit severe losses (see Baur and Lucey, 2009; Gulko, 2002 and Hartmann, Straetmans and de Vries, 2004).

2. Definitions

The theoretical argument, which is the basis for the subsequent analysis can be formulated as follows. If investors add an asset to their portfolios that specifically reduces losses

in times of market stress or turmoil by more than hedge or diversifier assets the severity of shocks decreases thereby increasing the stability of capital markets. In order to distinguish a safe haven asset from a hedge and a diversifier asset, we explicitly define all three types before we proceed.

Hedge:

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

A hedge does not have the (specific) property of reducing losses in times of market stress or turmoil since the asset could exhibit a positive correlation in such periods and a negative correlation in normal times with a negative correlation on average.

Diversifier:

A diversifier is defined as an asset that is positively (but not perfectly correlated) with another asset or portfolio on average.

Similar to the hedge, the diversifier does not have the (specific) property of reducing losses in extreme adverse market conditions since the correlation property is only required to hold on average.

Safe haven:

A safe haven is defined as an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil.

The specific property of a safe haven asset is the non-positive correlation with a portfolio in extreme market conditions. This property does not force the correlation to be positive or negative on average but only to be zero or negative in specific periods. Hence, in normal times or bullish market conditions the correlation can be positive or negative. If the haven asset is negatively

correlated with the other asset or portfolio in extreme adverse market conditions, it is compensating the investor for losses since the price of the haven asset rises when the price of the other asset or portfolio falls.

The definition of a safe haven proposed above is consistent with the definitions provided by Webster's dictionary[1]. The word "haven" is defined as a harbor or port, a place of safety and a place offering favorable opportunities or conditions. A safe haven is thus a place of safety that offers investors shelter (i.e. non-negative returns) in extreme market conditions.[2]

3. Econometric model

This section provides the econometric approach to test whether gold is a hedge, a diversifier or a safe haven. Our principal regression model is:

$$r_{gold,\,t} = a + b_1\, r_{stock,\,t} + b_2\, r_{stock,\,t(q)} + c_1\, r_{bond,\,t} + c_2\, r_{bond,\,t(q)} + e_t \qquad (1)$$

where r_{gold}, r_{stock} and r_{bond} are the returns of gold, stock and bond prices, respectively. The terms $r_{stock,\,t(q)}$ and $r_{bond,\,t(q)}$ account for asymmetries of positive and negative (extreme) shocks and are included in order to focus on falling stock and bond markets. In particular, we analyze the role of gold in times of stress or extreme stock or bond market situations and include regressors that contain stock or bond returns that are in the q% lower quantile such as the 5%, 2.5% and 1% quantile.[3] If the return is larger than the q% quantile, the value of $r_{stock,\,t(q)}$ or $r_{bond,\,t(q)}$ is zero. If different thresholds are estimated simultaneously, the parameters b_2 and c_2 can be viewed as vectors.

[1] http://www.merriam-webster.com/

[2] The word (prefix)„safe" in „safe haven" does not necessarily add information to the definition but puts an emphasis on the fact that a haven is safe.

[3] The choice of the quantiles is arbitrary to some degree. However, these quantiles have also been analyzed in other papers such as Bae, Karolyi and Stulz (2003).

The structure of the model assumes that contemporaneous and lagged stock or bond prices can affect the price of gold.[4] This is consistent with the safe haven hypothesis. If stocks or bonds exhibit extreme negative returns, investors buy gold and bid up the price of gold. If the price of gold is not affected, investors neither purchase nor sell gold in such adverse market conditions.

We further assume that the price of gold does not influence stock or bond prices which rules out any feedback effect in the above model. The evidence is very limited for a causal relation running from gold to stock markets, with only weak effects and those concentrated in markets with significant numbers of gold mining stocks (see Davidson, Faff and Hillier, 2003)[5]. We are aware of no paper that has examined the relation between gold and bond returns.

It is important to analyze the link between the assets dynamically since lagged stock or bond returns can have a different impact on gold returns than contemporaneous stock or bond returns. Capie, Mills and Wood (2005) also estimate a dynamic regression model and assume the error term to exhibit conditional autoregressive heteroskedasticity modelled via a GARCH process. We follow their approach and specify an asymmetric GARCH process for the errors in equation 1.

We now focus on the basic version of equation 1 to explain the relation of the model and the hypotheses. If b_1 (c_1) is zero or negative, it implies that gold is a hedge for stocks (bonds) since the assets are uncorrelated with each other on average. Whether gold is a safe haven asset for stocks or bonds is tested via the parameters b_2 and c_2, respectively. If the total effect in (extremely) falling stock or bond markets is non-positive (sum of b_1 and b_2 for stocks and sum of c_1 and c_2 for bonds), gold serves as a safe haven asset for stocks or bonds since they are

[4] Equation 1 is augmented with lagged gold, stock and bond returns if the terms are statistically significant.
[5] We estimated a VAR (no cointegration being found between the series) with four lags for each country and found no evidence that gold returns cause (in the Granger sense) either stock or bond returns.

uncorrelated (sum of coefficients is zero) or negatively correlated (sum of coefficients is negative) with each other. A negative correlation of gold and stocks or gold and bonds in extreme market conditions implies that the price of gold increases in such conditions thereby compensating investors for losses incurred with stock or bond investments.[6]

4. Empirical analysis

The data consist of daily prices of MSCI stock and bond indices and US closing spot gold. The MSCI bond indices are sovereign total return indices with maturities longer than 10 years. All stock and bond prices are in local currency, i.e. US dollar, British pound and euro. The gold price is converted into British pound (GBP) or euro when necessary. The data cover November 30, 1995 until November 30, 2005. The fact that we analyze the data in local currencies implies that the study focuses on the characteristics of gold for US investors, UK investors and German investors.[7] If prices were converted to US dollars, for example, the results would be applicable from a US investor's perspective only.

4.1 Descriptive statistics

Figure 1 presents the prices for the entire sample period for stocks (upper graph), bonds (center) and gold (bottom graph).

< Insert figure 1 about here >

Stock prices peaked around March 2000 followed by a bear market that ended around March 2003. Bond prices show a different pattern. In general, prices have been rising for the entire sample period with relatively short periods of falling markets compared to stock prices.

[6] A diversifier asset can be viewed as a weak-form hedge (i.e. correlation with another asset is positive and smaller than one) and is not considered here in more detail.

[7] While the inclusion of the USA and UK is self evident, being large capital markets that also have important roles in the gold markets, we include Germany as a form of "control". Germany is very similar in industrial and capital composition to the other two countries yet has no role to speak of in terms of gold trading.

The bond prices of all three markets are clearly higher at the end of the sample than in the beginning of the sample period. Gold prices are also higher at the end of the sample compared to the beginning but there was no obvious trend of the price for gold. Two gold price regimes are easily discerned: the gold price fell until 2000 and increased afterwards.

An analysis of the continuously compounded returns of stocks, bonds and gold (not reported in detail) shows that stocks are generally more risky than bonds. Unexpectedly, gold despite its potential safe haven property appears relatively risky in terms of the standard deviation and the minimum and maximum values. The largest negative returns of gold are close to the ones of stocks and the maximum positive returns exceed the extremes of stocks for all three countries or currency denominations.

4.2. Econometric results

< Insert table 1 about here >

Table 1 presents the results for the model in equation 1. The coefficient estimates for the average effect of stocks on gold is -0.0475 for the US, -0.1821 for the UK and 0.0401 for Germany. All estimates are significant at the 1% level. The coefficient estimates for bonds are 0.0069 for the US, 0.0754 for the UK and -0.0528 for Germany. These estimates imply that gold is a hedge for stocks in the US and in the UK but not in Germany. The opposite effect holds for gold as a hedge for bonds. Gold is a hedge for bonds in Germany but not in the US and in the UK.

For extreme negative stock returns, the coefficient estimates are positive for the 5% quantile and negative for the 2.5% and 1% quantile in all markets. The overall effect for any quantile is given by the sum of all coefficient estimates up to the chosen quantile. For example, the overall effect for the 1% quantile is the sum of all coefficient estimates that involve stock

returns. This leads to a value of -0.0183 for the US, -0.2961 for the UK and -0.0727 for Germany and implies that in situations where stock returns exhibit extreme negative returns that are in the 1% quantile, the gold price increases slightly in the US and in Germany and strongly in the UK.

The fact that the sum of the coefficient estimates is non-positive for the 2.5% and 1% quantile but positive for the 5% quantile for the US and Germany implies that gold only serves as a safe haven for shocks exceeding the 2.5% and 1% threshold (quantile).

The choice of the optimal lag length leads to a specification of one lag for the US and no lags for the UK and Germany. Thus, we need to add the lagged effects to the overall contemporaneous effect in the US. The overall effect (-0.0401) including the lagged effect is stronger than the contemporaneous effect of -0.0183.

The relevant coefficient estimates for bond returns regarding the safe haven hypothesis show that we cannot reject the safe haven hypothesis for the 5% quantile in the US and in Germany. In addition, for more extreme returns the overall effect becomes positive, implying that bonds and gold move in the same direction if bonds fall. This also holds for the UK for all quantiles.

The fact that gold is a safe haven for stocks implies that investors that hold gold in normal times and in times of stress receive compensation for losses caused by negative stock returns through positive gold returns. However, what happens if investors purchase gold after an extreme stock market shock has occurred? The sum of the estimates of lagged stock returns and extreme lagged stock returns for the US are negative for the 2.5% and 1% quantile indicating that negative stock returns at t lead to positive gold returns at $t+1$. There is no such effect for the UK and Germany. Therefore, purchasing gold *after* an extreme stock market shock yields a

positive gold return implying that gold also functions as a safe haven for investors that buy gold only after an extreme market shock occurred.

The fact that gold is both a hedge and a safe haven for stocks but neither a hedge nor a safe haven for bonds in the US and in the UK is an empirical result but neither of the findings is implied by the other one. Theoretically, it is possible that gold is negatively correlated with stocks on average (gold is a hedge) but positively correlated with stocks in extreme market conditions (gold is not a safe haven). Finally, it is also possible that gold does not lose any value in extreme stock market conditions (gold is a safe haven) but co-moves with stocks on average (gold is not a hedge).

4.2.1. Sub-sample analysis

This section examines whether the results based on the full sample period are also valid in sub-samples. We divide the sample in periods of bull and bear markets in order to investigate the question whether the role of gold is different in these market conditions. In order to minimize the number of sub-samples, we use relatively long periods and neglect shorter periods of opposite market movements. This approach leads to three distinct periods. A bull market regime until March 2000, a bear market regime from March 2000 until March 2003 and a bull market regime from March 2003 until November 2005. The periods are selected by computing the peaks and troughs within the full sample for any market.

The results for the US are in table 2 and confirm the hypothesis above. Gold plays a different role in bull and in bear markets, especially in the US. While there is no significant estimate regarding gold as a hedge or a safe haven in bull markets, the estimates are highly significant in a bear market. The estimates for the UK are relatively similar across the three regimes but also show a slightly higher coefficient estimate for the hedge regressor indicating

that gold is a stronger hedge for stocks in bear markets than in bull markets. The results for Germany are similar to the findings for the US. The results for the UK and Germany are not reported in detail but are available from the authors.

< Insert table 2 about here >

The fact that the beginning of the bear market (March 2000) coincides with a breakpoint in the evolution of the gold price – the price of gold starts to increase around 2000 – suggests that the role of gold (a safe haven or a hedge) is determined by the evolution of the gold price itself. The falling gold price in the first half of the sample leads to a rejection of the safe haven hypothesis. On the contrary, the increasing gold price in the second half of the sample implies that gold is a safe haven in this period. This is congruent with studies that have shown significant psychological elements of the gold price (see for example Aggarwal and Lucey, 2007).

In summary, this section reports the effect of stocks and bonds on gold conditional on different market conditions and finds that gold exhibits the properties of a safe haven asset in falling stock markets in all three markets analyzed.

4.3. Portfolio analysis

This section analyzes the average cumulated return of a portfolio comprising gold and stocks for the period spanning 50 trading days after the occurrence of an extreme negative stock return. The aim of this exercise is to illustrate the change in a portfolio comprising gold and stocks through time. It also reveals the average evolution of stock and gold returns after an extreme negative stock market shock. In other words, are extreme negative shocks followed by another negative shock or a positive shock? How does gold perform in the period between the initial shock at t and $t + x$ trading days? This information does not emerge from the regression

model. Since the analysis is not based on the estimates obtained with the regression models as specified above it also serves as an implicit robustness check.

Figure 2 shows the average cumulated gold and stock returns after an extreme negative stock return smaller than the 5% quantile for the US, the UK and Germany. The plot shows that the return of gold is positive on the day an extreme negative shock in the stock market occurs. However, the gold price declines in the days following the extreme negative shock and the initial positive effect is reduced to zero after about 15 days. This effect can be observed for the US and the UK. There is no positive effect of the gold price with a shock to the stock market in Germany.[8]

< Insert figure 2 about here >

The results for the 1% quantile can be summarized as follows: the cumulated gold return increases slightly only at the time of the initial shock and then remains around zero in the US and in Germany. It is clearly positive in the UK and turns negative about 15 trading days after the initial shock. In the US, the gold price becomes negative after less than 10 days and after 1 day in Germany. These results show that gold is a safe haven only in the short-run.

The empirical finding that gold is a safe haven for a relatively short period after an extreme negative shock occurred can be explained with the property that gold is also a hedge for stocks. A hedge correlates negatively with another asset on average. This implies that if the price of one asset increases the price of the hedge asset falls. Since stock and bond prices usually rise some time after an extreme negative shock has occurred, the existence of a hedge works against a safe haven asset in the longer run.

[8] Results are qualitatively similar for the 2.5% quantile.

This section illustrates the evolution of the value of a portfolio comprising stocks and gold through time. We find that gold works as a safe haven asset only for around 15 days.

5. Conclusions

This paper analyzes whether gold works as a safe haven asset in financial markets. A safe haven asset is distinguished from a hedge and a diversifier asset, which provide diversification benefits on average but not necessarily when they are needed most, that is, in times of market turmoil.

Our empirical results show that gold is a safe haven for stocks. However, gold is generally not a safe haven for bonds in any market. Gold only functions as a safe haven for a limited time, around 15 trading days. In the longer run, gold is not a safe haven, that is, investors that hold gold more than 15 trading days after an extreme negative shock lose money with their gold investment. This finding suggests that investors buy gold on days of extreme negative returns and sell it when market participants regain confidence and volatility is lower. Future research could extend the number of stock and bond markets analyzed and examine the role of exchange rates for the safe haven hypothesis.

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Table 1
Estimation results for the US, the UK and Germany

The lag length and the GARCH model is selected with the Akaike and Schwarz information criteria. Only for the US market the first lags are statistically significant and improve the model fit. For the UK and Germany, contemporaneous stock and bond returns are sufficient. An asymmetric GARCH model with a threshold is selected for all markets. The results show that stocks are a hedge in the US and in the UK but not in Germany. In contrast, bonds are not a hedge in the US and in the UK but only in Germany. Stocks are a safe haven in all markets with stronger evidence in the UK and in Germany. Bonds are not a safe haven in any of the three markets.

Equation:

$$r_{gold,\,t} = a + b_1\, r_{stock,\,t} + b_2\, r_{stock,\,t(q)} + c_1\, r_{bond,\,t} + c_2\, r_{bond,\,t(q)} + e_t$$

$$h_t = \alpha e^2_{t-1} + \gamma\, e^2_{t-1} D(e_{t-1<0}) + \beta\, h_{t-1}$$

USA (US$)					**UK (£)**					**Germany (€)**				
Gold	**Coeff. est.**	**Std. err.**	**t-stat.**		**Gold**	**Coeff. est.**	**Std. err.**	**t-stat.**		**Gold**	**Coeff. est.**	**Std. err.**	**t-stat.**	
b_1	-0.0475	0.0147	-3.23	***	**b_1**	-0.1821	0.0199	-9.15	***	**b_1**	0.0401	0.0108	3.72	***
b_2 (5%)	0.1130	0.0322	3.51	***	**b_2 (5%)**	0.0722	0.0504	1.43		**b_2 (5%)**	0.0754	0.0327	2.31	**
b_2 (2.50%)	-0.0793	0.0499	-1.59		**b_2 (2.50%)**	-0.0204	0.0593	-0.34		**b_2 (2.50%)**	-0.0857	0.0392	-2.18	**
b_2 (1%)	-0.0046	0.0470	-0.10		**b_2 (1%)**	-0.1659	0.0375	-4.42	***	**b_2 (1%)**	-0.1026	0.0297	-3.46	***
c_1	0.0069	0.0284	0.24		**c_1**	0.0754	0.0370	2.04	**	**c_1**	-0.0528	0.0325	-1.62	*
c_2 (5%)	-0.0434	0.0843	-0.51		**c_2 (5%)**	0.1184	0.1176	1.01		**c_2 (5%)**	-0.0631	0.0959	-0.66	
c_2 (2.50%)	0.1029	0.1123	0.92		**c_2 (2.50%)**	0.0678	0.1692	0.40		**c_2 (2.50%)**	0.3216	0.1357	2.37	**
c_2 (1%)	-0.0581	0.1024	-0.57		**c_2 (1%)**	-0.0342	0.1682	-0.20		**c_2 (1%)**	-0.0818	0.1292	-0.63	
1 lag														
b_1	0.0078	0.0136	0.58											
b_2 (5%)	0.0094	0.0406	0.23											
b_2 (2.50%)	-0.0758	0.0532	-1.42											
b_2 (1%)	0.0116	0.0466	0.25											
c_1	-0.0155	0.0278	-0.56											
c_2 (5%)	0.1875	0.0721	2.60	***										
c_2 (2.50%)	-0.2070	0.1220	-1.70	*										
c_2 (1%)	0.1032	0.1263	0.82											
Conditional volatility					**Conditional volatility**					**Conditional volatility**				
α	0.0313	0.0077	4.05	***	**α**	0.0349	0.0084	4.14	***	**α**	0.0245	0.0066	3.72	***
γ	0.0849	0.0097	8.75	***	**γ**	0.0543	0.0103	5.27	***	**γ**	0.0798	0.0092	8.70	***
β	0.9096	0.0064	141.38	***	**β**	0.9228	0.0078	117.67	***	**β**	0.9076	0.0064	141.43	***

***Indicates statistical significance at the 0.01 level. ** Indicates statistical significance at the 0.05 level. *Indicates statistical significance at the 0.10 level.

Table 2

Sub-sample analysis for the US

This table shows the estimation results for three different periods: a bull market from November 1995 until March 2000, a bear market from March 2000 until March 2003 and a bull market from March 2003 until November 2005.

Equation:

$$r_{gold,\,t} = a + b_1\, r_{stock,\,t} + b_2\, r_{stock,\,t(q)} + c_1\, r_{bond,\,t} + c_2\, r_{bond,\,t(q)} + e_t$$

$$h_t = \alpha e^2_{t-1} + \gamma\, e^2_{t-1} D(e_{t-1<0}) + \beta\, h_{t-1}$$

	Bull market (- March 2000)			*Bear market (- March 2003)*			*Bull market (March 2003 -)*		
	Coeff. est.	**t-stat.**		**Coeff. est.**	**t-stat.**		**Coeff. est.**	**t-stat.**	
b_1	0.0082	0.41		-0.0915	-4.51	***	0.0188	0.44	
b_2 (5%)	-0.0086	-0.19		0.3018	7.22	***	-0.3999	-1.11	
b_2 (2.50%)	0.0644	0.93		-0.2129	-3.60	***	-0.0846	0.00	
b_2 (1%)	0.0678	1.14		-0.1162	-1.45		0.7870	0.00	
c_1	-0.1299	-3.75	***	0.1232	2.32	**	0.1822	2.83	***
c_2 (5%)	0.0258	0.27		-0.3155	-1.37		0.0521	0.32	
c_2 (2.50%)	-0.0034	-0.02		0.3306	1.31		0.2249	0.81	
c_2 (1%)	0.0246	0.16		0.0235	0.12		-0.4613	-1.59	
α	0.1254	5.31	***	0.0403	1.48		-0.0477	-3.76	***
γ	0.1245	3.90	***	0.2165	4.90	***	-0.0046	-0.14	
β	0.7840	45.19	***	0.7688	21.03	***	0.5193	1.58	

***Indicates statistical significance at the 0.01 level. ** Indicates statistical significance at the 0.05 level. *Indicates statistical significance at the 0.10 level.

Figure 1
Stock, bond and gold prices (1995-2005)

The figure presents the evolution of the stock prices (top), bond prices (center) and the gold price (bottom) for the US, the UK and Germany.

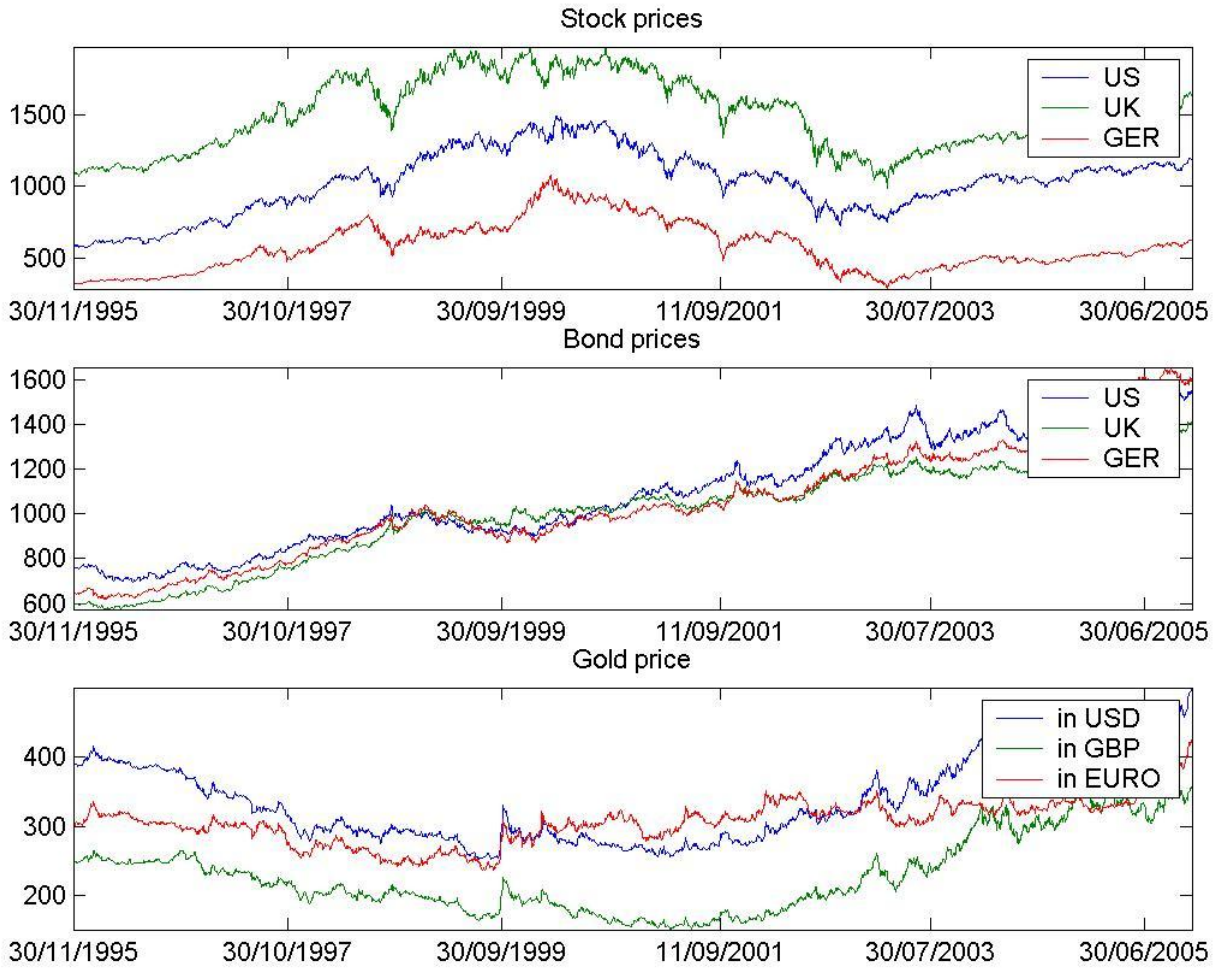

Figure 2
Portfolio analysis

The figure shows how stock returns and gold returns evolve for different investment horizons (x-axis). Period 1 is the time where an extreme negative stock return (in the 5% quantile) occurs. The vertical axis contains the average cumulated stock and gold returns. The top panel presents the US market, the intermediate panel the UK market and the bottom panel the German market. The time-series show that the return of gold is positive on the day an extreme negative shock in the stock market occurs and declines in the days following the extreme negative shock. The stock market returns tend to be positive after an extreme negative shock leading to an upward trend in the cumulated returns of stocks.