Hedges and safe havens: An examination of stocks, bonds, gold, oil and exchange rates

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ABSTRACT

In this paper we investigate the return relations between major asset classes using data from both the US and the UK. Our first objective is to examine time variation in conditional correlations to determine when these variables act as a hedge against each other. Secondly, we provide evidence on whether the dependencies between the asset classes differ during extreme price movements by using quantile regressions. This analysis provides evidence on whether these asset classes can be considered as safe havens for each other. A noteworthy finding of our study is that gold can be regarded as a safe haven against exchange rates in both countries, highlighting its monetary asset role.

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1. Introduction

Understanding informational dependencies across financial asset classes is of significant interest for at least two reasons. First, it can be argued that portfolio strategies of market participants are sensitive to the correlation structure between financial assets, especially considering that correlations are time-varying. Secondly, if information spills over across asset classes, financial and economic decisions will likely have cross-market influences and this is of interest to policy makers to determine the full impact of their decision.

The primary objective of this study is to build on this background and provide an empirical analysis of the dynamic linkages across several financial markets. As discussed in greater detail below, our study distinguishes itself by closely examining the time-varying nature of correlations across the asset markets and also, by particularly examining the behavior of prices during large and unlikely events using quantile regression methods. The prior work suggests that “extreme” events tend to impact the distribution of financial returns differently than “normal” fluctuations, which has been investigated extensively in prior work. We particularly focus on the ability of gold and oil, to provide protection during extreme declines in more traditional asset classes, such as equities and bonds. Moreover, we provide evidence from both the US and UK markets for additional robustness of our findings.

Not surprisingly, many papers examine similar questions in prior work. The initial literature largely focuses on the relation between equities and bonds, and the studies generally report negative comovement between these markets; see Shiller and Beltratti (1992) for instance. This is usually explained by the “discount factor”, the fact that increases in interest rates impact the bond prices and stock prices, within the context of present value relations, in opposite directions. However, more recent work suggests that there could be in fact time variation in the relation between stocks and bonds. Both Baele, Bekkaert, and Ingelbrecht (2009) and Andersen, Bollerslev, Diebold, and Vega (2007) argue that the negative relation reported in earlier studies holds only during contractions in the business cycle, while there is a positive relation during expansion in business cycle.

Other papers expand the asset markets investigated to include currency and gold prices by building on the motivation that there are theoretical reasons to expect that these markets exhibit informational dependencies. For instance, exchange rates and interest rates are closely linked via the uncovered interest rate parity. Similarly,

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1 The authors dub this as “cash flow effect”, stemming from the notion that interest rate increases could be results of higher growth and hence, greater profits for companies during an expansion in the business cycle. More evidence on this is detected in Rigobon and Sack (2003). In a simultaneous relation of bond and stock prices, these authors find that information transmission process may run in several directions; for instance, the correlation may change from positive to negative depending on which asset is dominant in specific periods.

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arguments exist to suggest a dependency between currency values and equities. According to “flow models” of exchange rate determination, changes in currency values affect international competitiveness and trade balance of a nation. This in turn is likely to impact output and hence, corporate cash flows. The “stock” models, on the other hand, suggest that foreign exchange values equate supply and demand for financial assets, predicting a dynamic correlation between prices of equities (and bonds) and exchange rates (see, Phylaktis & Ravazzolo, 2005, for further discussion). Studies, such as Roll (1992), and Chow, Lee, and Solt (1997) usually find a positive relation between dollar revaluations and stock returns.3

As mentioned above, our data also include gold price series to investigate its dynamic linkage with the other important financial prices. While gold has some (limited) industrial uses as a commodity and more importantly, there exists demand for it in jewelry, several authors argue that it also has a monetary role, similar to that of a currency. Baur and Lucey (2010) and Baur and McDermott (2010) recently detect important linkages between gold and stocks and bonds, even though the relation seems to be short-lived. In earlier research, Jaffe (1989), among others, points to the diversification gains obtained when gold is included in traditional portfolios.4 In terms of gold and currency dynamics, Capie, Mills, and Wood (2005) suggest that gold can act as an inflation hedge and hence, provides protection against dollar devaluations, which is also supported by Hammoudel, Sari, and Ewing (2009).

Finally, we include oil in our data set to investigate price dynamics. While oil should be regarded as a commodity rather than a financial asset, its sheer importance in the global economy suggests that significant relations can be expected between oil and financial markets. For instance, a voluminous literature exists on the impact of oil price changes on equity valuations, see Huang, Masulis, and Stoll (1996), Ciner (2001, 2012), Apergis and Miller (2009), Park and Ratti (2008) among others. This research, overall, concludes that oil price changes impact stock prices; however, the sign of the relation is debated. Research by Park and Ratti (2008) is important in this regard in that they show the impact depends on whether oil prices increase because of demand or supply shocks in the economy, again suggesting a time-varying relation.5 In terms of oil price–exchange rate relations, the research reports reason to expect significant linkages. As early as Krugman (1983) pointed out that an oil-exporting (oil-importing) country could experience exchange rate appreciation (depreciation) when oil prices change.6

It is important to note that linkages between financial prices have also been examined during periods of “extreme” movements. This branch of the literature aims to determine whether unlikely events occur simultaneously in separate financial markets; for instance, do different markets crash jointly, or is a significant fall in one associated with gain in another? Hence, the goal is to isolate, at least to some degree, the impact of true “shocks” from normal price movements. Recent empirical examples of this research include Hartmann, Straetmans, and de Vries (2004), who investigate dependencies in international stock and bond markets during periods of stress; and also, Cumperayot, Keijzer, and Kouwenberg (2006), who examine linkages between extreme stock market and currency returns.
In this article, we rely on two econometric methods to combine these two branches of the literature to investigate interdependencies between these variables. We utilize the dynamic conditional correlation approach of Engle (2002) to investigate dependencies in normal evolution of asset prices in these markets. The main advantage of this approach lies in the fact that it generates time varying correlations between the variables, which proved to be important in prior work as mentioned above. Since the correlation structure is essential in understanding portfolio diversification benefits, we dub this as “hedging” relations between the variables.

However, we also recognize that there can be important and different dynamics between the markets in times of stress and turmoil, as illustrated by the literature cited above. We rely on the quantile regression approach, also used by Baur and Lucey (2010), to examine correlations in the case of large and unlikely events, such as when a move occurs in the lower 5 quantiles of the observed distribution. If an asset is negatively correlated with another in times of stress, we dub that asset as a “safe haven” relative to the other.

While our main focus is portfolio dynamics and comovements between financial variables under varying conditions, it is noteworthy that examining asset market linkages under extreme conditions is related to the growing field of behavioral finance, in particular the prospect theory. Originally formulated by Kahneman and Tversky (1979), this theory implies that investors react differently to gains versus losses, being more sensitive to losses than gains. In a survey study, Duxbury and Summers (2004) suggest that there exists a general prevalence of loss aversion among financial agents. In particular, Ang, Bekaert, and Liu (2005) argue that investors seem to engage in abrupt switches between assets, implying that extreme price movements can be rather informative which further motivates our analysis.7

We organize the rest of the study as follows: In the next section, we discuss the data used in the paper. We present the dynamic conditional correlation analysis in Section 3 and the quantile regression results in Sections 4. In Section 5, we examine potential time variation in the findings. In the final section, we offer the concluding remarks of the article.

2. Data

Our data consist of daily observations, and cover the period between January of 1990 and June of 2010. As mentioned above, we provide evidence from both the US and the UK data and include variables to represent equity, bond, currency, gold and oil markets. Equities are represented by S&P 500 and FTSE Indexes for the US and the UK, respectively. The bond market proxies are the 10-year government bonds for each country. We use the Federal Reserve Bank’s Nominal Trade Weighted Effective Index and the Bank of England’s Sterling Effective Exchange Rate index for exchange rates. For gold, we use the nearby contract prices of the gold futures contract traded on the New York Mercantile Exchange (NYMEX) and the London A.M. fix prices, for the US and the UK, respectively.

Finally for the oil market, we collect the prices from nearby contracts of crude oil futures traded on the NYMEX and similarly the nearby futures prices of the Brent crude oil contract traded on the International Commodities Exchange (ICE), for the US and the UK. The US series have a total of 5057 observations and the UK series consist of 5159 data points. All data are obtained from Reuters/Ecowin. We provide a visual inspection of the series in Fig. 1. The series clearly show a great deal of variation. We can observe the impact of the information technology (dot-com) crash in March of 2000 in the equity series as well as the global financial markets crisis, beginning in 2007. An upward trend in gold price is also evident in recent data. We also provide some summary statistics in Table 1. The returns are not statistically different from zero, consistent with prior work.

### 3. Conditional correlations

As mentioned above, one of the main purposes of our study is to examine whether financial assets included in the data set can be used as hedges against each other in portfolios, which is essentially a correlation concept. Hence, in this part of the study we examine the dynamic correlation structure between the variables. We rely on

![Table 1: Summary statistics.](image)

![Table 2: DCC results.](image)

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7 Moreover, the concept of safe haven is consistent with downside risk measures discussed in the literature. Several authors have suggested that investment decisions can be better explained by risk measures that focus explicitly on return dispersions below a specified target. For instance, Harlow (1991) uses data from US and international equity markets and shows that investors obtain a better risk-return trade-off when downside risk measures are used. We thank a referee for suggesting these points.
Let Engle, and Sheppard (2006) investigate equity market correlations first stock return correlations significantly increase both within and outside the European Monetary Union after January 1999. Since the estimation details are spelled out in several papers in the literature, we refer the readers to the aforementioned papers.

We present, for information, the results of the regressions in Table 2 and the DCC analysis in Fig. 2. We estimate a simple mean equation where the returns are individually regressed on a constant and AR(1) and error term, and specify Asymmetric GARCH(1,1) for the variances. We do not elaborate on the DCC GARCH results, save to note that the results are as we might expect: the constant coefficients in the mean equation are generally insignificant, the GARCH parameters, including the asymmetry terms significant, the equations are well specified in terms of residual ARCH and other specification errors. The purpose of the paper and in general the purpose of DCC modeling is however not to derive estimates of the equations but to use these as a generating point for the conditional correlations over time. This we do. A number of noteworthy points emerge from this analysis. First, while there is almost zero correlation between oil and the dollar for most of our sample, this relation changes significantly in 2003, becoming negative and remaining so for remainder of the sample. Since this coincides with significant increases in global price of oil, this evidence seems to be consistent with the argument that oil can be regarded as a hedge against the potential declines in the US dollar in more recent data.

There is also a low to negative relationship between oil and bond markets, with some significant breaks around the two Gulf wars. As argued in the Introduction, this is also to be expected as bond and oil markets are likely connected via the inflationary expectations that may be caused by oil price increases and negatively impacting bond markets, in general. Surprisingly, the oil-stock return relation is close to zero for most of the sample period, against the arguments in the literature for significant dependencies between these variables. However, there are two exceptions; the first one is during the period

A: US data

![Graph showing dynamic conditional correlations for US data.]

B: UK data

![Graph showing dynamic conditional correlations for UK data.]

**Fig. 2.** Dynamic conditional correlations.

the dynamic conditional correlation (DCC) approach with a GARCH specification, originally put forward by Engle (2002). This approach has the advantage of providing time-varying correlations, which should be important given the discussion above in regard to the changes in the relation between the variables established in prior work. The DCC model can be estimated in two steps: first, time-varying variances of the series are estimated using a univariate GARCH specification and the second, parameters of the model are estimated.

Formally, Let \( r \) stand for the vector of returns, with \( D \) a diagonal matrix of standard deviations. \( P \) is a time varying correlation matrix.

We then have

\[
rtF_{t-1} = F(0, H_t), \quad H_t = D_t R_t D_t \equiv D_t^{-1} r_t, \quad E_t(q_t) = R_t. \quad \text{Eq. (1)}
\]

Let

\[
e_t = D_t^{-1} r_t
\]

be standardized residuals then

\[
F = \frac{1}{T} \sum_{t=1}^{T} e_t e_t^	op.
\]

Then a DCC\((p,q)\) process is given as

\[
Q_t = F + \sum_{i=1}^{p} \alpha_i (e_{i-1} e_{i-1}^	op - R) + \sum_{i=1}^{q} \beta_i (Q_{t-i} - R).
\]

Many papers already use the DCC approach to model the linkages between financial and economic variables. For instance, Cappiello, Engle, and Sheppard (2006) investigate equity market correlations following the introduction of the single currency, euro, and find that stock return correlations significantly increase both within and

\footnote{The correlations between stock and bonds returns showed no clear pattern; hence, we focus on interactions with gold and oil.}
around the Gulf War 1, a significantly negative relation for a two year period. The second is in fact a positive relation during 2008–2009, which presumably reflects the impact of the global credit crunch. Hence, little evidence exists to suggest that oil can be used to hedge stock markets risks in portfolios.

However, a clear negative relation is detected between gold and dollar, as well as between gold and equities. This is consistent with the extant literature, arguing that gold could be regarded as a monetary asset, rather than a commodity. In other words, gold seems to act as an “anti-dollar” during most of the sample period; hence, it can be regarded as a hedge against dollar risks. The result on the relation between gold and equities is also supportive of the notion that gold can play a role as a financial variable that is important for stock market investors. However, it is noteworthy that there is little relation between gold and bond prices, in general. This indicates that gold’s hedging property against both dollar and equities could be more than simply acting against inflation risk, as a significant relation would be observed in the bond market, also. A potential explanation is that gold is a market sentiment proxy that is more likely to impact riskier assets than fixed income securities.\textsuperscript{9}

With respect to the analysis for the UK, which is also reported in Fig. 2, the dynamic evolution of the correlations is perhaps most interesting in the case of oil and stock returns. We observe a fairly large, positive correlation between the oil and equity markets in the 1990s; however, the relation completely switches to negative in the decade after. Hence, one could argue that oil seems to act as a hedge against the stock market risk in the latter half of the sample

\textsuperscript{9} We thank an anonymous referee for commenting on this point.

### Table 3

Quantile regressions — US data.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Gold returns</th>
<th>Oil returns</th>
<th>Equity returns</th>
<th>Bond returns</th>
<th>Dollar returns</th>
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<td>P-value</td>
<td>Coeff</td>
<td>P-value</td>
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<td>0.79</td>
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\textsuperscript{9} We thank an anonymous referee for commenting on this point.
period. Considering that the UK is an oil-exporting nation, this finding could indicate the changing dependency on oil for UK corporate profits and levels of energy consumption in the economy. Also, in the period after the 2007–2008 financial crisis, a positive correlation between oil and the British pound emerges, while the correlation is largely nonexistent before. For the other relations examined and reported in Fig. 2, the analysis largely yields insignificant correlations.

### 4. Safe haven dynamics

The conditional correlation analysis conducted above is informative on understanding the general relations between variables. However, it is not useful to determine whether these financial assets provide protection for each other in extreme price changes, which is this part of our focus in the empirical analysis. As mentioned in the Introduction, following Baur and Lucey (2010), we dub this as the “safe haven” analysis, which is related to the tail behavior of financial asset return distributions and extreme price movements. Take gold as an example — its behavior is then modeled as follows (asset specific coefficients suppressed)

\[
r_{\text{Gold}} = \alpha + b_{\text{Gold}}r_{\text{each other asset}} + \epsilon_{\text{Gold}}
\]

\[
b_{\text{Gold}} = \epsilon_{0} + \epsilon_{1}D(r_{\text{each other asset}}^{1}) + \epsilon_{2}D(r_{\text{each other asset}}^{2,5}) + \epsilon_{3}D(r_{\text{each other asset}}^{10}) + \epsilon_{4}D(r_{\text{each other asset}}^{20}) + \epsilon_{5}D(r_{\text{each other asset}}^{50}) + \epsilon_{6}D(r_{\text{each other asset}}^{75}) + \epsilon_{7}D(r_{\text{each other asset}}^{90}) + \epsilon_{8}D(r_{\text{each other asset}}^{95})
\]

\[
h_{\text{Gold}} = \pi + \alpha\epsilon_{\text{Gold}}^{2} + \beta\epsilon_{\text{Gold}-1}^{2} + \gamma(e_{\text{Gold}-1})
\]
distributed as a Generalized error distribution, in which density function is given as
\[ f(x) = \frac{\exp\left(-|x|/b\right)^{\gamma/2}}{b\left(2(\gamma+1)^{\gamma/2}\right)} \]

Thus the return on gold depends on the contemporaneous and one period lagged return on each asset (stocks, bonds, oil and the dollar, separately) and on dummy variables that indicate whether those returns were in the lower 5th, 2.5th or 1st percentile of the distribution. The variance of the error term is specified as an asymmetric GARCH(1,1) process with a GED distribution to capture any thick tailed behavior, estimated with robust standard errors.\(^{10}\) The primary parameters of interest are the coefficients on the dummy variables on the quantiles, which can be used to infer whether one of the variables in our data set can provide protection during an extreme fall in the valuation of another, i.e. act as a safe haven. To use the same example as above, if gold can be regarded as a safe haven against equities then, for a stock market decline of quantile \(q\) in equities should generate a negative, and statistically significant coefficient value.

Following the prior work, in this paper we particularly focus on the properties of gold and oil against the conventional asset classes. For the US data, the results are reported in Table 3 and show that gold in fact does not act as a safe haven for equities. The reactions in the gold market following extreme reactions are never significant. This is against the conclusions of Baur and Lucey (2010) and perhaps stems from the fact that our data cover a more recent period, in which gold has jumped in valuation. It appears that the increase in its popularity as an investment vehicle, and possibly the rise of financial instrument related to gold (rise in the Exchange Traded Funds and gold-linked traded indices) has caused a decline in its primary attraction for many financial market participants, which is the notion that gold can be trusted as a safe haven against the equity market volatility.

Gold, however, continues to perform its traditional role as a safe haven against declines in the US dollar. Our results show that gold price increases significant when there is an extreme decline in the value of the dollar index, which again confirms the role of gold as a monetary asset. The result on the relation between gold and bonds is particularly noteworthy. Note that gold has insignificant correlation with bonds as discussed in the previous section. However, the results in Table 3 show that gold can be a safe haven for bonds, which is consistent with the notion that the behavior of financial assets in the tails of their distributions can be starkly different than their “normal” behavior, i.e. distributions about the mean.

Oil also acts as a safe haven against extreme declines in the US bond markets. This supports the notion that oil, in addition to being one of the most important global commodities, has a financial variable role. However, it does not exhibit the same relation against the other variables in our data set. Hence, the results suggest that its financial market role is less significant than that of gold. On the other hand, the bond market continues to play its traditional role as a safe haven against equity market declines. Bond returns are positive when there are extreme declines in equities. In fact, the bond market is the only asset market in our sample that provides a safe haven against the US equities. However, as a counterintuitive result, we see a positive correlation between bond returns and extreme dollar declines. Finally, the currency market presents no safe haven relations against any of the asset markets in the US data.

The findings for the UK, which are presented in Table 4, show that gold plays a similar role as “anti-currency”, similar to the results reported above. The fact that gold acts as a safe haven against more than one international currency provides further support for its role as a monetary asset. The equity market in the UK is a safe haven against the British pound and oil, which is somewhat surprising. A noteworthy result is that bonds play a safe haven role against equities in the UK, also. However, there is positive correlation between bond and gold (and oil) markets. Perhaps the most interesting finding in the UK data is that the British pound can be regarded as a safe haven against extreme declines in equities, bonds as well as gold. This result suggests that the role played by the British currency in financial markets is very different than the role played by the US dollar in regard to extreme movements and has not been reported before to the best of our knowledge.

5. Time variation

The analysis above highlights noteworthy relations on the extent to which the variables in our data act as safe haven during market

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\(^{10}\) Likelihood ratio tests for all estimations indicate that an IGARCH restriction on the variance process is valid, as is the restriction of a GED for errors. Further tests indicate no residual ARCH processes in residuals. These results are available from the corresponding author.
turmoil. However, there may be linkages between the markets during specific time periods, for instance during financial crises, that may not be uncovered in our full sample analysis. Our aim in this section is to provide further detail on the extent to which these asset classes act as safe havens for each other. We again primarily focus on the role of gold and oil.

To investigate time-varying safe haven relations, we estimate the equation in (1) using rolling regressions and set the sample period for each case to 100 observations (approximately 4 months of data). The period selection is somewhat arbitrary; however, it is motivated on the grounds that it coincides with maturity of most traded commodity futures contracts and portfolio evaluation of a large number of investment managers. We show in Table 5 the percentage of days per annum when we find oil or gold acting as a contemporaneous safe haven against a 5% lower tail fall in a set of assets, for both the USA and the UK. We show in Fig. 3 a more detailed time variation evolution (Fig. 4).

Our analysis yields several noteworthy findings. We show, in particular, that as we expected a priori there are linkages between the variables that are not detected in the full sample analysis. For example, our results discussed above indicate that the oil market does not in general act as a safe haven for stocks. However, we find that oil in fact acts as a safe haven during specific periods, such as around 1990, which is presumably related to the first Gulf War and recently, after the 2007–2009 financial crisis (the “credit crunch”). Moreover, the role of oil following the most recent crisis seems to be continuing.

Similarly, oil acted as a safe haven for bonds after the 1987 stock market crash and also, after 2000, which is presumably related to the crash in technology and telecommunications stock on the NASDAQ. These results seem to create a pattern for the role of oil that has not been reported before. Similarly, we find specific periods in which gold market acts as a safe haven. In particular, for equities, we detect evidence for this after 1990, again presumably related to the war, and also, for the recent credit crunch. The role of gold as the anti-dollar is further confirmed in this analysis, also. Gold can be considered a safe haven for dollar in most of the last decade.

We analyze the time variation in safe haven property for the UK data in a similar manner. Our main finding perhaps is that we continue to observe a significant role for the oil market as a safe haven when short time periods are targeted in our rolling regression analysis. Perhaps, this is to be expected as the UK is a major oil producer. In particular, oil acts as a safe haven for the UK stocks around 2001–2002, which coincide with the technology stocks collapse, and as well as around 2007–2008, which coincide with another crash in stock values.
Fig. 4. Time-variation: UK data.
during the “credit crunch”. Moreover, oil is a safe haven for the UK bonds also around 2001–2002 period. On the other hand, gold cannot be considered a safe haven for the UK dollar during these equity markets turmoil periods, which should be of interest to market participants.

Gold, however, continues to play its role as a safe haven against paper currencies with regard to the Sterling, also. Hence, our findings indicate that the attributes of gold in this regard are not confined to the US dollar. We find that gold is a safe haven for Sterling around 1998, which was a period of turmoil in financial markets due to the collapse of the hedge fund LTCM; around 2001, again a period of turmoil due to collapse in technology stocks as mentioned above; and further around 2007–2008, which is of course the recent global financial crisis.

6. Concluding remarks

In this study, we investigate the dynamic correlations between oil, gold, currency, bond and stock markets using daily data from the US and the UK. The analysis is useful to determine whether these markets can be used to diversify risks on average, which we dub as the “hedging” property. Our primary result in this part of the empirical analysis is that the bond market continues to play its traditional role as a hedge for the equity market, at least on average. Similarly, there is evidence to suggest that the gold market can be regarded as a hedge against the exchange rate fluctuations, supported in both the US and the UK data. We also examine, in the second part of the empirical analysis, the relation between the variables in our data during extreme price movements. In other words, we investigate whether the markets provide protection for each other during significant price declines, which we dub the “safe haven” analysis, by utilizing the quantile regression methods. The noteworthy finding we report in this section is that gold consistently acts as a safe haven when exchange rates drop significantly in both the US and the UK cases, which confirms the role of gold as a monetary asset.

References


