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HEDGING STOCKS IN CRISES AND MARKET DOWNTURNS WITH GOLD AND BONDS: INDUSTRY ANALYSIS

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ABSTRACT

This paper analyzes the dynamic return relationships between stocks and other asset classes, namely gold, government bonds and corporate bonds, to investigate whether these asset classes can serve as a hedge and a safe haven for stocks during crises and stock market downturns in Thailand. The result suggests that gold generally provides a hedge for the stock market and industry indexes, and that it also works as a safe haven for stocks in some crises. However, bonds tend to offer less hedging effect. In fact, the correlations between bonds and stocks even increase in some crises, contradicting a common belief that bonds are a safe haven for stocks. A possible explanation for this striking finding is that since stocks and bonds share similar sources of companies' cash flows, bonds are viewed as risky as stocks in times of extreme market volatilities and hence market players treat them as one and the same. Finally, these hedging and safe haven effects are observed in some, but not all, industries and they do not behave consistently in every crisis.

Contribution/Originality: In this paper, the dynamic stock–gold and stock–bond correlations are extensively investigated at industry level to further understand diverse behavior of individual industries relative to the overall market. Furthermore, the impact of crises on the correlations is also investigated individually since they may not be homogeneous across all crises.

1. INTRODUCTION

Understanding the nature of time variation in correlations between asset returns has always been a crucial issue in finance because a cross-correlation carries theoretical implications for understanding the formation of asset prices as well as practical implications for asset allocation and risk management (Connolly, Stivers, & Sun, 2005). Hedging stock markets with gold has received a great deal of attention in financial markets, particularly in the wake of the 2008 global financial crisis. Over the past two decades, the literature revealed that gold serves as a hedge and a safe haven for stocks during economic catastrophes or stock market stress. Hillier, Draper, & Faff (2006) documented that gold, together with other precious metals, are a hedge for stocks, especially during periods of abnormal stock market volatility. Using US, UK and German daily data, Baur & Lucey (2010) found that gold is a hedge for stocks in the US and the UK with the two assets having zero or negative correlations. Furthermore, a safe haven property of gold was also detected in all three markets. Correlations between gold and stocks become

negative during stock market turmoil since investors sell risky stocks and evacuate funds to safe assets such as gold. This phenomenon is known as "flight-to-quality" or "flight-to-safety".

Baur & McDermott (2010) further extended the issue by covering more countries with both developed and emerging markets and by using different data frequencies, including daily, weekly and monthly observations. They found that gold is a hedge and a safe haven for the US and major European stock markets, but not for Australia, Canada, Japan and large emerging markets. The hedging and safe haven properties of gold are strongest in daily data, implying that the impacts were short-lived. Hood & Malik (2013) compared the ability of gold with that of the VIX index in hedging and serving as a safe haven for the US stock market and they found that VIX was a superior hedging tool and served as a better safe haven than gold during the sample period.

Gurgun & Unalmis (2014) confirmed the hedge and safe haven properties of gold in some emerging and developing countries. Chkili (2016) employed A-DCC to analyze stock–gold time-varying correlations for BRICS countries (Brazil, Russia, India, China and South Africa). The result suggests that the stock–gold correlations were low to negative during both the global financial crisis of 2007–2008 and the European debt crisis of 2010–2011. Shahzad, Raza, Shahbaz, & Ali (2017) showed that gold provides a strong hedge for most markets investigated during normal and bullish conditions. However, this hedging ability disappears during extreme bear markets.

Bonds are another asset class that has been extensively explored regarding whether they act as a hedge or a safe haven for stocks. However, the empirical findings for bonds are mixed. Many studies (Baur & Lucey, 2009; Connolly, Stivers, & Sun, 2005; d'Addona & Kind, 2006; Kim, Moshirian, & Wu, 2006; Li & Zou, 2008; Li, Zheng, Chong, & Zhang, 2016; Yang, Zhou, & Wang, 2009) show that the flight-to-safety phenomenon is also typically observed in a stock–bond relationship. As investors reorganize their portfolios by replacing risky assets with safe assets, bond and stock market returns become negatively correlated (Kim, Moshirian, & Wu, 2006). Baur & Lucey (2009) studied stock–bond correlations in eight developed markets and revealed that the flight-to-safety phenomenon occurred during many crises and it commonly took place across countries. Hence, they suggest there is a link between the occurrence of the flight-to-safety phenomenon and a cross-country contagion. Skintzi (2019) document flight-to-safety in the Eurozone countries. Interestingly, the result showed that uncertainty in domestic stock markets drove stock–bond correlations in core EU countries during normal times, whereas uncertainty in global markets influenced the stock–bond correlations in peripheral EU countries during volatile periods.

On the other hand, some studies document positive relationships between stock and bond returns. The primary argument presented is that stocks and bonds share the same economic factors that influence their future cash flows and discount rates. Li (2002) suggests that uncertainty around expected inflation and real interest rates is the key driver of stock–bond correlations. Ilmanen (2003) found that during high inflationary periods, changes in common discount rates dominated changes in cash flow expectations and caused the stock–bond co-movements to be positive. Yang, Zhou, & Wang (2009) examined time-varying stock–bond correlations in the US and the UK over the past 150 years. Although they found that stock–bond correlations during recessions were lower than those during economic expansions in the US, the result in the UK indicated greater stock–bond correlations during economic expansions. Park, Zhongzhen, & Young (2019) an examined stock–bond correlation in Korea and the flight-to-safety phenomenon during the global-risk driven crises of 2007–2012 was reported. However, stock and bond returns declined together during the local risk-driven crisis of 1997–1999 forcing stock–bond correlations to be positive. Flavin & Lagoa-Varela (2019) examined the relationship between stock and long-term government bond returns in the crisis-hit Eurozone peripheral economies, including Greece, Ireland, Italy, Portugal and Spain, and concluded that the stock market and government bond returns moved even more in lockstep during the crisis period. Interestingly, they found that the key driver of the increased correlations between stock and bond returns was largely attributable to the financial sector.

In this paper, the hedging and flight-to-safety properties of gold and bonds during substantial stock market downturns and crises using daily data from the Stock Exchange of Thailand (SET) is examined. This paper offers

contributions to the existing literature in several ways. First, existing literature concentrates more on investigating this issue in developed markets, whereas there is a lack of findings observed in emerging markets and even less so in the comparison of gold and bonds as hedge instruments for stocks. Second, previous studies largely consider stocks as a single asset class. Hence, the relationship between stock and bond returns as well as the relationship between stock and gold returns are estimated based on a stock index level that represents the overall stock market. As motivated by Flavin & Lagoa-Varela (2019), stock–bond correlations are not homogenous across industries and a finding based on the market level could only potentially be driven by some industries. Baele & Londono (2013) also documented that the cross-sectional dispersion in industry betas is larger during recessions. Therefore, this paper extends the issue by investigating at the industry level to establish an understanding around diverse behavior of individual industries relative to the overall market.

Third, to examine hedging and flight-to-safety properties of gold and bonds during events of market stress or turmoil, previous studies typically proxied the events by using periods of extreme stock market volatilities, large negative stock return environments and crises. In this paper, periods of crises and stock market downturns cover a longer time frame than those used in previous studies. For example, Baur & Lucey (2009) covered 20 trading days (i.e., one calendar month) for a crisis period. However, each stock market pullback in this paper could take several months to complete. Having a longer time frame could lead to a more general conclusion than employing a shorter time frame. This is because flight-to-safety behavior does not only take place during crisis days but also occurs during periods leading to the crises and other substantial market downturns as the sentiment of holding stocks turns poor. Finally, the effect of crises and stock market downturns on stock–gold correlations are separately investigated for each individual crisis since different crises could cause distinct effects on the correlations.

The rest of the paper proceeds as follows: Section 2 describes the data used in the study and presents descriptive data analysis; Section 3 outlines the methodology employed; Section 4 discusses the empirical findings; and the final section offers some conclusions.

2. DATA DESCRIPTIVE

The data used in this study consist of daily observations of the Thai stock market and industry indexes, bond indexes and gold price covering the period between January 1st, 2004 and March 23rd, 2020. The total return indexes of the SET and the SET's industries were adopted for computing stock returns in the Stock Exchange of Thailand. The industry classification is based on the SET and covers the following eight industries: agriculture and food (Agro & Food), consumer products (Cons), financials (Fin), industrial (Ind), property & construction (Prop & Con), resources (Res), services (Serv) and technology (Tech).

The daily London Bullion Market Association (LBMA) gold bullion prices are converted to Thai baht and are applied instead of spot gold prices in the local Thai market since the spot gold prices released by the Gold Trader Association in Thailand are not available in terms of daily time-series; the time-series of daily prices of gold futures contracts traded on the Thailand Futures Exchange (TFEX) do not cover all the periods in this study. Furthermore, disregarding the movement of the exchange rate of THB/USD, the local gold price in Thailand tends to follow the LBMA gold price. Even the TFEX relies on the LBMA to price the underlying asset for its gold futures contracts. All of the total return indexes for the Thai stock market and industries are collected from Refinitiv Datastream. The total return indexes of Thai government bonds and corporate bonds are used to compute daily rate of returns of bonds in Thailand. These bond indexes are reported by the Thai Bond Market Association (ThaiBMA), which is the primary market for trading bonds in Thailand. The data for bonds are collected from Bloomberg. For the period of data used in this study, five crises and stock market downturns are identified in Table 1.

Table 1. Crises and substantial stock market downturns.

Crisis and Stock Market Downturn Periods	Date
Global Financial Crisis in 2008	May 5th, 2008 to Oct 29th, 2008
European Debt Crisis in 2011	Aug 1st, 2011 to Oct 4th, 2011
Political Turmoil in 2013	May 28th, 2013 to Jan 3rd, 2014
Stock Market Downturn in 2015	Feb 20th, 2015 to Sep 23rd, 2015
Covid-19 Pandemic in 2020	Jan 17th, 2020 to March 23rd, 2020

In Figure 1, the daily rebased time-series of the stock market index in relation to the government and corporate bond indexes and the gold price are illustrated. The highlighted areas indicate the periods of the crises and stock market downturns. Figure 1 shows that when the stock market substantially declines, gold prices tend to increase and provide a hedge for stocks, particularly during the global financial crisis in 2008, the stock market meltdown in 2015 and the Covid-19 pandemic in 2020. Both government and corporate bond indexes tend to be stable and less correlated with the stock index during crises and downturns.

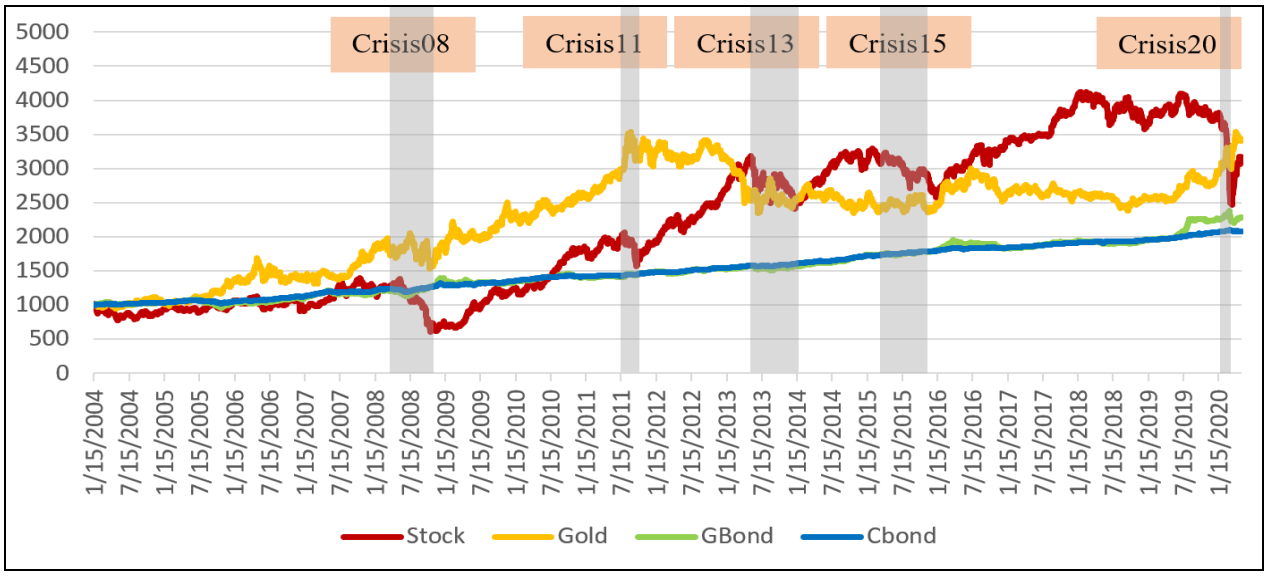

Figure 1. Performance of stocks, bonds and gold during crises and market downturns.

Table 2 reports the mean and standard deviation of annualized daily returns on the stock market and industry indexes, the bond indexes and gold for the overall observation and observations for each crisis and market slide. For the full sample, the average daily returns on the stock market index (i.e., the SET index) are 7.1% per annum with a standard deviation of 20.1% per annum. Considering industry performances, services, and agriculture and food considerably outperformed the market, whereas consumer products, financials, industrials, and property and construction underperformed. In the same period, gold offered a slightly higher return (7.7% per annum) and a lower risk (SD of 18% per annum) than stocks. Government and corporate bonds provided lower returns and risks, as expected. Unsurprisingly, the stock market index experienced a large negative return of 95.7% per annum in crisis and stock market downturn periods. This average negative return was primarily prompted by the global financial crisis in 2008, the European debt crisis in 2011 and the Covid-19 pandemic in 2020. Industry-wise, financial, industrial, property and construction, and resource stocks performed particularly poorly during the crises. On the other hand, gold provided a positive average return and even performed slightly better during the crises and downturn periods. This evidence indicates that gold can be a hedge for stocks during stock market stress. The average government and corporate bonds return during crises and downturns are still positive and are generally similar to those of the full sample period.

Table 2. Descriptive Statistics.

Asset Class	Full Samples		All Crises		Crisis08		Crisis11		Crisis13		Crisis15		Crisis20	
	Return	SD	Return	SD	Return	SD	Return	SD	Return	SD	Return	SD	Return	SD
Stock market index	7.1%	20.1%	-95.7%	30.6%	-180.8%	39.2%	-147.0%	30.9%	-42.1%	24.7%	-21.9%	14.1%	-237.0%	51.3%
Agriculture and food	12.9%	28.0%	-94.8%	26.5%	-110.8%	24.6%	-128.5%	28.8%	-22.1%	24.8%	-14.4%	14.3%	-198.4%	50.3%
Consumer products	2.7%	12.2%	-67.6%	16.0%	-62.2%	16.8%	-77.5%	19.2%	-22.1%	10.8%	-41.2%	15.7%	-135.1%	23.3%
Financials	4.1%	24.1%	-143.5%	36.0%	-169.5%	49.9%	-166.4%	33.4%	-48.8%	28.7%	-42.1%	16.5%	-290.6%	55.9%
Industrials	3.0%	24.7%	-159.1%	35.8%	-211.8%	40.3%	-262.2%	45.0%	-20.1%	25.6%	-14.8%	22.0%	-286.4%	61.7%
Property and construction	4.3%	20.9%	-131.8%	30.6%	-195.2%	35.9%	-157.5%	30.1%	-56.2%	29.6%	-13.1%	14.6%	-236.8%	48.2%
Resources	8.3%	26.3%	-147.7%	38.5%	-210.3%	50.9%	-180.9%	36.4%	-27.9%	22.4%	-35.9%	22.8%	-283.7%	69.8%
Services	12.0%	17.5%	-103.3%	27.9%	-162.4%	28.6%	-85.1%	28.8%	-46.3%	27.7%	-5.9%	14.3%	-217.1%	48.0%
Technology	8.0%	23.9%	-70.1%	30.6%	-134.4%	36.0%	-24.6%	29.1%	-49.3%	33.1%	-16.3%	14.9%	-125.9%	42.5%
Gold	7.7%	18.0%	9.5%	24.5%	-24.1%	34.7%	25.4%	30.8%	-3.3%	20.6%	7.1%	13.4%	42.6%	26.1%
Government bond	5.3%	3.2%	4.6%	4.5%	14.2%	5.7%	11.6%	3.5%	0.0%	3.6%	4.0%	2.2%	-7.0%	8.1%
Corporate bond	4.7%	1.6%	5.8%	1.7%	7.3%	2.7%	6.9%	1.4%	3.1%	1.6%	5.5%	1.0%	6.1%	0.4%

3. RESEARCH METHODOLOGY

To examine hedging and flight-to-safety properties of gold and bonds during substantial stock market retreats, two approaches are employed.

3.1. Examining Dynamic Correlations during Crises and Stock Market Downturns

The DCC-GARCH model has been used by a number of studies to model time-varying stock–bond correlations and stock–gold correlations (e.g., Barunik, Kocenda, & Vacha, 2016; Basher & Sadorsky, 2016; Ciner, Gurdgiev, & Lucey, 2013). It is important to inspect whether these correlations are stable over time and behave differently across stock market conditions, especially declines.

The DCC-GARCH model is estimated in two steps. First, we estimate a univariate GARCH for each return series to obtain a time-varying standard deviation matrix and standardized residuals, which will be required to construct the dynamic conditional covariance matrix in the second step. Equations 1 and 2 present the specification of the GJR-GARCH (1,1) as follows:

$$r_{i,t} = \alpha_{i,0} + \sum_{p=1}^{5} \alpha_{i,p} r_{i,t-p} + \varepsilon_{i,t} \quad (1)$$

$$h_{ii,t} = \beta_{i,0} + \beta_{i,1} h_{ii,t-1} + \beta_{i,2} \varepsilon_{i,t-1}^2 + \gamma_i I_{i,t-1} \varepsilon_{i,t-1}^2 \quad (2)$$

where $r_{i,t}$ and $h_{ii,t}$ are the returns and conditional variances of a pair of assets, such as a stock market index and gold, to be tested in period *t*. Five lags for the autoregressive process in the return equation is allowed to capture the day-of-the-week effect. The GJR-GARCH specification allows for the asymmetric effect of news on volatility. $I_{i,t-1}$ represents a dummy variable that equals one if the lagged shock to returns, $\varepsilon_{i,t}$, is negative, and zero otherwise.

In the second step, we model the conditional covariance matrix (H_t) by using the estimated series obtained from the first step. The conditional covariance matrix can be specified in Equation 3.

$$H_t = D_t R_t D_t \quad (3)$$

where $D_t = diag\{\sqrt{h_{ii,t}}\}$ is obtained from the estimation of univariate GARCH. R_t is the time-varying conditional correlation matrix that is formed by the standardized residuals (i.e., $z_{i,t} = \varepsilon_{i,t}/\sqrt{h_{ii,t}}$ results from the univariate GARCH estimates). Equations 4, 5 and 6 show the detail of this process as follows:

$$R_t = \left(diag(Q_t)\right)^{-1/2} Q_t \left(diag(Q_t)\right)^{-1/2} \quad (4)$$

$$Q_t = (1 - a - b)Q_0 + a z_{t-1} z_{t-1}' + b Q_{t-1} \quad (5)$$

$$\left(diag(Q_t)\right)^{-1/2} = \text{diag}\left[\frac{1}{\sqrt{Q_{11,t}}}, \ldots, \frac{1}{\sqrt{Q_{nn,t}}}\right], \quad (6)$$

where $Q_t = (q_{ii,t})$ represents the time-varying covariance matrix of z_t, and Q_0 represents the unconditional variance matrix of z_t. For simplicity, the element of the conditional correlation matrix $\rho_{ii,t}$ can be expressed in Equation 7.

$$\rho_{ii,t} = \frac{q_{ii,t}}{\sqrt{q_{ii,t}q_{jj,t}}} \quad (7)$$

Once time-varying stock–gold correlations and stock–bond correlations are obtained from the DCC-GARCH process, these correlations are then examined to determine whether gold and bonds can serve as a hedge or a safe haven for stocks.

3.2. Hedging Stock Market and Industry Returns Using Gold and Bond Returns

To test whether gold and bonds act as a hedge or engender a flight-to-safety phenomenon for the stock market and its individual industries, I employ the approach initially used by Baur & Lucey (2009) and Baur & Lucey (2010). Their approach has also been used or adapted in several later studies (e.g., Baur & McDermott, 2016; Ciner, Gurdgiev, & Lucey, 2013; Hood & Malik, 2013). This approach estimates the correlation between the returns of a stock market and those of another asset class by measuring the sensitivity of the asset class returns (i.e., gold and bond) with the stock returns. The main advantage of this approach is that the correlations observed in the form of betas and the marginal effects of crises and stock market downturns on the betas can be statistically tested. The testing model is described in Equations 8 and 9 as follows.

$$r_{i,t} = \alpha + \beta_0 r_{stock,t} + \varepsilon_t \quad (8)$$

$$\sigma^2_{i,t} = a + b_1\sigma^2_{i,t-1} + b_2\varepsilon^2_{i,t-1} + b_3 I_{i,t-1}\varepsilon^2_{i,t-1} \quad (9)$$

Where r_i represents returns on gold or bonds, which are a hedge instrument for stocks, whereas r_{stock} represents returns on the stock market index or returns on each of the eight individual industry indexes. The β_0 coefficient captures the correlation between gold or bonds and stocks. To control for heteroscedasticity in the analysis, a conditional variance is modeled by using GJR-GARCH (1,1).

To extend the analysis to test whether there are any changes in the stock–gold and stock–bond correlations during the crises and stock market downturns, the regressions presented in Equations 10 and 11 are estimated.

$$r_{i,t} = \alpha + \beta_0 r_{stock,t} + \beta_1 r_{stock,t} Crisis + \varepsilon_t \quad (10)$$

$$\sigma^2_{i,t} = a + b_1\sigma^2_{i,t-1} + b_2\varepsilon^2_{i,t-1} + b_3 I_{i,t-1}\varepsilon^2_{i,t-1} \quad (11)$$

In Equation 10, *Crisis* is a dummy variable that captures the all crises and stock market downturn periods, including the global financial crisis in 2008, the European debt crisis in 2011, Thailand's political turmoil in 2013, the stock market crash in 2015 and the Covid-19 pandemic in 2020. The β_1 coefficient measures an additional sensitivity or correlation between gold returns (or bond returns) and stock returns during those crisis periods, while β_0 measures correlations for non-crisis periods. A negative β_1 would indicate a safe haven property of gold or bonds for stocks since it implies that investors sell risky stocks and shelter the funds in safe assets such as bonds or gold during stock market volatility.

Park, Zhongzhen, & Young (2019) documented that stock–bond correlations are not stable across crises. Therefore, in this study, the combined crisis dummy was split into five individual crisis dummies as shown in Equations 12 and 13.

$$r_{i,t} = \alpha + \beta_0 r_{stock,t} + \beta_{11} r_{stock,t} Crisis08 + \beta_{12} r_{stock,t} Crisis11 + \beta_{13} r_{stock,t} Crisis13 + \beta_{14} r_{stock,t} Crisis15 + \beta_{15} r_{stock,t} Crisis20 + \varepsilon_t \quad (12)$$

$$\sigma_{i,t}^2 = a + b_1 \sigma_{i,t-1}^2 + b_2 \varepsilon_{i,t-1}^2 + b_3 I_{i,t-1} \varepsilon_{i,t-1}^2 \quad (13)$$

In Equation 12, *Crisis*08, *Crisis*11, *Crisis*13, *Crisis*15 and *Crisis*20 are dummy variables that capture each individual crisis and stock market downturn. The crisis betas (i.e., β_{11}, β_{12}, β_{13}, β_{14} and β_{15}) represent an additional impact that each crisis has on the correlations.

4. EMPIRICAL FINDINGS

4.1. Estimates of the Dynamic Correlations of Stocks, Gold and Bonds

Figure 2 illustrates the dynamic daily correlation of the stock market returns with gold, government and corporate bond returns estimated using the DCC-GARCH model. The highlighted areas indicate the periods of crises and stock market downturns. In Panel A, the daily correlations of stock and gold returns vary over time, both in small positive and negative territories. However, the correlations become predominately negative in all crises and downturn periods. This evidence supports the property of gold as a hedge and a safe haven for stocks during stock market turbulence as investors flee from risky stocks to safe assets, such as gold. On the other hand, the results for government and corporate bonds reported in Panels B and C, respectively, are somewhat mixed. The stock–government bond and stock–corporate bond correlations during crises and downturns oscillate between negative and positive zones. Furthermore, the correlations behaved differently in each crisis. The stock–bond correlations were noticeably positive during the global financial crisis in 2008 and the political turmoil in 2013, but they were clearly negative in the European debt crisis in 2011.

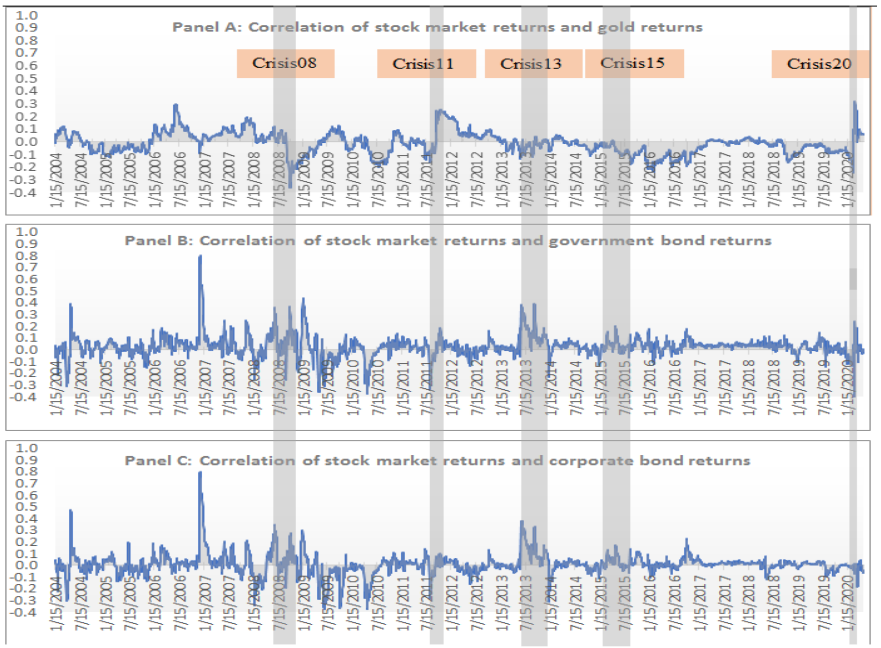

Figure 2. Dynamic correlations of stock market, gold and bond returns.

Table 3. Dynamic correlations of stocks, gold and bond returns estimated from the DCC-GARCH model.

Panel A reports the averaged correlations of the stock market and industry returns with gold returns.

Correlations	All Samples	All Crises	Crisis08	Crisis11	Crisis13	Crisis11	Crisis20
Stock index & Gold	-1.3896%	-4.5285%	-2.3908%	-4.0205%	-3.7509%	-7.5976%	-3.3526%
Agriculture and food & Gold	-1.9308%	-3.1857%	-3.8888%	3.0168%	-3.7084%	-2.9455%	-6.7199%
Consumer products & Gold	0.7390%	0.7140%	0.3433%	1.3702%	0.6130%	0.6929%	1.3524%
Financials & Gold	-2.5588%	-4.9131%	-7.1746%	-3.5772%	-3.9855%	-5.7852%	-1.0741%
Industrials & Gold	-0.0111%	-0.6034%	2.6165%	0.7791%	1.5312%	-4.4329%	-5.0019%
Property and construction & Gold	-1.5987%	-4.9593%	-6.9258%	-2.4705%	-2.9853%	-6.9427%	-2.9745%
Resources & Gold	-0.4267%	-0.1116%	6.5804%	-3.7477%	1.8043%	-5.4632%	-2.5709%
Services & Gold	-0.8487%	-0.8861%	-2.2457%	1.4466%	-1.1067%	-1.2788%	2.0101%
Technology & Gold	-2.8892%	-4.6895%	-6.2891%	-5.4043%	-4.3175%	-4.5743%	-1.6383%

Panel B reports the averaged correlations of the stock market and industry returns with government bond returns.

Correlations	All Samples	All Crises	Crisis08	Crisis11	Crisis13	Crisis11	Crisis20
Stock index & Govt. bond	2.6446%	6.2210%	9.4344%	-8.5885%	14.2985%	3.8819%	-5.7881%
Agriculture and food & Govt. bond	0.9771%	1.1796%	1.5740%	0.5866%	1.7069%	1.0993%	-0.6496%
Consumer products & Govt. bond	3.8678%	4.0530%	4.2063%	3.2551%	4.1452%	3.9509%	4.4925%
Financials & Govt. bond	2.3524%	7.6962%	11.8280%	-8.0976%	17.2328%	2.9129%	-2.7984%
Industrials & Govt. bond	-0.9526%	-0.6536%	-0.2406%	-1.6610%	-0.3996%	-0.7410%	-1.2070%
Property and construction & Govt. bond	5.2136%	8.7391%	10.6265%	-3.3708%	15.8670%	6.2053%	0.9327%
Resources & Govt. bond	0.1975%	0.3134%	0.7688%	-0.6600%	0.3774%	0.3385%	-0.1061%
Services & Govt. bond	4.2630%	4.6519%	5.0726%	3.3248%	5.2176%	4.2675%	4.3010%
Technology & Govt. bond	5.2841%	6.3748%	6.6735%	4.1372%	8.6810%	5.7116%	2.4481%

Panel C reports the averaged correlations of the stock market and industry returns with corporate bond returns.

Correlations	All Samples	All Crises	Crisis08	Crisis11	Crisis13	Crisis11	Crisis20
Stock index & Corp. bond	0.6853%	6.0530%	8.7397%	-6.9185%	13.2160%	3.0560%	-1.5321%
Agriculture and food & Corp. bond	0.4699%	1.5867%	2.6074%	-0.7249%	2.9160%	0.7482%	-0.3228%
Consumer products & Corp. bond	-0.1178%	0.7346%	1.6433%	-1.9082%	1.3394%	0.5945%	-0.3652%
Financials & Corp. bond	0.9878%	8.2680%	14.0101%	-7.6727%	16.6821%	3.5023%	-2.4185%
Industrials & Corp. bond	-2.3635%	-1.7428%	-1.1003%	-2.7012%	-1.4780%	-1.9843%	-2.4659%
Property and construction & Corp. bond	2.7517%	7.8442%	9.3368%	-2.6131%	15.1447%	4.4672%	1.3712%
Resources & Corp. bond	-1.0960%	-0.9522%	-0.9335%	-2.5051%	0.0102%	-1.1486%	-1.9606%
Services & Corp. bond	1.1129%	1.6770%	2.2195%	0.6307%	2.2522%	1.2401%	0.8781%
Technology & Corp. bond	4.6712%	6.1685%	7.1904%	2.7308%	7.9552%	5.3920%	3.7104%

Table 3 reports the average daily correlations of the stock market and industry returns with gold and bond returns from the DCC-GARCH model. In Panel A, the result shows that stock–gold correlations are generally negative and become even more negative during crises and downturn periods, particularly during the stock market upheaval in 2015. This finding is consistent with the result illustrated in Figure 2, indicating gold as a hedge and a safe haven for stocks. Considering individual industries, the result suggests that the negative stock–gold correlations during stock market turmoil are mainly propelled by the property and construction, financials and technology industries, while the correlations of the other industries do not seem to change significantly from the full sample. In contrast, the result of the stock–bond correlations presented in Panels B and C downplay the role of both government and corporate bonds as a hedge and a safe haven for stocks since the correlations are, on average, slightly higher during the crises and downturns even though the correlations remain low, which may suggest that they still possess some diversification capability. Furthermore, the stock-bond correlations observed are inconsistent across crises. They are negative in the European debt crisis in 2011 and the Covid-19 pandemic in 2020, but they turn out to be positive in the other three crises and downturns. This result coincides with findings by Park, Zhongzhen, & Young (2019), who discovered that the stock–bond correlations are not homogenous across crises; the results are somewhat different across industries. Interestingly, the increasing stock–government and stock–corporate bond correlations during crises are more pronounced in the property and construction, financials and technology industries.

4.2. Hedging Stock Market and Industry Indexes Using Gold

In Table 4, Models 1, 2 and 3 report the result of stock–gold correlations estimated from Equations 8, 10 and 12, respectively.

Table 4. Stock market–gold correlations during crises and stock market downturns.

Variables	Model 1	Model 2	Model 3
α	0.0002 (1.3523)	0.0002 (1.0337)	0.0002 (1.2069)
β_0	-0.0147 (-0.7820)	-0.0096 (-0.4608)	-0.0096 (-0.4608)
β_1		-0.0293 (-0.3166)	
β_{11}			-0.1167 (-1.0896)
β_{12}			0.1857 (1.0255)
β_{13}			-0.0289 (-0.3807)
β_{14}			-0.2243 (-1.7836)*
β_{15}			0.0375 (0.2441)
a	0.0000 (2.12056)**	0.0000 (1.9583)*	0.0000 (2.2334)**
b_1	0.9414 (67.6156)***	0.9413 (46.7082)***	0.9419 (66.5136)***
b_2	0.0638 (3.7870)***	0.0640 (2.9551)***	0.0624 (3.9059)***
b_3	-0.0173 (-0.8929)	-0.0173 (-1.0241)	-0.0154 (-0.9122)

Notes: The *t*-statistics are reported in parenthesis. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

The β_0 coefficient in Model 1 is negative but insignificant. It suggests that, in general, the sensitivity or correlation between gold and the stock market is close to zero, indicating gold as a hedge for equities. Model 2

further investigates the impact of crises and market downturns on the correlations. The β_0 coefficient now captures the correlations in non-crisis periods, while β_1 captures an increase or decrease in the correlations caused by crises and downturns. The β_0 coefficient continues to be insignificantly negative. Similarly, β_1 is also insignificantly negative, which suggests that the flight-to-safety phenomenon between gold and stocks during crises and downturns does not generally or significantly exist in Thailand. However, when individual crises and downturns are examined, the results in Model 3 show that the stock market rout in 2015 (represented by β_{14}) is negatively significant at a 10% level. This finding suggests that the flight-to-safety phenomenon between stocks and gold was marginally observed in the 2015 downturn period where the stock–gold correlations became even more negative during the stock market distress.

Table 5 presents the results of the stock–gold correlations for individual industries. For brevity, only the results of Models 2 and 3 estimated from Equations 10 and 12, respectively, are reported.

Table 5. Stock market–gold correlations during crises and stock market downturns.

Industry	Variables	Model 2	Model 3	Industry	Variables	Model 2	Model 3
Agro&Food	β_0	-0.0157***	-0.0163***	Prop&Con	β_0	-0.0111	-0.0117
	β_1	-0.0259			β_1	-0.0280	
	β_{11}		-0.1176		β_{11}		-0.1168
	β_{12}		0.1896		β_{12}		0.1871
	β_{13}		-0.0252		β_{13}		-0.0254
	β_{14}		-0.2213**		β_{14}		-0.2233**
	β_{15}		0.0437		β_{15}		0.0393
Consumer	β_0	-0.0026	-0.0012	Resource	β_0	-0.0016	-0.0008
	β_1	-0.0378			β_1	-0.0372	
	β_{11}		-0.1259		β_{11}		-0.1252
	β_{12}		0.1765		β_{12}		0.1768
	β_{13}		-0.0383		β_{13}		-0.0380
	β_{14}		-0.2332**		β_{14}		-0.2329**
	β_{15}		-0.2332		β_{15}		0.0285
Finance	β_0	-0.0145	-0.0144	Service	β_0	-0.0140	-0.0151
	β_1	-0.0235			β_1	-0.0258	
	β_{11}		-0.1096		β_{11}		-0.1169
	β_{12}		0.1905		β_{12}		0.1891
	β_{13}		-0.0229		β_{13}		-0.0221
	β_{14}		-0.2195*		β_{14}		-0.2203*
	β_{15}		0.0429		β_{15}		0.0426
Industrials	β_0	-0.0037	-0.0045	Resource	β_0	-0.0142	-0.0140
	β_1	-0.0352			β_1	0.0271	
	β_{11}		-0.1221		β_{11}		-0.1162
	β_{12}		0.1824		β_{12}		0.1864
	β_{13}		-0.0351		β_{13}		-0.0222
	β_{14}		-0.2287*		β_{14}		-0.2227*
	β_{15}		0.0327		β_{15}		0.0374

Notes: The *t*-statistics are reported in parenthesis. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

The β_0 coefficient is insignificant for all industries except the agriculture and food industry, which reports a strong negative correlation at a 1% significance level in both Models 2 and 3. This suggests that the ability of gold in hedging stocks is more pronounced in the agriculture and food industry. Considering the impacts of crises and downturns on the correlations presented in Model 2, β_1 is not significant for all industries. However, when individual crises were investigated (see Model 3), β_{14}, which represents the 2015 downturn variable, is strongly negatively significant for four industries, namely agriculture and food, consumer products, property and construction and resources, whereas those of the other industries are also negatively significant but at a 10% level.

Therefore, the results presented in Tables 4 and 5 indicate that gold can serve as a hedge for the stock index and individual industries but the effects can vary to a certain extent across industries, as documented by Flavin & Lagoa-Varela (2019). Consistent with Park, Zhongzhen, & Young (2019), the flight-to-safe phenomenon, where the stock–gold correlations become even more negative, was only found to be significant in some crises.

4.3. Hedging Stock Market and Industry Indexes Using Government Bonds

Table 6 reports the result of stock–government bond correlations. The β_0 coefficient is significantly positive at a 10% level in all three models, implying that the stock market–government bond correlations are generally positive, albeit close to zero.

Table 6. Stock market–government bond correlations during crises and downturns.

Variables	Model 1	Model 2	Model 3
α	0.0002 (7.8532)***	0.0002 (7.8532)***	0.0002 (7.3132)***
β_0	0.0056 (1.9489)*	0.0042 (1.6508)*	0.0043 (1.6868)*
β_1		0.0274 (1.1625)	
β_{11}			-0.0126 (-0.6891)
β_{12}			-0.0104 (-0.8909)
β_{13}			0.0497 (2.1399)**
β_{14}			0.0117 (-0.7834)
β_{15}			-0.0590 (-1.7706)
a	0.0000 (2.4417)**	0.0000 (1.9857)**	0.0000 (2.9246)
b_1	0.6131 (6.8038)***	0.6359 (7.0485)***	0.6450 (9.1631)***
b_2	0.3522 (4.2564)***	0.3593 (4.4070)***	0.3392 (4.8325)**
b_3	0.0025 (0.3723)	0.00764 (0.1181)	0.0010 (0.1732)

Notes: The *t*-statistics are reported in parenthesis. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

The β_1 coefficient in Model 2 is insignificant, which suggests that the correlations do not significantly change during the crises and downturns. However, when individual crises and downturns are investigated in Model 3, the correlations are not affected by each individual crisis and downturn except in the political turmoil in 2013. The correlations in this crisis significantly increased by approximately 5%. This finding implies that government bonds provide less of a hedging effect, when such an effect is most needed, and clearly contradicts the findings in several prior studies (e.g., Baur & Lucey, 2009; Kim, Moshirian, & Wu, 2006; Skintzi, 2019) that support the presence of the flight-to-safety phenomenon between stocks and bonds. Nevertheless, the result is consistent with Ilmanen (2003), Yang, Zhou, & Wang (2009) and Park, Zhongzhen, & Young (2019) in that it shows increases in the stock–bond correlations in times of stock market turbulence as market players turn to consider bonds as equally risky as stocks.

Table 7 reports the results of stock–government bond correlations based on individual industries. The correlations in non-crisis periods, β_0, stay close to zero in all cases. The crisis variable in Model 2 is not significant, which indicates that, overall, the crises and downturns do not influence the correlations between industry and government bond returns.

Table 7. Industry–government bond correlations during crises and downturns.

Industry	Variables	Model 2	Model 3	Industry	Variables	Model 2	Model 3
Agro&Food	β_0	0.0013*	0.0014*	Prop&Con	β_0	0.0051*	0.0050*
	β_1	0.0309			β_1	0.0270	
	β_{11}		-0.0075		β_{11}		-0.0090
	β_{12}		-0.0067		β_{12}		-0.0094
	β_{13}		0.0534**		β_{13}		0.0496**
	β_{14}		0.0153		β_{14}		0.0132
	β_{15}		-0.0554*		β_{15}		-0.0572*
Consumer	β_0	0.0031	0.0038	Resource	β_0	0.0030	0.0037
	β_1	0.0305			β_1	0.0300	
	β_{11}		-0.0075		β_{11}		-0.0085
	β_{12}		-0.0073		β_{12}		-0.0088
	β_{13}		0.0532**		β_{13}		0.0530**
	β_{14}		0.0143		β_{14}		0.0126
	β_{15}		-0.0554		β_{15}		-0.0583
Finance	β_0	0.0027	0.0026	Service	β_0	0.0036	0.0037
	β_1	0.0295			β_1	0.0287	
	β_{11}		-0.0077		β_{11}		-0.0092
	β_{12}		-0.0082		β_{12}		-0.0083
	β_{13}		0.0519**		β_{13}		0.0510**
	β_{14}		0.0146		β_{14}		0.0137
	β_{15}		-0.0562*		β_{15}		-0.0571
Industrials	β_0	-0.0008	-0.0003	Tech	β_0	0.0042*	0.0043*
	β_1	0.0321			β_1	0.0275	
	β_{11}		-0.0073		β_{11}		-0.0126
	β_{12}		-0.0056		β_{12}		-0.0104
	β_{13}		0.0543**		β_{13}		0.0497**
	β_{14}		0.0163		β_{14}		0.0117
	β_{15}		-0.0545*		β_{15}		-0.0590*

Notes: The *t*-statistics are reported in parenthesis. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Table 8. Stock market–corporate bond correlations during crises and downturns.

Variables	Model 1	Model 2	Model 3
α	0.0002 (9.9334)***	0.0002 (9.1738)***	0.0002 (9.8911)***
β_0	0.0032 (1.3818)	0.0017 (0.9717)	0.0017 (0.7950)
β_1		0.0105 (0.9856)	
β_{11}			0.0041 (0.7136)
β_{12}			-0.0090 (1.0046)
β_{13}			0.0166 (1.8279)*
β_{14}			0.0066 (0.9077)
β_{15}			0.0138 (0.8776)
a	0.0000 (1.0624)	0.0000 (1.0145)	0.0000 (1.0381)
b_1	0.8784 (28.0203)***	0.8852 (26.6789)***	0.8864 (27.8383)***
b_2	0.1086 (3.2413)***	0.1099 (2.6635)***	0.1116 (3.1803)***
b_3	0.0059 (1.3729)	0.0044 (0.9445)	0.0038 (1.05817)

Notes: The *t*-statistics are reported in parenthesis. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

However, when individual crises and downturns are analyzed, the political turmoil in 2013 significantly increased the correlations in all industries. These results are also consistent the results previously reported in Table 6 suggesting less of a hedging ability of bonds during crises. Conversely, during the Covid-19 pandemic in 2020, the flight-to-safety phenomenon was only observed in some industries, including agriculture and food, industrials, property and construction and technology, which is consistent with findings by Park, Zhongzhen, & Young (2019). It suggests that the correlations are not stable across crises and can be unpredictable.

4.4. Hedging Stock Market and Industry Indexes Using Corporate Bonds

Table 8 reports the results of stock–corporate bond correlations. The results generally led to similar conclusions as the previous result on the stock–government bond correlations; the stock–corporate bond correlations stayed close to zero. Crises and downturns did not tend to affect the correlations except during the political turmoil in 2013. This crisis increased the correlations by 1.66% at a 10% significance level.

Table 9 reports the results of stock–corporate bond correlations based on individual industries. Consistent with the results of the overall market, the correlations in non-crisis periods were not significantly different from zero in all cases. Only the political turmoil in 2013 saw significantly enlarged correlations in every industry except technology.

Table 9. Industry–corporate bond correlations during crises and downturns.

Industry	Variables	Model 2	Model 3	Industry	Variables	Model 2	Model 3
Agro&Food	β_0	0.0001	-0.0001	Prop&Con	β_0	0.0014	0.0016
	β_1	0.0122			β_1	0.0115	
	β_{11}		0.0059		β_{11}		0.0047
	β_{12}		-0.0073		β_{12}		-0.0084
	β_{13}		0.0181**		β_{13}		0.0172*
	β_{14}		0.0085		β_{14}		0.0072
	β_{15}		-0.0191		β_{15}		0.0147
Consumer	β_0	-0.0051	-0.0044	Resource	β_0	-0.0001	0.0012
	β_1	0.0128			β_1	0.0122	
	β_{11}		0.0069		β_{11}		0.0057
	β_{12}		-0.0053		β_{12}		-0.0074
	β_{13}		0.0191**		β_{13}		0.0182**
	β_{14}		0.0107		β_{14}		0.0082
	β_{15}		0.0153		β_{15}		0.0154
Finance	β_0	-0.0006	-0.0003	Service	β_0	-0.0021	-0.0017
	β_1	0.0125			β_1	0.0131	
	β_{11}		0.0061		β_{11}		0.0068
	β_{12}		-0.0071		β_{12}		-0.0061
	β_{13}		0.0184**		β_{13}		0.0193**
	β_{14}		0.0085		β_{14}		0.0096
	β_{15}		0.0156		β_{15}		0.0161
Industrials	β_0	-0.0019	-0.0015	Tech	β_0	0.0017	0.0017
	β_1	0.0130			β_1	0.0105	
	β_{11}		0.0068		β_{11}		0.0041
	β_{12}		-0.0059		β_{12}		-0.0090
	β_{13}		0.0188**		β_{13}		0.0166
	β_{14}		0.0098		β_{14}		0.0066
	β_{15}		0.0158		β_{15}		0.0138

Notes: The *t*-statistics are reported in parenthesis. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

5. CONCLUSION

This paper examined whether gold and bonds can serve as a hedge or a safe haven asset for stocks during crises and stock market downturns in Thailand. First, in comparison to bonds, gold provides a better hedge for stocks since stock–gold correlations are predominantly negative. Meanwhile, despite boasting positive correlations on average, the relationships between stocks and bonds often stay close to zero. Second, gold can act as a safe haven for stocks during stock market turmoil although this finding was only observed in some crises. Stock–bond correlations, on the other hand, increased slightly in some crises suggesting that bonds provide less hedging protection to stocks when it is most needed. This striking finding is also consistent with the results when individual industries were analyzed. More importantly, it contradicts a common belief that bonds are a safe haven for stocks. A possible explanation for this discovery is that since stocks and bonds share similar sources of companies' cash flows, bonds are viewed as risky as stocks in times of extreme market volatility and hence market players treat them as one and the same. Finally, the correlations were not stable across crises and industries of stocks investigated.

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