

Does Bond Market Development impact the Flight-to-
Quality from Stock to Bond during COVID-19?



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ผลกระทบของระดับการพัฒนาของตลาดตราสารหนี้ต่อ Flight-to-Quality จากหุ้นสู่หุ้นกู้
ในช่วง COVID-19



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This paper analyzed flight to quality effect from stocks to government bonds in 46 countries including developed and emerging countries during COVID pandemic. The empirical result from panel data framework shows that the flights exist and government bonds remain offered diversification benefit to investors when they are most needed. The negative stock-bond correlation was also amplified when pandemic is more severe in developed countries. Moreover, this study reveals that countries with a higher degree of bond market development can support bonds act as a safe haven better and have more negative in stock-bond correlation.



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1. Introduction

The major motive for investing in multiple assets is to protect investment returns from a single asset's poor performance. A diversified portfolio must include a variety of investments, such as equities, commodities, fixed income, or mutual funds. This approach requires distributing total capital around so that the exposure to any specific asset is limited. Diversification is understood as not guaranteeing against loss, but it is a crucial component of achieving long-term diversification goals (Ahmad et al., 2022). Such goal of the diversification is to reduce the risk of a loss, especially the loss that occur during the crisis. The decrease of correlations across different asset classes in crisis time creates benefit of the asset diversification in portfolio (Hunter & Simon, 2004). The phenomenon that one asset's price increase during crisis and make partially compensation from the loss in stock market is called "Flight-to-Quality" (Baur & Lucey, 2009; Brière et al., 2012; Hartmann et al., 2001)

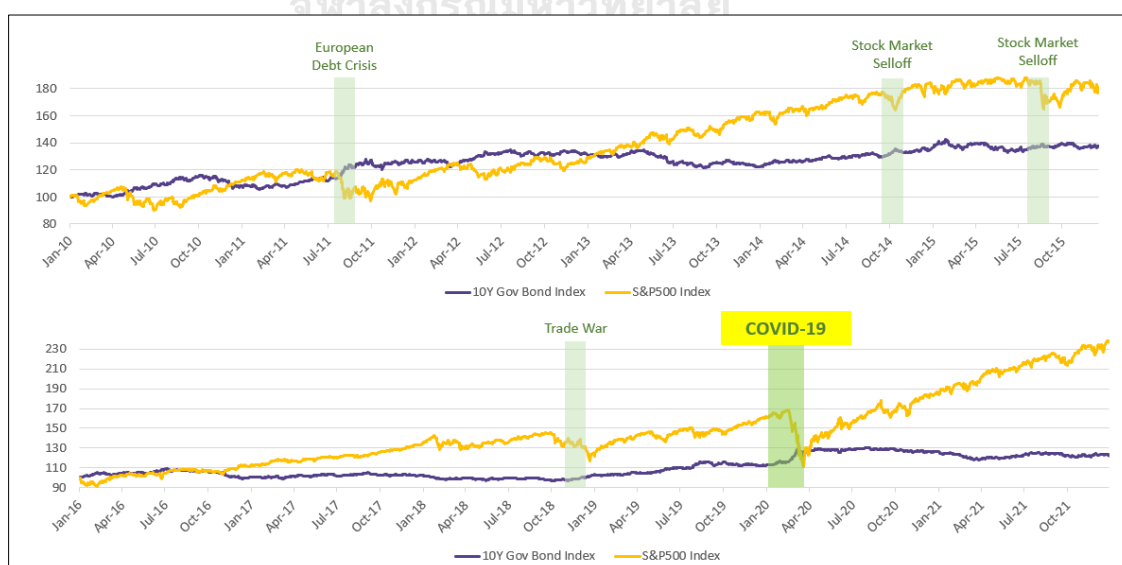
Stocks and bonds are the two most common asset classes that experience a flight to quality event. During the financial downturn, the stock market crashes and experiences tremendous volatility. Investors will shift away from risky assets like equities to other assets with a lower correlation to equities (Mustafa et al., 2015). This is particularly the case for correlations between stocks and bonds.

Due to the risk-off sentiment in the period of financial turmoil, Government bonds tend to rally during stock market crashes. During typical economic times, when investors feel enthusiastic about the future economy, they are more likely to increase their stock and bond holdings in their portfolios, contributes to a positive correlation between these two financial assets. On the contrary, when investors feel worried for

the future of the economy, they may be selling their stock convert to a bond which is a safer asset, leading to a lower (or even negative) correlation between stocks and bonds. This flight-to-quality from stock to bond has the potential to increase the stability and resiliency of the financial system, as it eases the potential losses that investors suffer in crises periods(Baur & Lucey, 2009; McMillan, 2019).

The daily rebased time-series of the US stocks index and the 10-year US government bond index are depicted in Figure 1. The stock market fell during the European debt crisis in 2011, the stock market selloff in 2014 and 2015, the event that market participants were concerned about a trade war towards the end of 2018, and the COVID outbreak in 2020. The S&P 500 index dropped, but the 10-year US government bond index rose. This chart depicts the negative direction movement between stocks and bonds during crises, indicating that investors may be shifting their capital from stocks to bonds.

Figure 1. Performance of US stocks index and 10-year US government bond index



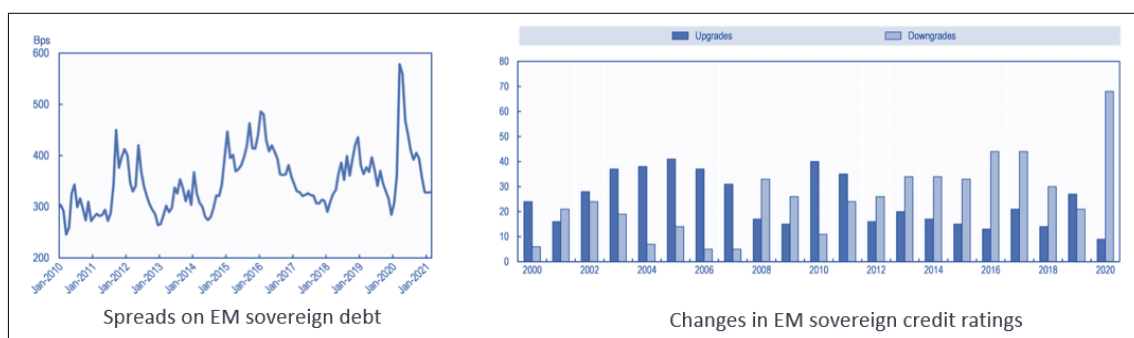
The emergence of COVID-19, which was declared a global epidemic by the World Health Organization (WHO) on March 11th, 2020, has been a typical serious public health issue since the beginning of 2020. It has not only caused a public health problem, but it has also had a significant impact on the worldwide financial market. During the outbreak, the return level of stocks and bonds fluctuated dramatically reflecting market participants' confidence. This was due to concern about what would happen between COVID-19 and also its ending. Therefore, the most obvious concern for governments to tackle is how to enhance market confidence and economic growth pace(Liu et al., 2022).

Fiscal and monetary policies are two significant macroeconomic control tools that have been utilized around the world to impact economic and financial market volatility. However, changes in policy can probably increase uncertainty about the outcomes of interventions, leading to higher market volatility. Although the government's initiatives are intended to improve healthcare outcomes while lowering COVID-19's economic and social costs, this goal is often not realized. Particularly in emerging countries, where citizens have less trust in the government(Papadamou et al., 2021; Zaremba et al., 2021).

Despite the fact that many studies have been done on the market's flight to quality effect, the majority of them have focused on developed countries and found that markets have a flight-to-quality effect during the crisis.(Baur & Lucey, 2009; Brière et al., 2012; Papadamou et al., 2021). On the other hand, some research based on emerging market data discovered that during the crisis, investors did not shift their capital from stocks to bonds(Mustafa et al., 2015; Pisedtasalasai, 2021). This is owing

to the government's trust, as well as the fact that market players have alternative assets to invest in.

Figure 2. Spreads on Emerging Sovereign Debt and Changes in Emerging Sovereign Credit Rating



COVID pandemic hit the economy differentially between developed and emerging country. Governments have taken a various action to fight with the COVID-19 outbreak, which, when included with decreasing tax revenue, has resulted in an increasing of sovereign borrowing demands. While most advanced economies enjoyed very low interest rates and high demand for government debt, many emerging nations confronted the COVID-19 crisis with massive levels of public debt as well as the necessity to refinance existing debt at high interest rates.

The onset of the COVID-19 problem coincided with a major decline in investor sentiment and risk appetite, resulting in a sudden reversal of capital flows. The cost of borrowing for emerging sovereigns skyrocketed in March and April 2020. As illustrated in Figure 2, an unusually significant number of emerging countries were downgraded in 2020, showing a surge in risk perception associated with investing in

emerging debt. This, in turn, has a particularly negative impact on countries with limited access to deep and liquid local currency bond markets.

The stage of bond market development in each country is one of the factors that causes the results to differ between developed and emerging countries. More developments in bond market are more resilient because the market has more liquidity and efficiency. Bonds can fully function as a safe haven investment, reducing the chance of an investor losing funds in case of a bearish market. While the lack of development in bond market can create an adverse impact.



2. Literature Review and Hypothesis

2.1 Literature Review

The co-movement between stock and bond is considerably studied in existing literatures. The earliest study (Keim & Stambaugh, 1986), the first investigation paper on this relationship, found that there has a seasonality in changing correlation between stock and other assets but such seasonality is unlikely to explain. Most of literatures focus on stock return and government bond return in developed countries while less attention has been given to emerging countries or comparative study. Most results of studies based on advanced economies show that flight-to-quality behavior is existed which mean the correlations between stock and bond become lower or even change from positive to negative during the financial distortions (Asgharian et al., 2015; Brière et al., 2012; Ciner et al., 2013; Ilmanen, 2003)

However, the disparity in each country's bond market development is enormous and might have a significant impact. Bond markets that are more developed are more resilient because they offer more benefit from risk diversification. This is due to the fact that bonds can function as a safe haven investment, minimizing an investor's exposure to losses in the case of a bear market. While a lack of well-functioning bond markets, due to a lack of liquidity and efficiency, may have a negative influence. Therefore, the deeper develop in bond market, could decrease the vulnerability of economy when crisis hit. (Bhattacharyay, 2013; Hakansson, 1999; Herring & Chatusripitak, 2000; Smaoui et al., 2017)

Some of literatures study based on the data from emerging country which define as a low level of bond market development. (Mustafa et al., 2015) tested flight-

to-quality effect in Malaysia between stock and several types of bonds. They found that the flight effect is existed when stock market is in turmoil but investors did not shift their capital from stock to government bond. The flight-to-quality effect occurred between stock and corporate bond Islamic the most then stock and corporate bond conventional thereafter. It is because government bond in Malaysia involved the government policy intervention in market and the amount of bond is huge amount to compare with corporate bond.

(Pisedtasalasai, 2021), a study based on Thai data, examined the dynamic stock-gold and stock-bond correlations at the industry level in depth, as well as the impact of individual crises. He concluded that gold can generally function as a safe haven for both stock market and industry indexes during some financial collapses, but bonds give less hedging protection. In fact, during some crises, the relationship between bonds and equities can even strengthen. This conclusion defies popular perception that bonds are a safe haven for stock investors. One reason for this finding is that, since stocks and bonds are both sources of cash flow for corporations, bonds are considered as just as risky as stocks during periods of high market volatility, and market participants consider them as being the same.

To testing for flight-to-quality, some literatures analyze the change in the level of correlation between stock and bond by using the basic model estimated in panel data framework. The model from (Papadamou et al., 2021) is shown as follow:

$$r_{i,b,t} = \alpha + \beta \cdot r_{i,s,t} + \gamma \cdot r_{i,s,t} \cdot r_{i,case,t} + \delta \cdot r_{i,s,t} \cdot r_{i,case,t-1} + \varepsilon_{i,t}$$

$r_{i,b,t}$ = the government bond return for country i in day t

$r_{i,s,t}$ = the stock index return for country i in day t

$r_{i,case,t}$ = the daily logarithmic change in COVID-19 cases in country i in day t

The level of stock–bond correlation in a crisis period is given by the sum of the parameters β , γ and δ . If γ and/ or δ are significantly negative, then there is a negative change of the stock–bond correlation during the COVID outbreak compared to the normal correlation given by β . If the sum of β and γ is negative, there is flight-to-quality from stocks to bonds, since during the global pandemic crisis stock markets plummeted. Conversely, if γ and/ or δ are significantly positive and the sum of β and γ is also positive, then there is cross-asset contagion between stocks and bonds (Baur & Lucey, 2009)

The contribution of this paper is to test whether the level of bond market development enhance flight-to-quality effect. If the high stage of bond market development makes it easier for bonds to operate as a safe haven investment or enhances the flight effect, this finding will help policymakers plan to really expand the local bond market to improve the country's investment environment. For the measurement of the level of bond market development, many studies measured by the total amount of domestic sovereign and corporate debt securities as a share of GDP. This ratio can reveal the adequacy of a country's bond market to the size of its economy (Bhattacharyay, 2013; Smaoui et al., 2017). Furthermore, given the nations' capacities to handle the problem in this COVID outbreak differ, this study will focus on a comparative study of the flight effect between developed and emerging countries.

2.2 Hypothesis

COVID outbreak has had a never-before-seen impact on the economies especially in emerging countries where governments have a poor reputation for tackling the problem and reviving the economy. Several emerging economies experienced the COVID-19 problem with huge public debt and the need to refinance current debt at exorbitant rates. Many countries were downgraded, causing investors to lose trust in government bonds. Market players may keep cash or seek out an alternate asset to protect themselves from a stock market turmoil. This led to the first hypothesis:

Hypothesis 1: In this COVID-19 pandemic, there is no flight to quality from stocks to government bonds in emerging countries, but it does occur in developed countries.

In terms of risk diversification, more developed bond markets are advantageous. This is related to the reasons that bond returns are typically negatively correlated or non-correlated with stocks, lowering aggregate portfolio variances and allowing investors to reduce liquidity risk. Bonds can adequately serve as a safe haven investment to lower the chance of a loss during an epidemic if the bond market is more resilient, which means it has more liquidity and efficiency (McMillan, 2019; Smaoui et al., 2017). This led to the second hypothesis:

Hypothesis 2: The high degree of bond market development enhances the flight-to-quality effect.

3. Data and Methodology

3.1 Data

This study examined daily stock indexes, bond indexes, COVID confirmed cases, and yearly data on government outstanding debt and Gross Domestic Product (GDP) of 46 nations from January 1st, 2010 to December 31st, 2021. Table 1 lists the variables that were used in this study.

Table 1. Variable Lists

Variable	Notation	Description	Frequency	Source
Government bond return	$r_{i,b,t}$	The 10 years government bond index return for country i in day t	Daily	Bloomberg
Stock return	$r_{i,s,t}$	The stock index total return for country i in day t	Daily	Bloomberg
90 th and above percentile of the change in the cumulative number of COVID confirmed cases	$CASE_{i,t}$	Dummy variable which is one if the cumulative number of COVID confirmed cases' percent change is in the 90th or higher percentile rank.	Daily	Oxford
Covid Period	$COVID_t$	Dummy variable which is one if t is in a COVID period and zero otherwise	-	WHO
Emerging Country	EM_i	Dummy variable which is one if i is an	-	Bloomberg

		emerging country and zero otherwise		
Level of bond market development	LBD_i	Dummy variable which is one if i is a country in the defined quartile and zero otherwise	Yearly	Bloomberg

The countries are divided into two categories. First, developed countries which include Austria, Australia, Belgium, Canada, Denmark, United Kingdom, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Singapore, Spain, Sweden, Switzerland, and United States. Second, emerging countries which include Bulgaria, Brazil, China, Chile, Czech Republic, Hungary, Indonesia, India, Latvia, Lithuania, Malaysia, Mexico, Poland, Peru, Philippines, Romania, Russia, South Africa, South Korea, Taiwan, Thailand, and Turkey.

The mean and standard deviation of annualized daily return on stocks and bonds with a maturity of 10 years is shown in Table 2.

10 years government bond: all sample period

Developed Country	Annualized Daily Return	Standard Deviation
Austria	-9.68%	27.13%
Australia	-9.83%	41.56%

Emerging Country	Annualized Daily Return	Standard Deviation
Bulgaria	-16.48%	72.83%
Brazil	-1.47%	20.30%

Belgium	-9.33%	26.78%	China	-2.18%	12.27%
Canada	-7.51%	46.91%	Chile	-2.45%	25.64%
Denmark	-8.58%	25.96%	Czech Republic	-2.53%	47.73%
United Kingdom	-11.46%	84.04%	Hungary	-4.64%	33.99%
Finland	-9.43%	28.08%	Indonesia	-3.67%	16.10%
France	-9.07%	26.82%	India	-1.31%	10.43%
Germany	-9.19%	26.24%	Latvia	-7.72%	16.94%
Greece	-11.80%	53.63%	Lithuania	-11.61%	30.24%
Hong Kong	-5.77%	47.90%	Malaysia	-1.43%	15.68%
Iceland	-4.55%	17.31%	Mexico	0.06%	14.26%
Ireland	-11.00%	31.49%	Poland	-4.30%	29.24%
Italy	-9.88%	64.22%	Peru	0.04%	21.04%
Japan	-5.29%	17.01%	Philippines	-7.15%	18.20%
Netherlands	-9.44%	25.92%	Romania	-2.96%	16.66%
Norway	-7.09%	41.12%	Russia	1.40%	17.34%
New Zealand	-7.18%	38.67%	South Africa	0.55%	13.86%
Portugal	-9.81%	32.96%	South Korea	-6.46%	26.36%
Singapore	-3.88%	33.44%	Taiwan	-5.94%	31.07%

Spain	-9.28%	31.13%
Sweden	-8.23%	25.96%
Switzerland	-5.70%	21.85%
United States	-7.52%	47.86%

Thailand	-6.20%	27.09%
Turkey	2.68%	26.24%

Stock Index (TRI): all sample period

Developed Country	Annualized Daily Return	Standard Deviation
Austria	6.27%	21.14%
Australia	7.48%	15.32%
Belgium	7.79%	18.30%
Canada	6.90%	14.60%
Denmark	13.71%	17.57%
United Kingdom	5.66%	15.97%
Finland	9.75%	18.40%
France	8.13%	20.17%
Germany	7.96%	19.84%
Greece	-5.05%	31.74%

Emerging Country	Annualized Daily Return	Standard Deviation
Bulgaria	5.74%	10.76%
Brazil	5.77%	23.14%
China	2.60%	22.05%
Chile	1.47%	17.44%
Czech Republic	6.40%	15.89%
Hungary	7.20%	19.71%
Indonesia	7.78%	16.85%
India	10.99%	16.93%
Latvia	12.16%	16.92%
Lithuania	10.54%	11.41%

Hong Kong	3.83%	18.22%	Malaysia	1.58%	10.14%
Iceland	13.49%	13.62%	Mexico	4.02%	15.19%
Ireland	8.40%	19.21%	Poland	4.52%	16.85%
Italy	3.92%	24.44%	Peru	3.23%	18.64%
Japan	9.90%	20.38%	Philippines	-0.23%	22.95%
Netherlands	9.19%	18.56%	Romania	14.23%	15.43%
Norway	9.22%	17.70%	Russia	8.32%	19.44%
New Zealand	8.07%	10.26%	South Africa	10.85%	16.53%
Portugal	-3.27%	19.42%	South Korea	4.90%	16.97%
Singapore	3.93%	13.27%	Taiwan	8.46%	13.37%
Spain	1.89%	22.52%	Thailand	9.87%	16.08%
Sweden	20.77%	148.42%	Turkey	12.79%	22.64%
Switzerland	8.59%	15.28%			
United States	13.68%	16.93%			

3.2 Methodology

Since the data is in the form of panel data and the purpose is a correlation test, Pooled OLS is a model to apply in this paper.

3.2.1 To test whether it has flight to quality effect during COVID pandemic or not.

To examine the changes in the level of stock-bond correlation, this study applies the basic model estimated in panel data as follow(Baur & Lucey, 2009; Papadamou et al., 2021):

$$r_{i,b,t} = \beta_0 + \beta_1 \cdot r_{i,s,t} + \beta_2 \cdot r_{i,s,t} \cdot COVID_t + \beta_3 \cdot r_{i,s,t} \cdot COVID_t \cdot EM_i + \varepsilon_{i,t} \quad (\text{Eq.1})$$

Where:

- $r_{i,b,t}$ = 10 years government bond index return for country i in day t
- $r_{i,s,t}$ = Stock index total return for country i in day t
- $COVID_t$ = Dummy variable which equal to one if t is in a COVID period and zero otherwise
- EM_i = Dummy variable which equal to one if i is an emerging country and zero otherwise

According to earlier research, in times of extreme stock market volatility, huge negative stock return situations, and crises, there was a flight to quality effect(Baur & Lucey, 2009; Baur & Mcdermott, 2010; Pisedtasalasai, 2021). To identify the appropriate time frame of COVID period for dummy variable, this study will not specify a long COVID period.

Since the COVID outbreak has lasted almost over two years and is still ongoing, only anything new about this outbreak elicits a reaction from market

participants. Referred to existing study that assumed a crisis length of 1 month (Baur & Lucey, 2009), this approach sets COVID pandemic periods to be 2 weeks before and 2 weeks after the World Health Organization (WHO) declared COVID-19 a pandemic and reported on a new variant classification. Five periods of COVID are identified in Table 3.

Table 3. Periods of COVID

Covid Variant	Earliest Documented Samples	Date of Designation	Covid Period of Data Used in this Study
Covid-19	Multiple countries	Mar 11th, 2020	Feb 26th, 2020 to Mar 25th, 2020
Alpha, Beta	United Kingdom, South Africa	Dec 18th, 2020	Dec 3rd, 2020 to Jan 2nd, 2021
Gamma	Brazil	Jan 11th, 2021	Dec 27th, 2020 to Jan 26th, 2021
Delta	India	May 11th, 2021	Apr 26th, 2021 to May 26th, 2021
Omicron	Multiple countries	Nov 26th, 2021	Nov 11th, 2021 to Dec 11th, 2021

The interpretation of coefficients in Eq.1 is shown in Table 4.

Table 4. Coefficient Interpretation of Eq.1

β_1	β_2	β_3	$\beta_2 + \beta_3$	Description
+	+	+	+	Bonds and stocks have a positive correlation During the COVID: the positive correlation was amplified in both developed and emerging countries
+	+	-	+	Bonds and stocks have a positive correlation During the COVID: the positive correlation was amplified in developed countries. For emerging countries, the positive correlation also be amplified but lower degree.
+	+	-	-	Bonds and stocks have a positive correlation During the COVID: the positive correlation was amplified in developed countries. However, there has a flight to quality effect in emerging countries.
+	-	+	+	Bonds and stocks have a positive correlation During the COVID: there has a flight to quality effect in developed countries. However, the positive correlation was amplified in emerging countries.
+	-	+	-	Bonds and stocks have a positive correlation During the COVID: there has a flight to quality effect in both developed and emerging countries. The flight to quality effect is more severe in developed countries.
+	-	-	-	Bonds and stocks have a positive correlation During the COVID: there has a flight to quality effect in both

				developed and emerging countries. The flight to quality effect is more severe in emerging countries.
-	+	+	+	Bonds and stocks have a negative correlation During the COVID: bonds and stocks tended to move in the same direction in both developed and emerging countries.
-	+	-	+	Bonds and stocks have a negative correlation During the COVID: bonds and stocks tended to move in the same direction in both developed and emerging countries.
-	+	-	-	Bonds and stocks have a negative correlation During the COVID: there has a flight to quality effect in emerging countries. However, bonds and stocks tended to move in the same direction in developed countries.
-	-	+	+	Bonds and stocks have a negative correlation During the COVID: there has a flight to quality effect in developed countries. However, bonds and stocks tended to move in the same direction in emerging countries.
-	-	+	-	Bonds and stocks have a negative correlation During the COVID: there has a flight to quality effect in both developed and emerging countries. The flight to quality effect is more severe in developed countries.
-	-	-	-	Bonds and stocks have a negative correlation During the COVID: there has a flight to quality effect in both developed and emerging countries. The flight to quality effect is

				more severe in emerging countries.
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Furthermore, if there is a flight to quality effect in this COVID pandemic, whether in developed or emerging countries, this study specifically looked into the effects of severity of the pandemic on this flight to quality effect. This study uses the percent change in the accumulation of COVID confirmed cases to measure the pandemic's severity. However, the attention should only be on COVID's intense severity. Then, this study divides the percent change in the accumulation of COVID confirmed cases into percentile rank and use dummy variable to capture only 90th percentile and above.

The following is the model which is used to test for this impact:

$$r_{i,b,t} = \beta_0 + \beta_1 \cdot r_{i,s,t} + \beta_2 \cdot r_{i,s,t} \cdot CASE_{i,t} + \beta_3 \cdot r_{i,s,t} \cdot CASE_{i,t} \cdot EM_i + \varepsilon_{i,t}$$

(Eq.2)

Where: $r_{i,b,t}$ = 10 years government bond index return for country i in day t

$r_{i,s,t}$ = Stock index total return for country i in day t

$CASE_{i,t}$ = Dummy variable which is one if the cumulative number of COVID confirmed cases' percent change is in the 90th or higher percentile rank

EM_i = Dummy variable which equal to one if i is an emerging country and zero otherwise

If the β_2 is negative, it means that there has a flight to quality effect in developed countries when COVID is severe. For emerging countries, if the $\beta_2 + \beta_3$ is negative, it means that there has a flight to quality effect in developed countries when COVID is severe.

3.2.2 To test the impact of the level of bond market development on flight to quality effect

To test the impact of bond market developments' degree on the flight effect, the model measures the level of bond market development in each country by using total amount of government securities as a share of GDP. Due to fluctuation of GDP, this study divides level of bond market development in each country into 4 groups. The dummy variable LBD1 equals 1 for countries in the first quartile, which are the group with the lowest degree of development in the bond market, otherwise LBD1 equals 0. Countries in the next quartile have a higher degree of bond market development and countries in the fourth quartile have a highest bond market development.

To avoid multicollinearity, this study adds only 3 dummy variables to separate the group of 4 quartiles. The model is constructed as follow:

$$r_{i,b,t} = \beta_0 + \beta_1 \cdot r_{i,s,t} + \beta_2 \cdot r_{i,s,t} \cdot CASE_{i,t} + \beta_3 \cdot r_{i,s,t} \cdot CASE_{i,t} \cdot LBD1 + \beta_4 \cdot r_{i,s,t} \cdot CASE_{i,t} \cdot LBD2 + \beta_5 \cdot r_{i,s,t} \cdot CASE_{i,t} \cdot LBD3 + \varepsilon_{i,t}$$

(Eq.3)

Where: $r_{i,b,t}$ = 10 years government bond index return for country i in day t

$r_{i,s,t}$ = Stock index total return for country i in day t

$CASE_{i,t}$ = Dummy variable which is one if the cumulative number of COVID confirmed cases' percent change is in the 90th or higher percentile rank

LBD1 = Dummy variable which equal to one if the country is in the first quartile and zero otherwise

LBD2 = Dummy variable which equal to one if the country is in the second quartile and zero otherwise

LBD3 = Dummy variable which equal to one if the country is in the third quartile and zero otherwise

If the higher degree of bond market development can support bond to fully function as a safe heaven and enhance the flight to quality effect, the β_2 that represent the impact of countries in the fourth quartile should be lowest and the relation of coefficients should be:

Flight effect of countries
in fourth quartile

Flight effect of countries
in second quartile

$$[\beta_2] < [\beta_2 + \beta_5] < [\beta_2 + \beta_4] < [\beta_2 + \beta_3]$$

Flight effect of countries
in third quartile

Flight effect of countries
in first quartile

4. Empirical Results

4.1 To test whether it has flight to quality effect

This study applies a panel data framework to investigate stock-bond correlations before and during the crisis era in order to test the flight to quality hypothesis.

Table 5. Estimation results for Eq. 1

VARIABLES	$r_{i,b,t}$
$r_{i,s,t}$	-0.000806 (-0.27)
$r_{i,s,t} \cdot COVID_t$	-0.0740** (-2.01)
$r_{i,s,t} \cdot COVID_t \cdot EM_i$	-0.0514 (-0.66)
Constant	-0.000251*** (-4.40)
Observations	143,610
R-squared	0.001

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Eq. 1's estimation results are shown in Table 5. The β_1 coefficient is slightly negative but not statistically significant, showing that there is almost no correlation between stocks and government bonds in general. The β_2 is significantly negative, implying that the correlation between stock and bond starts to be lower over the COVID outbreak in developed countries. The β_3 is negative but insignificant, indicating that during the COVID period, there was no meaningful difference in stock-bond correlation between developed and emerging countries.

For hypothesis 1, β_2 captures the change in correlation between stock and government bond in developed countries when COVID occurred. While summation of β_2 and β_3 captures the change in correlation between stock and government bond in emerging countries in the same period. Then the null hypothesis, alternative hypothesis and result are shown as follow;

Hypothesis 1.1: In this COVID-19 pandemic, there is no flight to quality from stocks to government bonds in emerging countries.

$$H_0: \beta_2 + \beta_3 \leq 0 \text{ VS } H_1: \beta_2 + \beta_3 > 0$$

$$P\text{-value} = 0.9657$$

Hypothesis 1.2: In this COVID-19 pandemic, there has flight to quality from stocks to government bonds in developed countries.

$$H_0: \beta_2 \geq 0 \text{ VS } H_1: \beta_2 < 0$$

$$P\text{-value} = 0.0221$$

The null hypothesis of hypothesis 1.1 cannot be rejected, with p-value 0.9657, implying that there is no statistical evidence that a flight to quality effect does not

exist in emerging countries during COVID. This outcome contradicts the hypothesis of this paper, mean that government bonds remain a safe haven for the stock market in emerging countries. One explanation could be that while confidence in emerging-market governments is fading, government bonds remain a liquid and easy-to-invest asset. Another possibility is that this paper use panel data framework to investigate the flight to quality effect. Some emerging countries may have a high level of government trust or a limited selection of assets to invest in on the financial market. As a result, government bonds would then remain a secure asset to invest in.

The null hypothesis of hypothesis 1.2 is rejected, with p-value 0.0221, implying that there has a flight to quality effect in developed countries in this COVID period. This research shows that throughout the outbreak, government bonds tended to rally as the stock market plummeted. Government bonds in developed countries still provide investors with a diversification benefit at a time when they need it most.

Due to the high p-value of hypothesis testing, this research investigates whether the flight to quality effect exists in emerging countries.

$$H_0: \beta_2 + \beta_3 \geq 0 \text{ VS } H_1: \beta_2 + \beta_3 < 0$$

$$P\text{-value} = 0.0343$$

The result shows that there has a flight to quality effect during COVID in emerging countries with p-value 0.0343. All results from Eq.1 indicate that government bonds function as a safe haven asset for investors by making partially compensation from the loss in stock market during the outbreak. There has a flight to quality effect from stock to government bond in both developed and emerging countries during COVID pandemic.

Furthermore, this paper investigates more on the sensitivity of the flight to the quality effect and the intensity of the COVID outbreak. In Eq. 2, the severity of the pandemic is measured by the growing rate of COVID confirmed cases in each country. However, only the extreme severity of COVID should be the focus. The percentage change in the total number of COVID confirmed cases is then divided into percentile rank in this study and uses a dummy variable to capture only data from the 90th percentile and higher.

Table 6. Estimation results for Eq. 2

VARIABLES	$r_{i,b,t}$
$r_{i,s,t}$	-0.0050208* (-1.69)
$r_{i,s,t} \cdot CASE_{i,t}$	-0.1550942* (-1.83)
$r_{i,s,t} \cdot CASE_{i,t} \cdot EM_i$	0.071416 (0.62)
Constant	-0.0002477*** (-4.36)
Observations	143,610
R-squared	0.001

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

If flight to quality effect is occurred when COVID is severe, this can be hypothesized as

For developed countries; $H_0: \beta_2 \geq 0$ VS $H_1: \beta_2 < 0$

P-value = 0.0334

For emerging countries; $H_0: \beta_2 + \beta_3 \geq 0$ VS $H_1: \beta_2 + \beta_3 < 0$

P-value = 0.1449

From the result, flight to quality effect was occurred when COVID is severe in developed countries. The intensity of the pandemic influenced market participants in developed countries on their investment decision. In emerging countries, however, the severity of COVID is no obvious impact on the flight to quality effect. Possible cause is that the market is lacking in information. The number of COVID confirmed cases released may be delayed or unreliable, particularly in emerging countries where medical and technological advancements lag behind developed countries. As a result, investors may have lost faith in the number and will not respond to it.

4.2 To test the impact of the level of bond market development on flight to quality effect

The level of bond market development in each country is measured by using total amount of government securities as a share of GDP. This method divides bond market development into four quartiles, with the first quartile comprising the lowest level of bond market development and the fourth quartile containing the most.

Table 7. Estimation results for Eq. 3

VARIABLES	$r_{i,b,t}$
$r_{i,s,t}$	-0.0050202* (-1.69)
$r_{i,s,t} \cdot CASE_{i,t}$	-0.2009705 (-1.45)
$r_{i,s,t} \cdot CASE_{i,t} \cdot LBD1$	0.0448217 (0.26)
$r_{i,s,t} \cdot CASE_{i,t} \cdot LBD2$	0.0264826 (0.13)
$r_{i,s,t} \cdot CASE_{i,t} \cdot LBD3$	0.2095694 (1.34)
Constant	-0.0002483*** (-4.37)
Observations	143,610
R-squared	0.001

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

For hypothesis 2, if a greater degree of bond market development can boost the flight to quality effect, the hypothesis can be written as follows:

$$H_0: \beta_3 \leq \beta_4 \leq \beta_5 \leq 0$$

$$H_1: 0 < \beta_5 < \beta_4 < \beta_3$$

Table 8. Hypothesis 2 testing

Comparison of countries in	Null Hypothesis	Alternative Hypothesis	P-value
3 rd and 4 th quartile	$\beta_5 \leq 0$	$\beta_5 > 0$	0.0909
2 nd and 3 rd quartile	$\beta_5 - \beta_4 \geq 0$	$\beta_5 - \beta_4 < 0$	0.8747
1 st and 2 nd quartile	$\beta_4 - \beta_3 \geq 0$	$\beta_4 - \beta_3 < 0$	0.4587
1 st , 2 nd and 3 rd quartile	$\beta_3 = \beta_4 = \beta_5$	$\beta_3 \neq \beta_4 \neq \beta_5$	0.3145

Table 8 shows that only countries in the fourth quartile have a more severe flight to quality effect than countries in the third quartile. Furthermore, when comparing additional effects of flight to quality on countries in the first, second, and third quartiles, the result demonstrates that there is no difference between β_3 , β_4 and β_5 . It's mean that there is no statistical evidence that the flight to quality effect is different between countries in the first, second and the third quartile.

The degree of bond market development of countries in the fourth quartile is significantly higher than that of other groups, which is a likely explanation for hypothesis 2's finding. According to data collected in 2021, the average total amount of government securities as a share of GDP, which is used to measure the degree of bond market development, is 32 percent, 50 percent, 69 percent, and 141 percent for the first, second, third, and fourth quartiles, respectively. Countries in the first,

second, and third quartiles have roughly the same level of bond market development, whereas countries in the fourth quartile do not.

The findings of this paper can explain how countries with a deep and effective bond market can actually benefit bonds fully function as a safe haven investment, lowering the risk of an investor losing capital in market downturn. Only countries in the fourth quartile, which have a significantly higher degree of bond market development than the rest of the group, benefit from the bond function. Alternatively, the stage of development of the bond market may have no influence on the flight to quality effect.



5. Conclusion

This paper examines the flight to quality phenomenon during COVID pandemic, which analyzes at whether investors relocate their capital from stocks to government bonds when the market goes down. When the COVID pandemic causes some countries to face massive levels of public debt, and the current financial market offers more alternative assets to invest in, the question is whether government bonds will remain a safe haven asset.

According to empirical findings from a panel data framework, when the stock market crashed, government bonds still provided a diversification benefit, and the negative correlation between these two assets was amplified when COVID is severe in developed countries. However, the flight to quality effect is unaffected when COVID is severe in emerging countries.

Furthermore, whether the degree of bond market development enhances the flight to quality impact is investigated in this paper. The results shows that only countries with a significantly higher level of bond market development than others can facilitate bonds providing a diversification benefit and having a stronger negative stock-bond correlation.

Since the MSCI classification methodology is used in this study to differentiate between developed and emerging countries, some emerging countries may have varying levels of financial market development or distinct investor types. However, the quality variation between each country is not a focus of this study. Another limitation to this study is that it only considers the impact of flight on quality within each country, leaving out the cross-national impact.

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