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A LITERATURE REVIEW OF STOCK-BOND CORRELATION

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Abstract

For many years, the dynamic of stock-bond correlations is often used for portfolio diversification strategy by investors to minimize their risks. With the growing literature of stock-bond correlation, various key determinants have been identified but lacks the required framework to better understand the movement of this correlation. Hence, this paper critically reviews the existing literature of stock-bond correlation into two types. The first type refers to the reliance on econometric modelling to explain the time-variant characteristics of stock-bond correlation while the second type adopts factor model to explain how various factors affect the movement of stock-bond correlation. Based on the reviewed studies, a few inferences can be made. Studies that are categorized into the first type depend on the nature of stock and bond assets to justify the dynamics of stock-bond correlation, such as, asymmetric effect and different investment horizons. Another conjecture from this study is that while a majority of studies may conclude a consistent result of a particular factor on stock-bond correlation, there is possibility for other studies that found contradicting result. For instance, even though many previous researches document the negative association between market uncertainty and stock-bond correlation, there are studies that suggest otherwise. In this sense, high market uncertainty has caused investors to no longer perceive bond as a safer option to equity, which made it appeared to be 'equity-like'. Hence, as stock market goes down during high market uncertainty, the value of bond market also falls down which lead to positive stock-bond correlation.

Keywords: Bond market, literature review, stock-bond correlation, stock market.

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1. Introduction

As countries become more economically integrated, its financial markets will become more developed and sophisticated over time. Investors have more options to allocate their funds as financial assets become more diverse and available to them. Thus, investors are able to diversify their portfolio, which allow them to optimize their risks against potential loss, emerging from various factors. Such measures can be done by shifting their portfolio weightage between riskier and safer assets, which suit their risk tolerances. Stocks have been known to be a riskier asset due to its higher volatility and are more connected to the performance of the firms. Conversely, government bonds are perceived to be less risky since they are guaranteed to be paid by the government unless the government falls. Such risk differential between the two financial securities motivates investors and authorities to understand the dynamic relationship between both markets.

Research on stock and bond relationship was started by Fama and French (1989), Shiller and Beltratti (1992) and Campbell and Ammer (1993). According to these authors, bond and stock markets were argued to have positive relationship as empirically proven by the three studies above. One of the arguments put forward by these studies is that this positive association is due to macroeconomic change that influence the market discount rate. However, these earlier studies implicitly assumed the time-invariance of the co-movement. Since then, more studies have been challenging this assumption by arguing that stock-bond correlation is dynamic in process and fluctuate based on various factors at domestic and international levels.

In existing literature, there are two types of stock-bond correlation studies. The first type refers to econometric modelling that describes and predict the dynamic relationship of stock-bond returns. Studies that are included in this category often incorporate asymmetric effect to capture the leverage effect of the assets and identify the existence of flight-to-quality phenomenon (Cappiello et al., 2006; de Goeij & Marquering, 2004, 2009). The second type of stock-bond correlation studies utilize the dynamic factors model in explaining how various macroeconomic variables can affect the returns of stock and bond assets independently. Consequently, these factors determine the positive or negative co-movement of stock and bond markets. Such factors include the macroeconomic variables (Dimic et al., 2016; Ilmanen, 2003; Li, 2002; Yang et al., 2009), market uncertainty (Andersson et al., 2008; Asgharian et al., 2015a; Cappiello et al., 2006; Connolly et al., 2005) and market integration (Kim et al., 2006; Panchenko & Wu, 2009). Similarly, other studies attempt to relate stock-bond co-movement with illiquidity, non-macro variables as well as income and substitution effect (Asgharian et al., 2015b; Baele et al., 2010; Bansal et al., 2009; Goyenko & Sarkissian, 2010; Hong et al., 2014).

Ever since stock-bond correlation topic makes its debut into the academia world, articles that review and summarize its literature has been scanting. As most of the empirical studies can be classified into the first or second type, there should be some acknowledgement that these studies belong to a bigger framework of which many fail to point out. In particular, the framework refers to the cause of changes in stock-bond correlation which comprised of ‘internal’ and ‘external’ factors as represented by the first and second categories, respectively. Hence, this study seeks to bridge this gap by producing an in-depth discussion of the literature review according to the framework and highlight several key findings that describe the time-variant relationship of stock and bond returns.

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By classifying the existing literature into the aforementioned framework, a couple of conjectures can be made. First, the 'internal' factor (i.e. first category) of stock-bond correlation studies depends on the asset traits, which is connected to asymmetric effect and differences in investment horizon. Second, the 'external' factor (i.e. second category) of stock-bond correlation studies is due to various factors that surrounds a particular economy. These factors include economic variables, market uncertainty, market liquidity and market integration. By incorporating this framework, the literature on dynamics of stock-bond correlation will be more comprehensive and better implemented by market participants.

2. Problem Statement

Through the studies of stock-bond correlation, investors have gained a lot benefit in analysing the relationship between the two assets. While stock market may offer higher potential profit for investors, the situation is less likely to realize in the event of economic meltdown. To avoid this catastrophe, investors will pour a huge portion of their funds into the bond market as it provides a safety-net for investors to minimize their potential loss. Technically, investors will not sell all the stocks in their portfolio during economic turmoil since some of the stocks are considered highly valued and advantageous in the long run. Only those that are considered to be risky will be sold and the proceeds will be channelled into the perceived 'safe-haven' market i.e. bond market. Thus, the imperfect correlation of stock-bond returns will serve as the basis point for Markowitz (1952)'s portfolio diversification theory and to be exercised by investors.

Existing literature have suggested that the return correlation of stock and bond markets are connected to various factors albeit the effect may differ across countries. For example, as previous studies have demonstrated the negative association between market uncertainty and stock-bond correlation, there are studies that have proven otherwise. This calls for a study that can highlight this contradicting result for future reference. Additionally, having a framework that could classify the determinants of stock-bond correlation according to its type will make the process of portfolio diversification strategy to be more systematic.

In this regard, this paper attempts to critically review the studies of stock-bond correlation by incorporating the framework above. From our knowledge, no study has been made in reviewing the literature in this area and produced an in-depth discussion that distinguish these studies according to these two groups. The need for this discourse arises as existing studies fail to point out whether the dynamisms of stock-bond correlations are caused "internally" by the characteristics of the assets as depicted by the first category or "externally" by the various factors that surround a particular economy as portrayed in second category. Through this framework, investors have the option of analysing the relationship of stock and bond markets "internally", in separation of "external" factors.

3. Research Questions

i. What are the existing types of stock-bond correlation studies in current literature?

ii. What is the difference between the first and second types of stock-bond correlation studies?

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4. Purpose of the Study

By understanding the application of stock-bond correlations in portfolio diversification process, investors can protect themselves against any risk, especially a systematic one, which can jeopardize their portfolios. For instance, if stock market crashes during financial crisis, investors can still rely on bond market return to minimize their loss. Therefore, the biggest implication in learning how stock and bond move in relation to each other is to avoid "putting all your eggs in one basket". Additionally, investors can practice a time-varying portfolio diversification strategy that encapsulates various factors into consideration, rather than assuming a constant relationship between these two assets. Therefore, investors can change their investment strategies not only based on exogenous variables, but also based on the time-variant relationship between stock and bond markets.

From a policy maker perspective, stock-bond correlation can help them determine the market perceptions on the level of inflation and economic activity. This will allow the authorities to implement the appropriate monetary policy in respond to inflation and growth expectations (Andersson et al., 2008; Dimic et al., 2016).

This study classifies stock-bond correlation into two types. The first type employs various econometric tools to describe the behaviour of stock-bond correlations while the second type requires exogenous factors to determine the return correlation of stock and bond markets. This classification suggest that stock-bond correlation can be explained by the asset characteristics as well as the macroeconomic factors that affect the well-being of a country at both national and international levels. Therefore, investor can consider these two aspects of stock-bond correlation studies when building a diversified portfolio investment.

5. Research Methods

The studies of stock-bond correlation have been growing rapidly for the past few decades. Hence, numerous articles are available to be used as reference in this study. The first step in choosing these articles is by entering relevant keywords into a wide range of online databases. Additionally, prominent studies in the area are selected based on the number of citations. The selected studies are carefully reviewed and classified according to the categories that best reflect the study. Table 01 and Table 02 review the studies based on 'internal' and 'external' factors, respectively.

Table 01. 'Internal' factors

Author(s)/Year	Country(s) involved/ Period of Studies	Methodology	Underpinning Theory/Justification
Cappiello, Engle, and Sheppard (2006)	21 countries (European countries, Australasia and the Americas) (1987 – 2002)	Asymmetric Generalized - Dynamic Conditional Correlation (AGDCC-MGARCH)	Leverage Effect and Time-Varying Risk Premia
Dajcman (2015)	10 Eurozone countries (2000 – 2011)	Maximal Overlap Discrete Wavelet Transform (MODWT) Wavelet Correlation Analysis	Short and Long-Term Investment Horizons

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Ferrer, Bolós, and Benítez (2016)	Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, UK (1993 – 2012)	Wavelet approach	Short and Long-Term Investment Horizons, Economic Fundamental and Credit Rating
Kim and In (2007)	G7 countries (1957 – 2001)	Maximal Overlap Discrete Wavelet Transform (MODWT) Wavelet Correlation Analysis, long horizon regression	Short and Long-Term Investment Horizons
P. de Goeij and Marquering (2004)	U.S. (1982 – 2001)	Asymmetric Diagonal VECH model (MGARCH)	Leverage Effect
P. de Goeij and Marquering (2009)	U.S. (1982 – 2005)	Level Asymmetric Diagonal VECH model (MGARCH)	Leverage Effect
Wu and Lin (2014)	U.S. (1992 – 2009)	CCC-MGARCH, DCC-MGARCH and Copula-based GARCH model	Leverage Effect

Table 02. 'External' factors

Author(s)/Year	Country(s) involved/ Period of Studies	Methodology/Tools for analysis	Variables Studied
Andersson, Krylova, and Vähämaa (2008)	Germany, UK and US (1991 – 2006)	DCC-MGARCH, time series regression	Expected economic growth, expected inflation and stock market volatility expectation
Asgharian, Christiansen, and Hou (2015)	US (1986 – 2014)	DCC–MIDAS	Macroeconomic uncertainty index (MUI)
Asgharian, Christiansen, and Hou (2015b)	US (1986 – 2013)	Wavelet approach, DCC-MIDAS	Inflation, term spread, interest rate, stock and bond illiquidity, the state of economy variables, market uncertainty
Baele, Bekaert, and Inghelbrecht (2010)	US (1968 – 2007)	VAR, regime-switching, mixed data sampling (MIDAS)	Macro factors, risk-premium factors, liquidity factors
Bansal, Connolly, and Stivers (2009)	US (1997 – 2005)	Regime-switching	Daily VIX variability, implied volatility level from VIX, price-impact measure and return reversal measure of stock illiquidity and trading volume in stock futures contracts.
Baur (2010)	Australia, France, Germany, Italy, Japan, Switzerland UK and US (1989 – 2009)	Simple regression, temporal commonalities	Cross-country (same asset class) stock and bond market integration
Bianconi, Yoshino, and	Brazil, Russia, India, China (2003 – 2010)	VAR, heat maps, cointegration, DCC-MGARCH	US financial stress

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Machado de Sousa (2013)			
Chiang and Li (2009)	US (1996 – 2008)	Rolling correlation, BEKK-MGARCH, AGDCC-MGARCH, multiple regression	Stock market volatility, oil price volatility, credit spread, real GDP growth rate, capital inflow to US, domestic savings, inflation, federal funds rate, M2 own rate.
Connolly, Stivers, and Sun (2005)	US and other G7 countries (1986 – 2000)	VAR, regime - shifting analysis	Stock market uncertainty (VIX) and stock turnover
Dimic, Kiviaho, Piljak, and Äijö (2016)	Argentina, Brazil, Bulgaria, Colombia, Mexico, Peru, Philippines, Russia, Turkey, Venezuela and US (2001 – 2013)	Wavelet analysis approach, linear regression	Inflation, business cycle, interest rate, stock and bond market uncertainties (VIX and MOVE, respectively)
Hong, Kim, and Lee (2014)	Canada, Germany, Japan, UK and US (1985 – 2007)	Bivariate VAR, Cointegration	Ratio of market value to GDP, real GDP growth rate, spread between stock and bond returns, economic uncertainty
Ilmanen (2003)	US (1952 – 2001)	Rolling correlations	GDP growth, inflation, market volatility, monetary policy
Kim, Moshirian, and Wu (2006)	France, Germany, Italy, Japan, Spain, UK and US (1994 – 2003)	EGARCH, Principal component analysis (PCA), Seemingly Unrelated Regression (SUR)	Conditional exchange rate volatility, monetary and real convergence, January dummy variable and economic uncertainty
Li (2002)	G7 countries (1958 – 2001)	Linear regression, autocorrelation model, VAR	Uncertainties of expected inflation, real interest rate and unexpected inflation
Panchenko and Wu (2009)	18 emerging markets (1995 – 2005)	Logistic panel regression	Stock market integration, country-specific variables, international variables, market-development variables, financial openness variables
Perego and Vermeulen (2016)	Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherland, Portugal, Spain (2000 – 2013)	DCC-MIDAS	Inflation differential, volatility differential, debt differential, current account differential, growth differential and monetary policy rate
Yang, Zhou, and Wang (2009)	UK and US (1855 – 2001)	CCC augmented model MGARCH	Short rates, inflation rate, business cycle, dummy variables on 1) monetary regimes: classical gold standard, interwar, Bretton woods, floating exchange rates; 2) events in financial markets: 1951 Treasury-Federal Reserve Accord event, central bank controls over money supply, US issued fiat paper money.

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6. Findings

Based on the reviewed literature, a few inferences can be made. First, studies that are classified as the first type rely more on characteristics of stock and bond markets to justify its dynamics. For instance, Cappiello et al. (2006) and de Goeij and Marquering (2004) posit that both stock and bond have asymmetric behaviour in conditional variances, covariances and correlations. According to de Goeij and Marquering (2004), an asset with negative return shock will cause its volatility to be higher than an asset with positive return shock despite having the same level of shock. The authors also found that the stock and bond return conditional covariance is lower when there are two positive shocks as compared to two negative shocks. The evidence of asymmetric effects in these two assets is justified by the leverage effects and among other things[1].

Aside from the asymmetric effect, studies that employ wavelet approach are also utilized to explain the dynamic correlation of stock and bond returns in the short and long-term horizons. Implication from using this time-frequency method is that it distinguishes the behaviour of short- and long-term investors when assessing their portfolio selection. More specifically, asset co-movements at higher frequencies are often employed by short-term investors while asset co-movements at lower frequency are more applicable among long-term investors (Dajcman, 2012). Additionally, the asset relationship at long-term horizon has the tendency to be altered by short-term noise due to shift in portfolio rebalancing and market consumption (Harrison & Zhang, 1999; Kim & In, 2007). Thus, it is important for investors to incorporate frequency domain in their portfolio analysis since the dynamic of stock-bond correlation can be different in short and long-term horizons. One of the studies that supports this argument is Ferrer et al. (2016) where authors found stock-bond correlations to differ across countries, times and frequencies.

Even before stock-bond correlations were argued to be time-dependent, Shiller and Beltratti (1992) claim that the correlation between stock prices and changes in bond yield should be negative. Such negative relationship is due to the opposite effect of discount rate on both assets under the assumption of simple present value model. In particular, an increased in the expected future discount rate will lead to a decrease in stock prices and an increase in the long-term bond yield. However, the authors found the actual observed correlation has higher magnitude of negative correlations in both of their samples of U.S. and U.K. The result is also consistent with the study of Campbell and Ammer (1993) that exhibit positive relationship between stock and bond returns.

The second type of stock-bond correlation studies is the application of factor model in stock-bond correlations literatures. When factor model (also known as index model) was first introduced, it is used to explain how the asset returns can be influenced by different variables or “risk factors” (Markowitz, 1959; Sharpe, 1963). The model allows investors to optimize their portfolio selections based on their risk appetite. A factor model that consist of many risk factors are called multi-factor model and can be classified into three groups, which are the fundamental factor models, statistical factor models and macroeconomic factor

[1] Bekaert and Wu (2000) and Campbell and Hentschel (1992) explain the asymmetric effects using the volatility feedback approach. Alternatively, Veronesi (1999) justify asymmetric effect by showing that stock prices are less sensitive when good news hit the market but become overly sensitive when bad news hits the market during bad and good times, respectively.

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models (Connor, 1995). In stock-bond correlation literature, however, researchers have adopted the statistical[2] and macroeconomic factor models in explaining the dynamic movement of stock-bond correlation.

The application of statistical factor model in stock-bond correlation studies are quite limited. Nevertheless, one study that employ both statistical and macroeconomic factor model is Kim et al. (2006). In examining the effect of EMU formation towards stock-bond correlation, the authors employed principal component analysis (PCA) method to reduce the dimension of various macroeconomic variables into their model. There are two components of economic integration in this article, which are the real integration and monetary integration. To proxy for real integration, the authors conduct PCA method on the size of trade, the regional trade integration, correlations in changes of output, term structure and dividend yield. As for the monetary integration, the PCA method is conducted on the rolling correlations of inflation, nominal short-term interest rate and real short-term interest rate. After the real and monetary integrations variables are produced, seemingly unrelated regression (SUR) is employed in order to observe the relationship between these two variables on stock-bond correlation.

Another observation from studies that employ factor model is the macroeconomic factors that have been widely used in this area of research. Specifically, factors such as inflation, interest rate, business cycle and market uncertainty have been proven to significantly influence the dynamic of stock-bond correlation. Generally, the first three factors that are mentioned are positively linked to stock-bond correlation while market uncertainty shows negative relationship towards the asset co-movements. However, there are studies that provide contradicting results which typically justifiable by the implementation of economic policy, the economic outlook and even the different econometric tools used by the researchers.

For instance, although market uncertainty has been found to induce negative stock-bond correlations (Andersson et al., 2008; Asgharian et al., 2015a; Bianconi et al., 2013; Cappiello et al., 2006; Connolly et al., 2005), Dimic et al. (2016) found that under the long-term horizon, US stock market uncertainty is positively associated to stock-bond correlation in nine out of ten emerging market. This suggests that emerging bond markets are no longer considered as “safe-haven” by long-term investors, making the bond markets to appear “equity-like”. Hence, the decreased in return of stock and bond markets causes the return correlation to be positive in high market uncertainty. The bottom line is that while a majority of studies may suggest some factors exhibit consistent impact on stock-bond correlation, it is still possible if a small number of studies show contradicting result as shown by the example of market uncertainty factor above.

7. Conclusion

This study critically examines the existing literatures of stock-bond correlations. The main finding suggest that stock-bond correlation studies are separated into two parts, one which explains and forecast the dynamic composition between the two markets and the other one, uses factor model to determine the co-movement return of stock and bond markets. The first type of stock-bond correlation studies typically

[2] The statistical factor involves a high number of latent factors that may explain asset returns. However, if the observable factors are too many, the model may contain multicollinearity problem and therefore, factor analysis must be done to reduce the dimensionality of the model and find the true value that represents the data (Zhou & Fabozzi, 2011)

justifies the dynamic correlations using the characteristics of stock and bond assets. These characteristics include the asymmetric nature of the assets and how investors view these assets in short and long-term horizons. On the other hand, the second type of stock-bond correlation studies employ various macroeconomic data to understand the dynamic of stock-bond correlations. In respect to these findings, further conjecture suggest that stock-bond correlations can be affected "internally" by the characteristics of the assets and "externally" by the numerous factors that influence a particular economy as reflected in the first and second categories.

Although the study of stock-bond correlations has been widely explored for more than a couple of decades, there are a few avenues that need to be explored. Fiscal factor such as the amount of debt undertaken by incumbent government have shown significant effect on stock-bond correlations in European Union (Perego & Vermeulen, 2016). Additionally, credit rating can also be tested as one of stock-bond correlation determinants since the variable has shown that it can have significant impacts on intra-stock and intra-bond market co-movements (Christopher et al., 2012). Another factor that needs to be considered is the level of financial development since it has significant effect on international risk sharing and therefore, should have an indirect effect towards the movement of stock-bond correlation. Hence, these factors should be taken into account in order to build a more comprehensive framework in stock-bond correlation literatures.

Based on the literature above, many existing studies of stock-bond correlation only concentrate on developed markets, especially, the European Union. Although there are studies that focus on Asian and developing economies in general (Dimic et al., 2016; Panchenko & Wu, 2009), studies that focus on other economic union in Asian market have been lacking. In particular, economic union such as the ASEAN community will offer additional insights on how economic integration can impact the dynamic of stock-bond correlation. The reason is, unlike the EU, the level of economic integration in ASEAN is still at the lower level and it consist of developing countries that have weaker economic fundamentals. Therefore, such differences between the economic unions may produce different outcomes in analysing the impact of economic integration towards stock-bond correlations.

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