Analyzing Stock-Bond Correlation in Emerging Markets

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ABSTRACT
This study investigated stock-bond correlation in 17 countries of emerging markets (i.e. Czech Republic, Egypt, Greece, Hungary, Poland, Russia, Turkey, Israel, China, India, Indonesia, South Korea, Malaysia, Pakistan, Philippines, Taiwan, Thailand) during 2011 to 2018 using monthly price data. Data was analyzed using ARCH-LM test, GJR GARCH and Multivariate GARCH type Asymmetric DCC model. Finding of this paper revealed that sequence of return series are stationary contains white noise error, past return volatilities does not have the ability to predict future volatilities and conditional volatility is higher and negative momentum of the market increase the correlation of stock and bond in a country or vice versa and hence increase the diversification benefit for asset allocation in a portfolio construction and provide hedging assets characteristics among countries and it is verify that there is a co-movement between stock and bond in a country of emerging markets.

Keywords: Correlation, ARCH-LM, GJR-GARCH, ADCC, Asymmetric, Heteroscedasticity, volatility, uncertainty, EM.

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1. Introduction:

1.1 BACKGROUND TO THE STUDY

This paper investigate the stock and bond relation of various countries of emerging markets. Stocks and Bonds plays an important role for investment and portfolio making decision. These two financial asset classes correlation can effected because future cash flows and discount rate changes due to economic circumstances. During inflation, stock and bond correlation is positive when inflation is high and influence future cash flows as a result of changes of discount rate.

Economic and monetary policy unpredictable leads to “flight to quality” phenomena which means in periods of high uncertainty causes to increase the price of bond market as compared to stock market and their correlation is weaker even negative. This is the phenomena of transfer of money to bond market when risk of stock market is high. During economic expansion, stock market outperforms while in economic contraction bond market perform well. Positive stock-bond correlation occur when easing monetary policy. In the long run when macroeconomic condition are similar stock and bond move in the same direction and having “equity like” properties especially in emerging markets. Financial market uncertainty most influencing stock-bond correlation and investors rebalancing their portfolio in case of stock market uncertainty is high. Investors most frequently trades decreases the prices of stock and increases the prices of bond during economic bust also investor’s invest more in risky assets which causes negative stock-bond correlation. Stock and bond correlation is useful for hedging each other as bonds seems to be a safer assets as compared with stocks which is known for risky assets. Stocks hedge the inflation risk involve in bonds and bonds hedge economic risk associated with stocks.

Now a days stock-bond correlation gaining more attention in emerging markets because investors is seeking for portfolio diversification and government bond of emerging markets is the second largest financing sources since 1990’s and its appealing for investors for investing because of liquidity and transparency in emerging markets also increases.

Some early studies outline the Fed model to investigate the relationship of stock and bond markets (Yardeni, 1997). This model implies that P/E ratio of stocks of emerging markets is likely to reciprocal of the bond yields to maturity hence generating a positive relation between stocks.
E/P ratio and bond yields. So whenever the differential is created investors reallocate the portfolio lower investment to higher investment return through gross substitutes (Tobin, 1982).

1.2 PROBLEM STATEMENT:
The purpose of the study is to understanding stock-bond correlation in emerging countries. Emerging markets are riskier and uncertainty of the market is high. Investors is seeking to riskier market with trade off higher return. Stock and bonds are two important assets with prospects to good investment. If investor’s having ability to predict future co movement of stock-bond he can benefit through using different strategies. Historical evidence that stock-bond correlation in the end of 1990’s is positive and onwards is negative. During global financial crisis (2007) investor’s sell off their equity investment and shift their investment to bond for better return as their correlation is negative and investor’s quickly taking advantageous of this situation and this phenomena is said to be “flight to safety” phenomena where as in 2007 financial crisis emerging markets financial indicator extremely correlated and stock market reaches its top. As investor’s are risk averse and rapidly reallocate portfolio to safer assets (Nathaniel Frank, 2009). Movement of stock and bonds is depend upon economic factors like higher inflation tend to rise interest rate and also raising the dividends and reduce the correlation between them while in economic growth they have positive effect on correlation between stock and bond. However, investor’s demand premium for higher uncertainty related to stocks prices and bond yields. Some historical evidence that stock-bond correlation high during financial downturn likewise 1930’s depression, 1970 recession, 1987 stock market crash, 1990 Asian and Russian financial crisis, early 2000’s recession, European sovereign debt crisis and global financial crisis (2007) because of adverse of stock market volatility weakens the stock’s price value and increase the risk premium and it is notable that bonds premium decreases during economic contraction hence these conditions influencing the stock bond correlation rise (Idil, 2014) and remaining period (e.g. low inflation, low growth, volatility, weak equity) stock bond correlation negative. Negative correlation gives the benefit to bonds best hedging characteristics and “flight to quality” phenomena consistent with negative stock bond correlation. Emerging markets are more volatile and its assets having equity like characteristics and they payoff higher return and investors can diversify their risk whenever financial crisis occur EM assets value quickly decline as compared with developed
markets. In this research paper analyzing stock-bond correlation to identifying the impact of market shocks, volatility of EM on stock and bond.

1.3 GAP ANALYSIS:

(Valentyn Panchenko, 2009) Conducting a research to identifying the market integration impact between stock and bond varying over time through using parametric and non-parametric approach from sample data of 18 emerging markets and found that increase market integration with rest of the word negatively impact as increase the requirement of whereas bonds demand decrease remain unchanged hence segmentation market risk premium reduced and providing the diversification benefit to investor. Non parametric approach is most suitable for determining stock-bond co-movement. Another research investigating the stock-bond correlation in U.S. markets (Thomas C. Chiang J. L., 2009) and found that stock-bond correlation is negatively correlated with financial market uncertainty and positively correlated with short term rates and real income growth and depends on macro-economic factors during 1996 to 2008.

Examine financial market uncertainty and stock-bond correlation of BRIC nations from sample period to January 2003 to July 2010 (Marcelo Bianconi, 2013) and their research illustrate that worldwide financial crisis in US affect BRIC countries of Brazil, Russia and conditional correlation volatility also increase and inversely correlated to stock and bond after this crisis and bond market reacted favorable in very short period of time except India and in stock market of China low respond with reaction to financial crisis in US whereas in long period bond market divergence than stock and bond market divergence in between BRIC countries . This paper evidence that after financial distress volatility and disturbance of the market increases.

Analyzing six developed markets of countries (Canada, France, Germany, Italy, United Kingdom and United States) stock-bond correlation during 1992 to 2011 and examining structural changes over a period of time and observe that when economy is growing they showed positive correlation or vice versa. Financial market uncertainty (S&P-500) and conditional variance indicate negative stock-bond correlation consistent with “flight to safety” phenomena whereas positively correlated with crisis in bond market and stock and bond both move in the same direction. Whenever financial crisis happened that lead to increase the spread of T-bills and
default risk spread causing negative relationship of stock and bond across different countries. “Flight to quality” phenomena consistent with financial market uncertainty and bond market spread and this demonstrate that investor’s seeking adding good investment in their portfolio and shift allocation from stock to bond for higher return (Thomas C. Chiang J. L.-Y., 2015).

Many previous research paper conducting to identifying stock-bond correlation over a period of time and analyzing stock-bond relationship during financial crisis but no research paper found to examine stock-bond co-movement in emerging markets as a whole and identifying the pattern of stock and bond and market shocks impact on stock-bond correlation either good or bad.

1.4 RESEARCH OBJECTIVES
This paper is aim to identifying the stock and bond relationship of countries in emerging markets and investigating the market momentum impact on co-movement of stock and bond. Following are the main objective of this study

I. The goal of the study configuring the stock-bond movement using past return values
II. Identifying the asymmetric effect on stock and bond
III. Examine bivariate relationship between stock and bond using their volatilities.

1.5 RESEARCH QUESTION
Following are the purpose of investigating this study

I. How emerging market volatilities impact on stock-bond correlation?
II. Are past return volatilities predict future return volatilities of stock and bond?
III. Can it say that momentum of the market directing stock-bond correlation?

1.6 SIGNIFICANCE OF THE STUDY:
Stock- bond correlation having ability of anticipating future stock-bond correlation in response to changes economic conditions and recognized the bull and bear market and investor’s reallocate their portfolio accordingly and also using buy and hold portfolio strategy. It is also useful for hedging stocks when the economy is in contracts or vice versa. Stock-bond correlation in countries of emerging markets provides information regarding portfolio construction,
diversification benefits, policy makers and investors for allocating their asset with respond to shocks in the market.

The above Section 1 describes introduction between stocks and bonds relationship, Section 2 explain some recent studies literature concerning stock-bond correlation, Section 3 provide conceptual framework of previous studies, Section 4 & 5 presenting trend analysis and descriptive statistics of countries using in this paper, Section 6 explain methodologies using in this article, Section 7 is empirical finding of the paper and in the last Sections 8 & 9 discussed and concludes results of the article.

2. Literature Review:
Following are the some recent studies which provide evidence of existence of co-movement, correlation and volatility over the period of time between indices and government bonds in the market.

(Hossein Asgharian, Effects of macroeconomic uncertainty on the stock and bond markets, 2015) Investigating in their paper by using mixed data sampling (MIDAS) and analyzing how macroeconomic uncertainty influencing stock and bond correlation in the long run and their volatility. Their results show that flight to quality phenomena and macroeconomic variable and alternative macroeconomic like GDP growth results are similar and effect to volatility that is increasing over time. Out of sample results of macroeconomic uncertainty is very weak.

(Nebojsa Dimic, 2016) This paper analyzing stock-bond correlation of 10 emerging markets and applying the wavelet analysis approach over different time period. In short run, stock-bond changes sign rapidly and shows negative correlation during crisis period and consistent with “flight to quality phenomena” and in the long run stock-bond having positive correlation and shows “equity like” properties and only considering country specific risk. Their results also suggest that easing monetary policy helpful for explaining stock and bond correlation performances. Inflation is also one of the factor for influencing varying in stock-bond correlation. Bond prices reacted negatively with increase of inflation and high inflation also effect adversely to stock prices and in the long run shows a positive relationship between US and emerging
markets. This study is helpful for asset allocation decisions over the time period while explaining uncertainty global stock market plays a more significant role than bond market.

(Libing Fang, 2018) Analyzing investor’s expectation regarding increase or decline of trading activities in financial market which effect investor’s sentiment and uses composite index based on how investor’s sentiment effect stocks return when investors sentiment regarding stocks (small stocks, young stocks, high volatility stocks, unprofitable stocks, non-dividend-paying stocks, extreme growth stocks, and distressed stocks ) return is high their return is relatively low or vice versa (Malcom Baker, 2006) and measures long run U.S. stock-bond correlation by using DCC-MIDAS model which determines asset allocation decisions, evaluating portfolio weighs and performance when time varying and does not affect investor’s sentiment during crisis period i.e. 1997 Asian financial crisis and 2008 Global financial crisis while stock-bond correlation decreases. Since investors are risk averse it is suggested that policy makers taking account of investor’s sentiment index its helpful for improving the portfolio performance and risk management.

(Xia-Ming Li, 2015) This study examine economic policy uncertainty (EPU) shocks on stock-bond correlation in the US. Their finding suggest that positive shocks of uncertainty decreases the correlation and when controlling structural changes because of introduction of euro, asymmetric effect on non EPU index i.e. negative shock of EPU impact on post euro stock-bond correlation or vice versa and innovation in historical EPU is that negative shock raise the stock-bond correlation or vice versa.

(Fu-Lai Lin, 2018) This paper uses wavelet analysis to find out both long term and short term stock-bond relation during 1988 to 2014. Analyzing daily stock and bond returns of US market which shows that since 1990’s their relationship changes dramatically in the long run and time varying changes rely on macroeconomic conditions and financial market uncertainty. During crisis period stock-bond relation significantly shows a positive relation. Stock-bond return relation rely on two economic factor i.e. discount rate and short rate and they both have positive effect on short term as well as long term stock-bond relation and also shows positive impact during favorable economic conditions. This paper also analyzing volatility index effect which shows adverse impact on stock-bond relation on daily, weekly, quarterly and annual frequencies
and uniform with findings of “flight to safety” phenomena from (Robert Connolly, 2005) discover that future correlation of stock and bond having negatively related with stock market and when volatility, stock turnover increases bond return is large and (Lieven Baele, 2010) find that stock-bond correlation is positive in the end of 1980’s afterwards their correlation is negation and when they explore risk premium proxy approach also obtain negative stock-bond correlation their research indicate that “flight to safety” did not fit in their model. Hence frequencies results are varied of TED and crisis dummies so investigating continuous wavelet analysis of both high and low frequency data simultaneously. During long run of crisis period indicates the negative relation while in the short run shows positive relation. This study is considerable for investor’s for asset allocation, portfolio rebalancing and understanding the benefits of portfolio diversification. In times of crisis stock-bond correlation is positive which minimize the portfolio diversification. (Harumi Ohmi, 2015) This study analyzing long run trends of stock-bond return correlation and using smooth transition regression model i.e. STR of three transition variables (VIX, short rate and yield spread) of (Nektarios Aslanidis, 2012). It also examine the US, Germany and UK stock-bond correlation and observe declining trend of three countries. Some earlier studies established DCC model of Engle (2002) which recommend that financial stock-bond correlation returns are generally hugely serially correlated. In this article extending STR model by applying AR (1) terms which is extremely significant to all countries. Hence change in stock-bond correlation occur steadily as compared to previous economic variable prediction. Results of extended transition variable consistent with previous studies (Nektarios Aslanidis, 2012) in which analyzing stock-bond correlation through smooth transition patterns using extreme data frequency and result of the study indicate that using multiple transition variables gives more accurate empirical findings as compare with single transition variables. Hence large positive stock-bond correlation as a result of increasing level of short rate and yield spread whereas large negative stock-bond correlation indicate higher volatility index (VIX) and statistically significant for all countries. VIX is the most influencing transition variable for explaining stock-bond correlation as well as time trend component through in sample analysis finest model selection based on SIC and AIC where as in out of sample analysis transition variable i.e. VIX, time trend indicating other models. During
declining trend, short rate and yield spread did not have explanatory power while upward trend explain by transition variables and consistent with stock-bond correlation higher in developed markets (DM) than in emerging markets using copula model for analyzing short run and long run dependence and when diversification benefits minimized emerging markets have still some advantages because in period of crisis equity market of EM have only country specific risk (Peter Christoffersen, 2012). Hence, this study focus to investigating eight advanced market to analyzing the stock-bond correlation and interesting comparison showed for safer countries having decline trend of stock-bond correlation and for riskier countries i.e. Italy, Portugal and Spain increasing particularly during the rise of euro crises. Some earlier studies evidence that in the long run stock market move in the same direction vanished the international diversification benefits and prices of stock decreases for hedging this risk investor’s invest in bond market, thus decreases the stock-bond correlation. Similarly in euro crisis, increase of stock-bond correlation decreases the diversification effect and leads to “flight to quality” phenomena.

3. Conceptual Framework

(Hossein Asgharian, 2016) Studied long run stock bond correlation using mixed data sampling (MIDAS) with the help of dynamic conditional correlation (DCC) and found that long run stock-bond correlation rely on macro finance variable and lagged conditional variance and it indicate that only macro finance variable effect is very smooth on stock-bond correlation but in combine effect of macro finance and conditional variance is slightly volatile and long run stock bond correlation can be estimated through inflation rate, short term rate, industrial production, producer confidence and consumer confidence. Growth of economy support that higher stock-bond correlation or vice versa.

Another research conducted on stock-bond correlation by (McMillan, 2018) and found that stock-bond correlation can be using to estimated future outlook of economic growth and market performances. Positive correlation indicate economic expansion that would lead to raised asset prices whereas negative correlation lead to “flight to quality” phenomena and investor’s transfer assets from stocks to bonds during economic contraction. Positive or negative correlation illustrate market upward and downward performances and also macroeconomic variables effect on
forecasting stock-bond correlation. Moreover it is helpful for investors to making strategy for improving portfolio performances and having insight view of market interpretation.

(Jian Yang, 2009) Investigating stock and bond relationship over the past 150 years and analyzing macroeconomic impact over the period of time in US and UK. It is observe that when economic cycle is in peak higher correlation and business cycle is in trough lower correlation in US whereas in UK greater correlation is in trough and lower correlation is in peak and enhancing diversification in US for providing bonds as best hedging characteristics for uncertainty in stock market than UK. Stock-bond correlation depend on macroeconomic variable i.e. short term rate and inflation rate and suggesting that higher correlation result of higher inflation or vice versa. In this paper it is verify that UK stock bond correlation is substandard than US and overall follow the same pattern across the time period.

(Valentyn Panchenko, 2009) Taking account of stock-bond correlation explaining through inflation and stock market uncertainty. Higher inflation describe co-movement of stock and bond whereas larger stock market uncertainty as a result of negative stock-bond correlation and low inflation suggest lower correlation and no impact can be seen on correlation from macroeconomic conditions. Stock and bond correlation fluctuation is temporary period of time from positive to negative and market uncertainty and inflation expectations useful for forecasting stock-bond correlation.

Emerging markets are more fluctuated market and volatility of the market provide benefit to investor’s with trade off higher for taking higher risk when comparing with developed market they are less volatile and influencing overall market having low diversification benefit whereas low correlation in emerging market profitable for investor’s adding assets in a portfolio. Emerging market react with market momentum and move in this direction so it’s good for investors who have insight information for reallocating assets in a portfolio. However stocks and bonds both assets prices are volatile in emerging markets and having more riskier in contrast with assets of developed market whereas bond consider as safer assets because of less uncertainty and hedging characteristics against stocks due to these reasons considering stock-bond correlation in emerging markets is more important for investor’s point of view, risk management, asset allocation in a portfolio so that it’s helpful for investor’s for predicting correlation as higher financial market uncertainty leading positive correlation otherwise indicate negative correlation.
In figure 1 highest price fluctuation of index among other countries is Turkey because of containing political risk i.e. civil war in Syria as Turkey is neighbor country and Iraq and Syria border link with Turkey and they face war against ISIS and currency risk i.e. lira is falling and current account deficit while Pakistan and Hungary both have also larger price volatility remaining to other countries which means investor’s earning in those country indices investment is higher if they take advantage of the market information and it is also observe the same pattern follows by all index of emerging country. If emerging market is in position of bear than all countries index prices is fallen or vice versa.
In figure 2 Greece 10 year bond yield during January 2011 to January 2013 there is a greater upward movement in 10 year yield which shows during that period countries suffering from greater risk the reason behind that Greece facing Eurozone debt crisis which effect it’s economy badly and declare as default on debt and after that period of time it recovers from this situation and stabilized their yield. Egypt and Pakistan both have higher yield to offer higher return for taking higher risk but Pakistan slightly lower the yield to gain investor’s confidence in the economy. Overall emerging market countries 10 year yield showing slightly fluctuation of uncertainty in the economy.

Hence emerging market is faster growing economy and can be predict that it can promote the world economy around 42% and only China contribution will be 27% to the rest of the world and anticipated growth rate of five year 3.5% due to different geographical heterogeneity provide diversification easing. Emerging market complications is to have so much foreign debt and the recovery of their debt is quite difficult of low earning countries and causing currency depreciation (Aizpún, 2019).
5. Descriptive Statistic

Following table 1 and 2 both shows descriptive statistics of 17 countries from emerging markets from 2011 to 2018 of monthly data.

Table 1 Emerging Countries descriptive statistics of Indices

| Country | Czech Republic | Egypt | Greece | Hungary | Poland | Russia | Turkey | Israel | China |
|---------|----------------|-------|--------|---------|--------|--------|--------|--------|-------|
| Mean    | 1001.82        | 8702.81 | 852.54 | 24653.73 | 2299.81 | 1741.89 | 79813.45 | 1373.48 | 2765.70 |
| Standard Error | 9.51     | 90.56  | 25.95  | 251.93   | 26.18   | 33.22   | 356.46    | 16.80   | 58.24   |
| Median  | 989.83         | 7805.03 | 797.52 | 21760.53 | 2323.72 | 1667.80 | 78173.55 | 1403.87 | 2752.78 |
| Mode    | #N/A           | #N/A   | #N/A   | #N/A     | #N/A   | #N/A   | #N/A     | #N/A   | #N/A    |
| Standard Deviation | 93.13 | 3806.74 | 252.94 | 794.39    | 26.18   | 33.22   | 1590.93   | 16.80   | 58.24   |
| Sample Variance    | 8673.51 | 14491243.73 | 60580997.43 | 65773.96 | 105953.90 | 242981042.34 | 27089.27 | 325613.34 |
| Kurtosis | 1.10       | -0.58  | 0.63   | -0.92    | 0.34    | -0.86  | -0.02    | -0.75   | 0.50    |
| Skewness | 0.92       | 0.78   | 1.10   | 0.78     | -0.32   | 0.58   | 0.56     | -0.17   | 0.68    |
| Range   | 444.09        | 14673.22 | 1076.59 | 24413.41 | 1203.62 | 1169.35 | 68262.17 | 654.98  | 2632.53 |
| Minimum | 816.91         | 3622.35 | 516.71  | 15775.10 | 1709.51 | 1306.01 | 51266.62 | 1057.63 | 1979.21 |
| Maximum | 1261.00        | 18295.57 | 1593.30 | 40188.51 | 2913.13 | 2475.36 | 119528.79 | 1712.61 | 4611.74 |
| Sum     | 96174.85       | 826766.76 | 80991.61 | 2366757.60 | 220781.34 | 167221.27 | 7662090.72 | 131854.21 | 265507.63 |

| Country | India | Indonesia | South Korea | Malaysia | Pakistan | Philippines | Taiwan | Thailand |
|---------|-------|-----------|-------------|----------|-----------|-------------|--------|----------|
| Mean    | 25120.34 | 4903.43   | 2069.55     | 1702.57  | 29454.07  | 6628.83     | 8947.94 | 1426.52  |
| Standard Error | 639.77 | 80.03     | 18.39      | 11.56    | 1232.00   | 129.61      | 111.87  | 22.38    |
| Median  | 26131.61 | 4861.98   | 2012.69     | 1700.21  | 31248.29  | 6987.02     | 8820.36 | 1463.05  |
| Mode    | #N/A   | #N/A      | #N/A        | #N/A     | #N/A      | #N/A        | #N/A   | #N/A     |
| Standard Deviation | 6268.42 | 784.13    | 180.17      | 113.24   | 12071.12  | 1269.91     | 1096.13 | 219.32   |
| Sample Variance    | 39293033.81 | 614856.99 | 32461.64   | 12823.94 | 145712024.16 | 1612673.83 | 1201497.96 | 48100.28 |
| Kurtosis | -1.03   | -0.84     | 0.56        | -0.41    | -1.27     | -0.48       | -0.73   | -0.44    |
| Skewness | 0.28    | 0.14      | 1.18        | -0.38    | -0.11     | -0.73       | 0.29    | -0.46    |
| Range   | 23190.15 | 3196.46   | 796.81      | 495.58   | 39520.99  | 4997.28     | 4199.67 | 913.92   |
| Minimum | 15454.92 | 3409.17   | 1769.65     | 1387.13  | 11070.58  | 3766.73     | 6904.12 | 916.21   |
| Maximum | 38645.07 | 6605.63   | 2566.46     | 1882.71  | 50915.71  | 8764.01     | 11103.79 | 1830.13  |
| Sum     | 2411552.54 | 470728.90 | 80991.61    | 2366757.60 | 2827591.13 | 636367.56 | 859001.82 | 136945.72 |

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6. Methodology:

To examine the co-movement or correlation of stock-bond of emerging countries establishing two step methodology first constructing univariate asymmetric GARCH and in the second step analyzing multivariate extended GARCH model i.e. ADCC.

Financial market known for volatility clustering and it is captured by Engle model of “Autoregressive Conditional Heteroscedasticity (ARCH)” which means yesterday’s volatility explain tomorrow volatility and it is time varying conditional variance property. The ARCH (q) model equation is given below

\[ r_t = \mu_t + \sigma_t \]

Table 2: Emerging Countries of descriptive statistics of 10 year Government Bond

| Country     | Czech Republic | Egypt | Greece | Hungary | Poland | Russia | Turkey | Israel | China |
|-------------|----------------|-------|--------|---------|--------|--------|--------|--------|-------|
| Mean        | 1.7872         | 16.0281 | 11.0969 | 4.9408 | 3.8720 | 8.5870 | 10.0664 | 2.9310 | 3.6013 |
| Standard Error | 0.1120       | 0.1324 | 0.7512 | 0.2111 | 0.1133 | 0.1516 | 0.2538 | 0.1202 | 0.0429 |
| Median      | 1.8280         | 15.9800 | 8.6180 | 3.7900 | 3.4390 | 8.2600 | 9.6700 | 2.3485 | 3.5845 |
| Mode        | 3.2060         | 15.5000 | 6.9520 | 7.4900 | 2.9450 | 7.7100 | 9.6700 | 3.6000 | 3.6000 |
| Standard Deviation | 1.0972   | 1.2904 | 7.3599 | 2.0686 | 1.1096 | 1.4853 | 2.4870 | 1.1773 | 0.4203 |
| Sample Variance | 1.2307     | 1.6652 | 54.1684 | 4.2789 | 1.2313 | 2.2060 | 6.1853 | 1.3861 | 0.1767 |
| Kurtosis    | -0.6904        | -0.6769 | 2.8010 | -0.4744 | 3.4466 | 5.2121 | -1.2220 | 0.1767 | 0.0738 |
| Skewness    | 0.4929         | -0.0608 | 1.7523 | 0.7830 | 1.7114 | 2.0115 | 0.5146 | 0.0429 | 0.0738 |
| Range       | 4.0040         | 5.7200 | 32.8570 | 7.8500 | 4.3440 | 7.5600 | 14.5300 | 3.8130 | 1.8860 |
| Minimum     | 0.2500         | 13.0000 | 3.7340 | 2.0900 | 1.9960 | 6.5300 | 6.1700 | 1.5070 | 2.7440 |
| Maximum     | 4.2540         | 18.7200 | 36.5910 | 9.9400 | 6.3400 | 14.0900 | 20.7000 | 5.3200 | 4.6300 |
| Sum         | 171.5680       | 1522.6670 | 1065.2980 | 474.3200 | 371.7140 | 824.3540 | 966.3700 | 281.3770 | 345.7240 |

| Country     | India | Indonesia | South Korea | Malaysia | Pakistan | Philippines | Taiwan | Thailand |
|-------------|-------|------------|-------------|----------|----------|-------------|--------|----------|
| Mean        | 7.8529 | 7.3292     | 7.8926      | 8.7057   | 4.9433   | 1.2424      | 3.0756 |
| Standard Error | 0.0686 | 0.1056     | 0.0815      | 0.2249   | 0.1135   | 0.0284      | 0.0643 |
| Median      | 7.8600 | 8.7390     | 2.7030      | 3.9245   | 11.0900  | 4.5510      | 2.9350 |
| Mode        | 7.4490 | #N/A       | 4.4800      | 8.0270   | 5.9190   | 1.0400      | 2.7800 |
| Standard Deviation | 0.6720 | 1.0347     | 0.7981      | 2.2035   | 1.1250   | 0.2785      | 0.6297 |
| Sample Variance | 0.4516 | 1.0707     | 0.6369      | 4.8552   | 1.2376   | 0.0776      | 0.3965 |
| Kurtosis    | -0.4104 | -0.7585    | -0.6152     | -1.5503  | -0.4608  | -1.0229     | -1.2145 |
| Skewness    | -0.4613 | -0.2752    | 0.3783      | 0.0250   | 0.7315   | -0.0009     | -0.0579 |
| Range       | 2.8140 | 4.4570     | 3.3220      | 1.0540   | 6.8090   | 4.0730      | 1.0850 | 2.5450 |
| Minimum     | 6.2460 | 5.1670     | 1.3880      | 3.3700   | 7.5900   | 3.2470      | 0.6750 | 1.7300 |
| Maximum     | 9.0600 | 9.6240     | 4.7100      | 4.4240   | 14.3990  | 7.9500      | 1.7600 | 4.2750 |
| Sum         | 753.8830 | 703.6040   | 272.9030    | 373.6480 | 1032.7370 | 474.5540    | 281.3770 | 345.7240 |
\[ y_t = \sqrt{h_t} z_t^2 \]
\[ h_t = \omega + \sum_{i=1}^{q} \alpha_i y_{t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-i}^3 \]

ARCH model extension introduced by Bollerslev known as General Autoregressive Conditional Heteroscedasticity (GARCH) to analyzing heteroscedasticity in financial time series past squared returns and also describe past conditional variances and it is more flexible than ARCH model. Its equation can be defined as

\[ h_t = \omega + \sum_{i=1}^{p} \alpha_i y_{t-1}^2 + \sum_{i=1}^{q} \beta_i h_{t-i}^3 \]

In this equation conditional variance i.e. \( h_t \) describe by not only for past squared returns but also for past conditional variance\(^4\).

To adding leverage effect causing by good news and bad news and for analyzing financial market there is an extended version of the GARCH model called (Lawrence R Glosten, 1993) find that negative relation between expected return and conditional volatility and this model explain that positive and negative innovations in the having inverse effect on conditional variance. Following is the equation of the model

\[ h_t = \omega + \sum_{i=1}^{p} \alpha_i y_{t-1}^2 + \sum_{i=1}^{q} \delta_i I[y_{t-i} < 0] y_{t-1}^2 + \sum_{i=1}^{q} \beta_i h_{t-i} \]

Hence,

If there is any existence of leverage effect as a result of bad news impact on (\( \alpha + \delta \)) i.e. \( \delta > 0 \). In case of good news effecting \( \alpha \) as a result of positive shocks.

\[ I[y_{t-i} < 0] = \begin{cases} 1 & \text{if } y_{t-i} < 0 \\ 0 & \text{if } y_{t-i} \geq 0 \end{cases} \]

Univariate GARCH model used for considering individual asset volatility analysis. However, examine assets covariance and their co-movements multivariate GARCH is most useful for this

\(^2\) \( z_t \) is independent with mean zero and variance one

\(^3\) For holding stationary condition \( \alpha + \beta < 1 \)

\(^4\) \( h_t > 0 \) if \( \alpha_i, \beta_i \geq 0 \)

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purposes. In a portfolio, assets move together and their prices are dependent varying over time and having financial market volatilities. It can be defined as

\[ r_t = \mu_t + y_t \]
\[ y_t = H_t^{1/2} z_t \]

(Kevin Sheppard, 2001) Introducing DCC model through using S&P-500 indices and Dow Jones Industrial Average for investigating conditional covariance between assets with null hypothesis constant correlation against an alternative of Dynamic Conditional Correlation (DCC) and the purpose of this model for enabling time varying conditional correlation and extended version of this model is Asymmetric Dynamic Conditional Correlation (ADCC) GARCH established by (Lorenzo Cappiello, 2006) examine correlation of equity indices and government bonds of European countries and obtain that in case of adverse news in the market more influence conditional volatility of equity indices than government and when in time of financial downturn volatility of equity market increasing more rapidly as compared with government bonds whereas during financial crisis effect both equity market and government bonds. So adding asymmetric effect on the correlation model happening by good news and bad news to capture the combine volatility of stock and bond. Its equation is combined with conditional covariance matrix with conditional standard deviation which is defined as

\[ H_t = D_t R_t D_t^6 \]

Since DCC model is,

\[ R_t = Q_t^{-1} Q_t Q_t^{-1} \]
\[ Q_t = (1-a-b) \bar{Q} + a\epsilon_{t-1} \epsilon_{t-1}^T + bQ_{t-1} \]

Therefore,

\[ \bar{Q} = \frac{1}{T} \sum_{t=1}^{T} \epsilon_t \epsilon_t^T \]

Whereas \( Q_t \) is the diagonal matrix.

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5 \( r_t \) return
\[ \mu_t \] expected return
\[ y_t \] mean corrected return \( \rightarrow E[y_t] = 0, \text{Cov} [y_t] = H_t \)
\[ z_t \] is independent random vector with mean zero and co-variance matrix 1
\[ H_t \] is conditional covariance of past returns whereas \( H_t^{1/2} \) is \( H_t \) Cholesky factorization.

6 \( D_t = \text{diag}(h_{1t}^{1/2},...,h_{nt}^{1/2}) \) \( \rightarrow \) Conditional Standard Deviation
\( R_t = \text{Correlation matrix} \)

7 \( \bar{Q} = \text{Cov} [\epsilon_t \epsilon_t^T] = E[\epsilon_t \epsilon_t^T] \) \( \rightarrow \) unconditional covariance matrix, \( \epsilon_t \) \( \rightarrow \) standardized residuals
\[ Q_t^* = \begin{bmatrix} \sqrt{q_{11t}} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \sqrt{q_{nnn}} \end{bmatrix} \]

\[ |\rho_{ij}| = \left| \frac{q_{ijt}}{\sqrt{q_{iit} q_{jjt}}} \right| \leq 1 \]

Following are the conditions of the DCC model should hold

\[ \alpha \geq 0, \beta \geq 0 \text{ and } \alpha + \beta < 1 \]

The extension of version DCC model by adding asymmetric effect and it is created by Cappiello et al. (2006)

\[ Q_t = (\bar{Q} - A' \bar{Q} A - B' \bar{Q} B - G' \bar{N} G) + A' \varepsilon_{t-1} A + B' Q_{t-1} B + G' n_{t-1} n'_{t-1} G \]

Where,

\[ n_t = I \left[ \varepsilon_t < 0 \right] \circ \varepsilon_t \rightarrow \circ = \text{Hadamard product} \]

\[ l_i [y_{t-1} < 0] = \begin{cases} 1 & \text{if } y_{t-1} < 0 \\ 0 & \text{if } y_{t-1} \geq 0 \end{cases} \]

ADCC model condition if \( Q_t \) is positive definite

\[ Q - AA' \circ BB' \circ Q - GG' \circ N \]

By simplifying the above equation through replacing the coefficient i.e. \( A, B \) and \( G \) to scalars \( \sqrt{a}, \sqrt{b} \) and \( \sqrt{g} \) so the equation can be revised as

\[ Q_t = (Q - a \bar{Q} - b \bar{Q} - g \bar{N}) + a \varepsilon_{t-1} \varepsilon'_{t-1} + b Q_{t-1} + g n_{t-1} n'_{t-1} \]

7. Results:

In this paper collected monthly price of indices and bonds of 17 countries of emerging market namely: Czech Republic, Egypt, Greece, Hungary, Poland, Russia, Turkey, Israel, China, India,

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8 \( Q_t^* \) = diagonal matrix of square root of diagonal elements of \( Q_t \)

9 \( A, B \) and \( G \) are parameters of diagonal matrices

10 \( a + b + \delta g < 1 \)
Indonesia, South Korea, Malaysia, Pakistan, Philippines, Taiwan, Thailand for sample period during January 2011 to December 2018. For gathering data using the source of investing.com. To find out returns of stocks (Indices, 2019) and bonds of 10 years (World Government Bonds, 2019) taking log differences of their prices.

7.1 HYPOTHESIS:

H₀: Countries in emerging markets indices and government bonds does not having co-movement.

Hₐ: Countries in emerging markets indices and government bonds having co-movement.

Figure 3: Stocks Return
Figure 4: Bonds Return
In Fig: 3 and 4 it shows that stock indices and government bonds return are stationary, mean reverting and exhibit volatility clustering. ARCH-LM test proposed that past information having potential to predict future variances (Engle, 1982) using to detect sequence of return series is white noise and having heteroscedasticity. In table 3 p value of ARCH-LM test is greater than 0.05 except for South Korea Bond. Hence, countries having white noise error so the sequence of the series is unpredictable and residuals having least heteroscedasticity.
To analyze past volatilities that predict future volatilities in the return series constructing univariate asymmetric GARCH i.e. GJR-GARCH. There are three parameters i.e. $\alpha$, $\beta$, and $\delta$ is the component of past return volatilities, past variance volatilities and asymmetric effect reacting for good news or bad news in the market. As seen in Table 4\textsuperscript{11}: high mean of government bond recorded of countries Indonesia (0.113236) and China (0.162100) that shows high performance over the sample period 2011 to 2018. Similarly, for stock indices Pakistan has high mean value i.e. 0.115629. Most of countries values of $\alpha$ nearly zero so past squared return volatilities do not predict tomorrow’s volatility whereas in contrast $\beta$ values are huge showing that yesterday’s variance volatility predict future variance volatility. Taiwan bond having large value of

\textsuperscript{11} Table 4: estimates co-efficient showing two values e.g: $\mu = 0.006398$ parameter and 0.93619 significance at 5% etc. b= Bonds, s= Stocks. For holding stationary conditions $\alpha + \beta + \delta \leq 1$
asymmetric effect $\delta = 0.055795$ which means negative shocks increase the volatility similarly for index of Greece i.e. $\delta = 0.058034$. Therefore positive shocks decreases the volatility.

Table 4: Asymmetric GARCH

| Estimates | Czech Republic | Egypt | Greece | Hungary | Poland | Russia | Turkey | Israel |
|-----------|----------------|-------|--------|---------|--------|--------|--------|--------|
| $\mu^b$   | 0.006398       | -0.054331 | -0.082619 | 0.053668 | -1.83455 | 0.073312 | -0.009449 | 0.025008 |
| $\omega^b$| 0.936190       | 0.506120 | 0.267610 | 0.520665 | 0.008375 | 0.305611 | 0.850006 | 0.728760 |
| $\alpha^b$| 0.046057       | 0.032186 | 0.002217 | 0.020798 | 0.025743 | 0.007622 | 0.040306 | 0.024319 |
| $\beta^b$ | 0.600640       | 0.296810 | 0.736500 | 0.000208 | 0.448001 | 0.559764 | 0.000000 | 0.182400 |
| $\delta^b$| 0.011861       | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| $\alpha^s$| 0.730830       | 1.000000 | 1.000000 | 1.000000 | 0.977431 | 1.000000 | 1.000000 | 1.000000 |
| $\beta^s$ | 0.938777       | 1.000000 | 1.000000 | 1.000000 | 0.977431 | 1.000000 | 1.000000 | 1.000000 |
| $\delta^s$| 0.026181       | -0.051306 | -0.03232 | -0.034580 | -0.011809 | -0.026306 | -0.078798 | -0.043520 |
| $\omega^s$| 0.000000       | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| $\mu^s$   | 0.080508       | -0.045724 | -0.008380 | 0.078184 | 0.053520 | -0.018971 | 0.004082 | 0.054046 |
| $\omega^s$| 0.251840       | 0.520440 | 0.881434 | 0.260070 | 0.340530 | 0.792920 | 0.955445 | 0.465363 |
| $\alpha^s$| 0.090935       | 0.002397 | 0.058856 | 0.003296 | 0.004995 | 0.000438 | 0.057089 | 0.019698 |
| $\beta^s$ | 0.397200       | 0.847490 | 0.277616 | 0.000000 | 0.588000 | 0.981090 | 0.025542 | 0.020184 |
| $\omega^s$| 0.000000       | 0.004544 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| $\delta^s$| 0.100000       | 0.766050 | 1.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 | 0.999972 |
| $\omega^s$| 0.084473       | 0.996366 | 0.907741 | 1.000000 | 1.000000 | 0.998325 | 0.964484 | 1.000000 |
| $\delta^s$| 0.055460       | 0.912870 | 0.078368 | 0.000000 | 0.310850 | 0.965830 | 0.093225 | 0.018481 |
In the last step examine the stock and bond co-movement of stock and bond simultaneously build multivariate GARCH model type of asymmetric DCC model for this purpose. In table 5\(^{12}\) a, b and g coefficient defined as combination of bivariate impact of previous market shocks, conditional correlation and co-movement in response to positive or negative news in the market respectively. For stationary conditions \(a + b + g < 1\). As seen in table 5 negative shocks in the market (i.e. g) increase the co-movement of stocks and bond returns and past shocks (i.e. a) having least impact on bivariate of stocks and bonds.

\(^{12}\) Table 5 : estimates co-efficient showing two values e.g; a= 0.013045 parameter and 0.931720s significance at 5%

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8. Discussions

The study analyzing that return series having white noise error and it is uncorrelated and unpredictable while possessing stationary feature and found that GARCH conditions hold so it anticipated past variation predict future variations and asymmetric GARCH impact in emerging countries effect both assets i.e. stocks and bond but stocks reacted most rapidly than bonds when investigating combine asymmetric influences and establish that unfavorable momentum increase the correlation and reducing the diversification advantage and bonds hedging ability to stocks is not applicable while favorable momentum decreases the correlation and encourage diversification and consistent with “flight to quality” phenomena and these detection similarity with the research analysis of (Lorenzo Cappiello, 2006) and construct that equity index volatility having more impact than bond index conditional volatility with specific news in the market

| Estimates | Czech Rep | Egypt | Greece | Hungary | Poland | Russia | Turkey | Israel |
|-----------|-----------|-------|--------|---------|--------|--------|--------|--------|
| a         | 0.013045  | 0.042985 | 0.000000 | 0.045134 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| b         | 0.931720  | 0.227000 | 1.000000 | 0.176571 | 1.000000 | 1.000000 | 1.000000 | 1.000000 |
| g         | 0.736419  | 0.825628 | 0.964965 | 0.850383 | 0.943796 | 0.916801 | 0.926719 | 0.999002 |
|           | 0.375720  | 0.000000 | 0.000000 | 0.000017 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
|           | 0.070502  | 0.043514 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002970 |
|           | 0.849090  | 0.648520 | 0.999994 | 1.000000 | 0.999997 | 1.000000 | 0.999999 | 0.741231 |

| Estimates | China | India | Indonesia | South Korea | Malaysia | Pakistan | Philippines | Taiwan |
|-----------|-------|-------|-----------|-------------|----------|----------|-------------|--------|
| a         | 0.017791 | 0.000000 | 0.000000 | 0.008403 | 0.000000 | 0.000000 | 0.019098 | 0.069516 |
| b         | 0.804824 | 0.999998 | 0.999999 | 0.659100 | 1.000000 | 1.000000 | 0.450282 | 0.256744 |
| g         | 0.692083 | 0.933936 | 0.998460 | 0.951982 | 0.931885 | 0.607583 | 0.928732 | 0.750236 |
|           | 0.003576 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.796409 | 0.024322 |
|           | 0.098291 | 0.000000 | 0.004352 | 0.000000 | 0.000000 | 0.127996 | 0.003945 | 0.000000 |
|           | 0.660030 | 1.000000 | 0.727432 | 1.000000 | 1.000000 | 0.891403 | 0.905973 | 0.999999 |

| Estimates | Thailand |
|-----------|----------|
| a         | 0.000000 | 1.000000 |
| b         | 0.927904 | 0.000000 |
| g         | 0.000000 | 0.999999 |
especially in adverse situation like financial market crash event occur in 87, Gulf war and Asia market crash and correlation of assets increases in sectors where heterogeneity benefited to investor’s and diversification easing is reduced when it is demanded by investors during the crisis period and decrease the correlation by investors with using strategy of taking short position i.e. selling the assets. Furthermore, EMU suggest that after January 1999 introduction of exchange rate causing exact correlation and exhibit diversification profitability to transfer assets from Europe to US.

Another article results (DU, 2017) contradict to our findings and conclude that time varying stock bond correlation estimate conditional stock bond correlation. Dividend and inflation rate using for describing conditional stock-bond correlation with the help of non-identical bond maturities. Endogenous consumption volatility causing conditional stock-bond correlation to convert the sign from positive to negative. Investor’s risk averse of asset allocation expectation regarding change of economic growth and inflation did not impact on conditional stock bond correlation rather than anticipating heterogeneous risk for outlook of economy and inflation switching stock-bond correlation.

(Belen Nieto, 2015) Analyzing stock-bond correlation price transaction of the same firm and these type of data set are rare and investigating solely stock and bond return correlation for achieving target level of leverage adjustment over a period of time for capital composition selection. Their research determine that correlation between them is very small and for low liquidity bonds clearly explain correlation by applying non trading adjustment and persistence models and results indicate that macroeconomic variable does not impact on correlation while fluctuation of consumption growth of firms and default premium on bonds increases which decline the correlation and measures of firm specific risk also reason of changes the sign of the correlation and it conclude that greater the correlation between the firms there is higher probability of reaching target level of leverage and these detection opposite of results in the paper.

There is another article investigating correlation about European stock and government bonds (Erica R. Perego, 2016) and found that macroeconomic variables such as inflation, debt level and monetary policy of Euro zone countries influencing to derive stock bond correlation and divide
Euro zone into two areas i.e. northern and southern to identify the divergence effect and found that northern region “secure assets” in risky area correlated with “risky assets” in secure area similar with southern region and correlation between assets determined through future cash flow predictions of the region and heterogeneity of economic indicators is one of the factors that derive financial market uncertainty. Hence, these results does not consistent with the research findings.

Stock-bond correlation also investigated through anticipation of macroeconomic variables by (Conrad & Loch, 2016) and established that over long period of time economic inflation and changes of interest rate in three months in the economy and financial market fluctuation derive stock bond correlation and it is beneficial for analyzing business cycle and predicting correlation over that period of time and asset selection in a portfolio and managing risk and monetary policy directed by central bank for easing and tightening the monetary policy that effect stock-bond correlation and causing to enlarge correlation risk in a portfolio and asymmetric effect can be seen in Eurozone for managing portfolio risk and determination of the paper deny with the study. (Baur, 2010) Examine stock-bond co-movements and reveals that in a cross country analysis determine that stock bond co-movement domination in cross country and little correlation in all developed countries leading to decreases the diversification and causing often asset reallocation in a portfolio because of neutralize the effect low diversification easing and found that US dominate returns of stock and bond market and these results also contradict to research of the paper.

9. Conclusion

In this paper investigating the stock and bond correlation in 17 emerging countries from 2011 to 2018 of monthly data and first understanding trend analysis of the data and found that all countries follow the same pattern in the response to economic fluctuation except few countries which shows higher prices and yield that compensate with taking risk i.e. suffering low liquidity in debt like Greece and Turkey distressed with political and economic situation that hits it’s stock market. For the purpose of analyzing co-movement first inspect the returns hold stationary conditions through ARCH-LM test and in the second step applying univariate GJR-GARCH model
then in the last using Multivariate GARCH technique i.e. ADCC model. The finding of the results are stocks and bond return having white noise error as in the ARCH-LM test p value is greater than 0.05 and it can shows that returns are mean averting and returns series are unpredictable. For examine the individual impact of stock and bond of specific news in the market using technique of asymmetric GARCH (GJR GARCH) for adding leverage effect and it shows that past squared return having lower ability to predict future squared return (α) while past conditional variance values are large (β) and asymmetric effect negative impact increase the volatility (δ) and countries possessing higher volatility with the reaction of the news roaming around the market and it can be noted that bond impact is less than index of a country as bonds consider to safer assets because of emerging market are developing market and uncertainty of countries is higher as compared with developed market. For bivariate analysis using the ADCC model and their results can be explained as past shocks (a) having slightest impact on both variables, dynamic conditional correlation (b) showing higher conditional volatility and negative momentum in the market increases the correlation of stock and bond and positive momentum decreases the correlation (g) and it can also explain that for combine analysis of stock and bond there is mixture of favorable and unfavorable momentum among countries of emerging markets.

Hence, through these results conclude that countries in emerging market having greater financial uncertainty and countries facing economic and political uncertainty that will not helpful for predicting past return volatilities to future volatility both stock and bond market possessing volatilities and reacting with the news in the market while considering the co-movement of stock and bond having substantial conditional volatility and positive shocks occur in one country in contrast there is higher probability of negative momentum in another market and it can evidence that greater diversification benefit provided among countries and consistent “flight to quality” phenomena and it is advantageous for hedging assets among countries but showing positive correlation of individual countries and suggest that there is co-movement of stock and bond in a country of emerging markets.
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