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BRUCE BUDD

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CANARIES IN THE COAL MINE. THE TALE OF TWO SIGNALS: THE VIX AND THE MOVE INDEXES.

Abstract:

The purpose of this paper is to explore derived signals of the historical implied volatility measures between the U.S. equities market and the U.S. bond market using the VIX and MOVE Indices 2010-2015 respectively. This paper further examines the co-movement and dynamics (i.e. changes) within and between these markets.

This empirical analysis finds implied volatility of the treasury market MOVE Index can forecast the implied volatility of the equities market (VIX), though not always reliably. The signals between the VIX and MOVE Indexes in the last ten years has changed and the gap between these markets has widened. A relationship not witnessed since the early days before the 2008 Global Financial Crisis. The contributing factor to this widening gap is the greater volatility experienced by the MOVE Index compared to its VIX counterpart heightened by the record-low global interest rates and lack of liquidity in the bond market. The implications of this research are important for strategic forecasting policy decision-makers and analysts alike.

Keywords:

VIX Index, MOVE Index, Implied Volatility.

JEL Classification: G10, E44

1. Introduction

Accurate information of market volatilities of bond and share prices are central to many economic theories and domestic/international agencies. The derived signals from these data provide indispensable resources for all strategic forecasting policy decision-makers. Risk management, asset allocation, and speculation on future volatility are the prime motivators for forecasting volatility and their correlations. The purpose of this paper is to explore these signals of the historical implied volatility between the U.S. equities market and the U.S. bond market using the VIX and MOVE Indices 2010-2015 respectively, and to further examine the co-movement and dynamics (i.e. changes) within and between the markets.

With innovative and efficient improvements in communications providing exposure to the latest information updates, signals from these markets have never been so vital. The volatility movements of the futures option bond yields and stock markets prices have been historically characterized by strong correlation as well as mean-reversion, (where volatility departs from its long-run level, but returns to that level rather quickly). These two indices have shown remarkable positive statistical correlation between their comparative daily movements over the past two decades of about 75%. Yet recent data suggests departures from these trends. Investigation shows this correlation has fallen and the gap between these markets has widened. The volatility levels of the MOVE index, traditionally a relatively more conservative and steady market, have pushed higher while the VIX, a measure of stock market volatility, has remained low. The difference between these signals has now reached their highest level since 2008. The traditionally more conservative fixed income traders are now signaling a more volatile future ahead curiously in contrast to their seemingly more sedate stock market counterparts.

It is against this background this paper seeks to answer the following research questions: can the volatility of the treasury market, forecast implied volatility in the equities market? Are signals from the traditional stock and bond market volatility trend in the U.S. changing? Has the U.S. bond market implied volatility increased relative to stock market behavior? The structure of this paper is as follows. A literature review of previous research is discussed in Section 2. Section 3 discusses data. Section 4 reports the data and Section 5 the analysis and results. The final section provides a conclusion.

2. Literature Review

Implied volatility indices are constructed and published by stock exchanges all over the world from Asian–Pacific regions across Europe. Much research has widely recognized that implied volatility index has superior predictability for future stock market volatility (Giot & Laurent, 2006) , though others have challenged this predictive power of implied volatility (Beckers, et al., 2007). There is a growing literature characterized by the VIX implied volatility indices of stock markets (Fleming, et al.,

1995, Simon, 2003, Wagner & Szimayer, n.d.) yet the Merrill- Lynch MOVE Index of implied volatility of US Treasury markets, though in existence since 1988, is seldom discussed or even acknowledged. A simple google search of the VIX index raised countless 'hits' by comparison to its lesser known MOVE Index.

A volatility index can serve as an underlying asset to volatility derivatives playing the same role as the market index for options and futures. The volatility index can also be used for Value-at-Risk purposes (Giot, 2002), to identify buying/selling opportunities in the stock market (Stendahl, 1994, Whaley, 2000) and to forecast the future market volatility (Fleming, et al., 1995, Moraux, et al., 1999, Simon, 2003).

The VIX was introduced in its present form in 2003 (modified again in 2006) in the Chicago Board Options Exchange (CBOE). The VIX is a 30-day ahead forecast of implied volatility using all available Out of the money Options and the average of the ATM put and call on the market index. The VIX is a computed index, much like the S&P 500 itself, although it is not derived based on stock prices but uses the price of options on the S&P500. It tracks the future combined implied volatility of multiple options between the current date and the option's expiration date. It is widely used to measure of market risk and so-called "fear index". It is a useful signal of the mood of the future equity markets.

The MOVE (Merrill Lynch Option Volatility Estimate) Index measures the implied volatility of U.S. one month Treasury bond market issues by gauging options contracts on one-month Treasury issues. The MOVE index is the bond market's equivalent of the VIX for the equity market. It reveals the investors' sentiment of the market. Basically, it measures the future course of interest rates. Higher values of the Index indicate times when traders are willing to pay more for the protection against unexpected movements in rates.

Evidence of volatility spillover between equity and bond markets is consistent as spillovers are justified based on mutual and efficient information gathering following expectations in both markets (Dajeman, 2012). A further explanation of between market consistency is based on cross-market hedging. Portfolio managers often shift funds from stocks into bonds and vice versa due to new information arrival that alters their expectations about stock or bond returns. In this manner, a shock in one market is transferred to the other market due to trading activity and this is consistent with volatility spillover.

Traditionally bonds and share prices move in the same direction. When bonds and shares move in opposite directions (an inverse correlation) this can often signal a future change. When a market is slowing down, there is a tendency for shareholders to retreat to bonds, as prices and profits fall. This can lead to falling interest rates and ultimately rising bond prices. Conversely an improvement in market fundamentals (bullish market) such as GDP and lower unemployment rates, tend to improve share prices. Profits improve correspondingly with improving share valuation. Increasing prices can lead to higher rates of inflation which may cause bond prices to decrease when counter inflationary monetary policy raises interest rates. Increase in the cost of

capital forces companies to pay a higher interest rate when they issue new bonds. In turn the new bonds push down the prices of the lower-yielding existing bonds which further increases the price of bonds to match the new ones. Provided profits are increasing, shares prices continue to appreciate, while bonds could continue to fall.

It is against this background this study seeks to answer the following research questions: can the volatility of in the treasury market, forecast volatility in the equities market? Are historical signals from the traditional stock and bond market volatility trend in the U.S. changing? Has the U.S. bond market volatility increased relative to stock market behavior?

The structure of this paper is as follows. A literature review of previous research is discussed in Section 2. In Section 3, the data, Section 4 analysis and Section 5 the results. The final section provides a conclusion.

3. Data

Table 1 presents the summary of descriptive statistics of the VIX and MOVE indices for the sample period 2nd January 2009 to September 16th, 2015. There are 1748 daily observations. The average level of implied volatility for is 20.22% and 86.57% for the VIX and MOVE Indices, respectively over the sample period.

Table 1 Descriptive Statistics

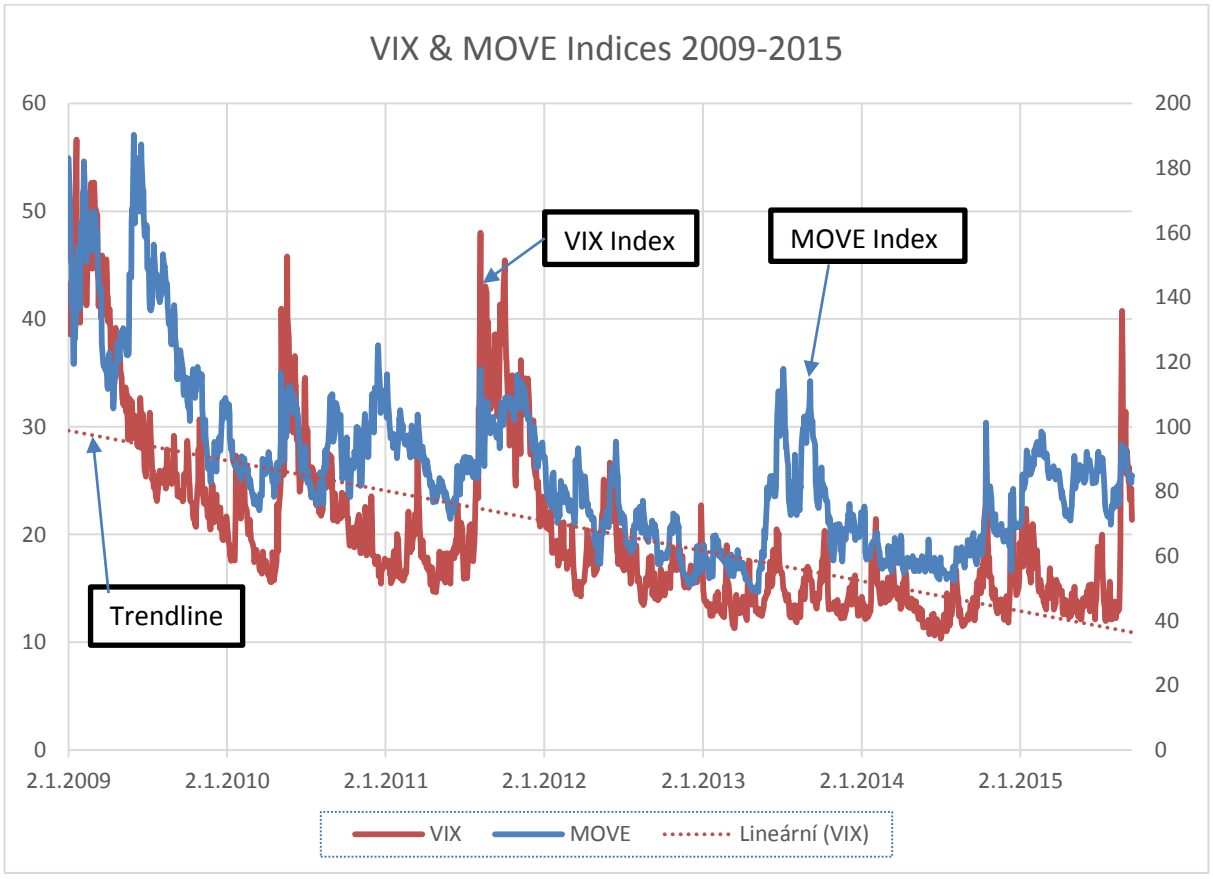
2009-15	VIX	MOVE
Mean	20.22	86.56
Standard Deviation	8.14	25.90
Skewness	1.55	1.21
Kurtosis	5.15	4.70
Maximum	56.65	190.30
Minimum	10.32	48.87
Observations	1748	1748
Jarque-Bera	1036.73	643.9230
Probability	0.000000	0.00000

Testing for stationarity statistics of autocorrelation indicate that both series are highly persistent. The distribution of the VIX and MOVE are both non-normal with positive skewness and excess kurtosis. Since the statistic of the Augmented Dickey-Fuller test is -3.94 and -3.93 for the VIX and MOVE respectively with p-values 0.0018 and 0.0019, the null hypothesis of unit root can be rejected at 1%. (Results are not reported but are available from the author). The average volatility for the VIX is 20.22 and a standard deviation on 8.12. The average volatility for the MOVE is 86.56 and standard deviation of 25.90. Both indices show the correlation of the two indices is

0.74 for the sample period. A value of 1 means both are synchronized with each other, a value of -1 means that when one category falls, the other rises, while zero means no relationship exists. A clear positive relationship is identified. Though closer inspection over different phases, shows some major falls in the direction and magnitude in this relationship.

Figure 1 illustrates a comparison of the time series movements of the VIX Index (with an approximate range of 10-60 on the left-hand axis), and MOVE Index, (with an approximate range of 48-190 on the right-hand axis). Figure 1 illustrates the time varying co-movements of these indices with differing magnitudes and direction of the data sets. Table 1 descriptive statistics, records the maximum index of 56.65 and 190.30 and the minimums of 10.32 and 48.87 for the VIX and MOVE Indices, respectively. Gaps between the two indices highlight their variable correlation to each other. Significant gaps identify events such as: the mid-2009 Quantitative Easing, 2011 Frank-Dodd Act, mid-2013 debt ceiling debacle, and mid-2015 tapering policy and looming interest rate rise speculation. Closer inspection of the graph further identifies a negative trend line signifying a general overall decline in future volatility since the 2008 Global Financial Crisis.

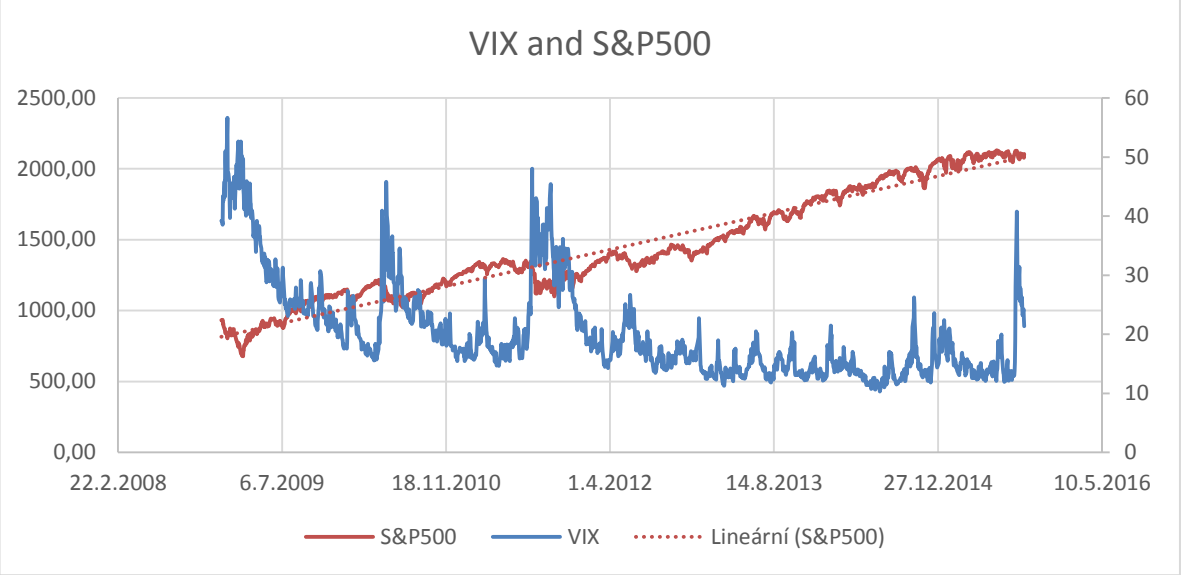
Figure 1 VIX & MOVE Indices



Source: *Own adjustment based on Bloomberg data.*

To further understand their relationship the markets are observed independently. Figure 2 shows the S&P 500 and VIX Index 2009-2015.

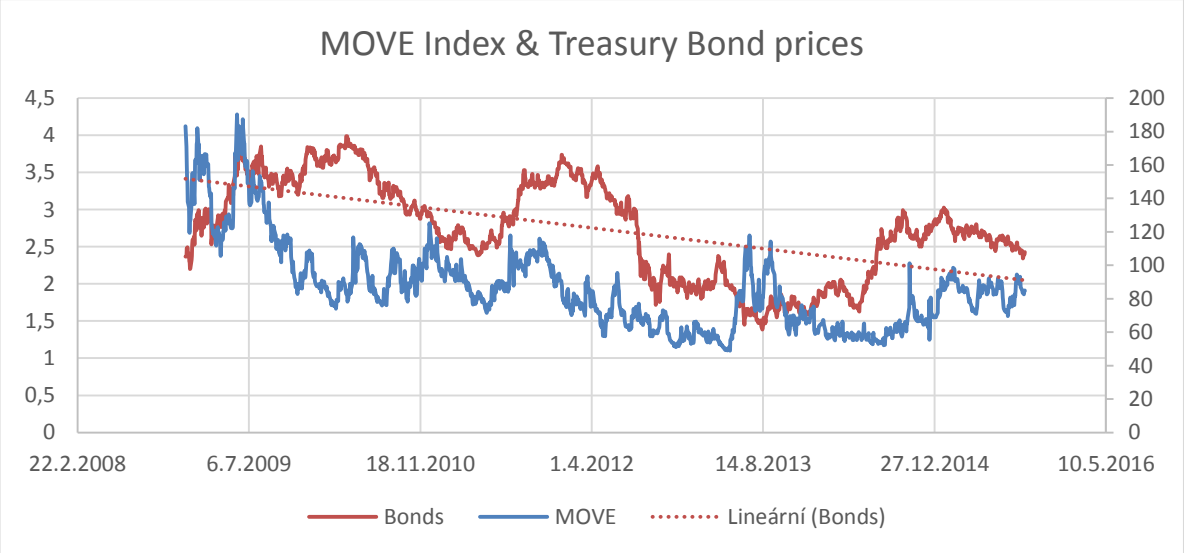
Figure 2 VIX and S&P500 – Equity Market



Source: *Own adjustment based on Bloomberg data.*

The divergence of the two signals shows a clear widening gap. Coefficients of greater than 28 signals excessive bearishness that foreshadows bullish reversals, and between 16-18 signals excessive bullishness of the VIX market foreshadowing bearish reversals. Clear spikes of the VIX index identify heighten fear in the foreseeable equity market. During GFC, the S&P 500 lost about 56% of its value from the October 2007 peak to the March 2009 trough and the VIX Index more than tripled.

Figure 3



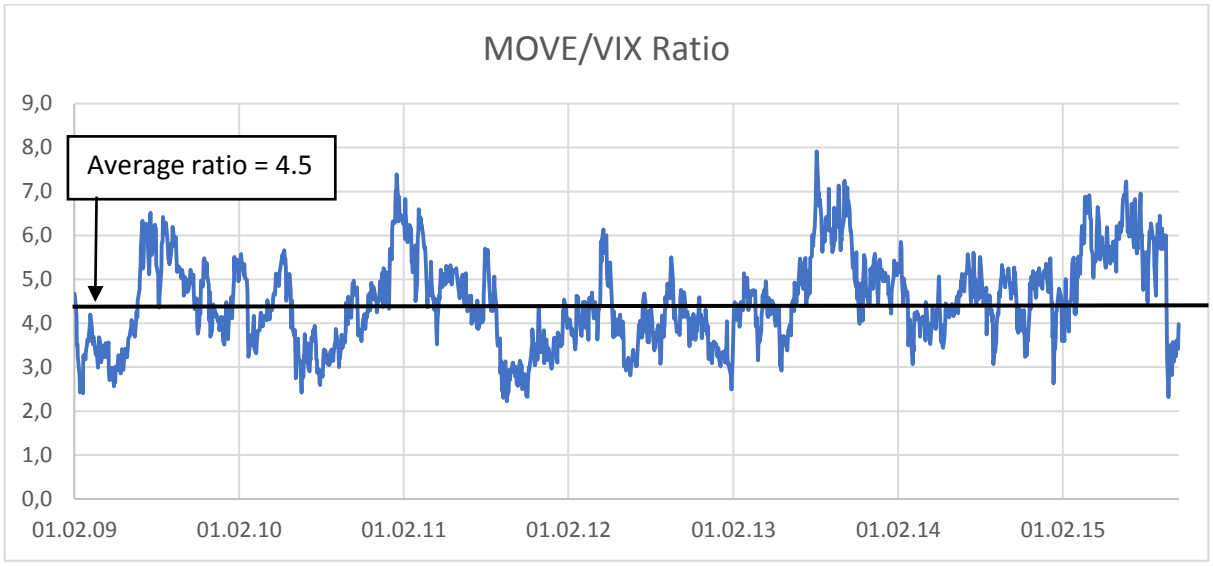
Source: *Own adjustment based on Bloomberg data.*

In Figure 3 the MOVE Index and the bond price show an overall negative trend though two distinct spikes of the VIX index is detecting during post GFC and 2013. When the MOVE Index is greater than 120, excessive bearishness volatility is assumed. Signals below 80 suggestion bullishness in the future market. During the Global Financial Crisis of 2008 the MOVE Index reached an historic height of 264 in October 2008 and a historic low of 51 in May 2007. The average reading since inception is 103.13. The average reading for this sample is 86.56.

The distinct features of both graphs are the changing magnitude of the gaps revealing changing correlations between the variables. The objective of this paper is not the relationship of the bond and equity markets but the future markets. Nevertheless, for future research, converting the data to 30-moving averages over the sample period as well as comparing the volume of daily turnover of bonds and equity, may provide some interesting revelations about the predictive power of these variables.

Calculating the ratio between the MOVE and VIX indexes for the last 15 years reveals significant time-varying correlation between equity and debt markets as shown in Figure 5. Evidence of greater volatility of the bond (MOVE) market seems to indicate these traders are responding far more actively than their equity (VIX) trader counterparts. This is illustrated by the higher activity shown above the ratio value of 4.5 15-year average line depicted in the graph. Uncertainty of Federal Reserve interest rises which had not changed since 2006 (which ultimately changed in December 2016) and the lack of liquidity in the bond market may have contributed to this anomaly.

Figure 5 The MOVE (bond sentiment) Index / VIX (equity sentiment) Index Ratio



Source: Own adjustment based on Bloomberg data.

Descriptive statistics of the daily ratio MOVE/VIX sample show a maximum ratio of 7.91 and minimum of 2.22, a kurtosis of -0.39 and standard deviation of 1 revealing a greater change in magnitude from the MOVE (bond) data than the VIX (equity) data.

The recent decade within the global equity and bond markets have witness one of the greatest mean reversions in the history of market activity, despite surges of price rises. Traditionally, the bond market is a more sedate and less volatile market to its more speculative equity market counterpart. Dramatic movements in the MOVE Index, an indicator for investors in assessing the mood of the bond market; as well as the VIX (or fear index) in the equity markets, have shown remarkable statistical correlation over the past fifteen years. Then again 2015 witnessed a more volatile bond market reflected by a greater divergence between these two market indices. These divergences can predict greater future market volatility. With a decade of near zero U.S. Federal Reserve Bank interest rate and the uncertainty of its imminent rise, as well as the corresponding impact of lack of liquidity in the U.S. bond market, traditional viewpoints of the positive relationship between the bond and equity markets seem to have been challenged. With much political and economic unrest and uncertainty in Europe, Asia, Russia, the U.S. – basically the world, these markets may be signaling an ominous change (black swan!).

4. Analysis

To get a better view of the relationship between these two indexes, a simple regression of the VIX level (dependent variable) based on the MOVE (explanatory variable) is followed (Dupire, 2010).

$$VIX = EXP (1.84 + 1.06 * LN(MOVE)) \quad (1)$$

The regression tests the relationship between the closing MOVE index and its prediction of the future VIX volatility level. In Table 2 the summary of the regression statistics results show a statistically significant relationship of the MOVE index as an explanatory variable of the dependent variable VIX as illustrated by the high *t*-statistic and low *p*-values. The Adjusted R square result shows the explanatory variable explaining a fifty-five per cent of the dependent variable VIX. Figure 6 illustrates these variables.

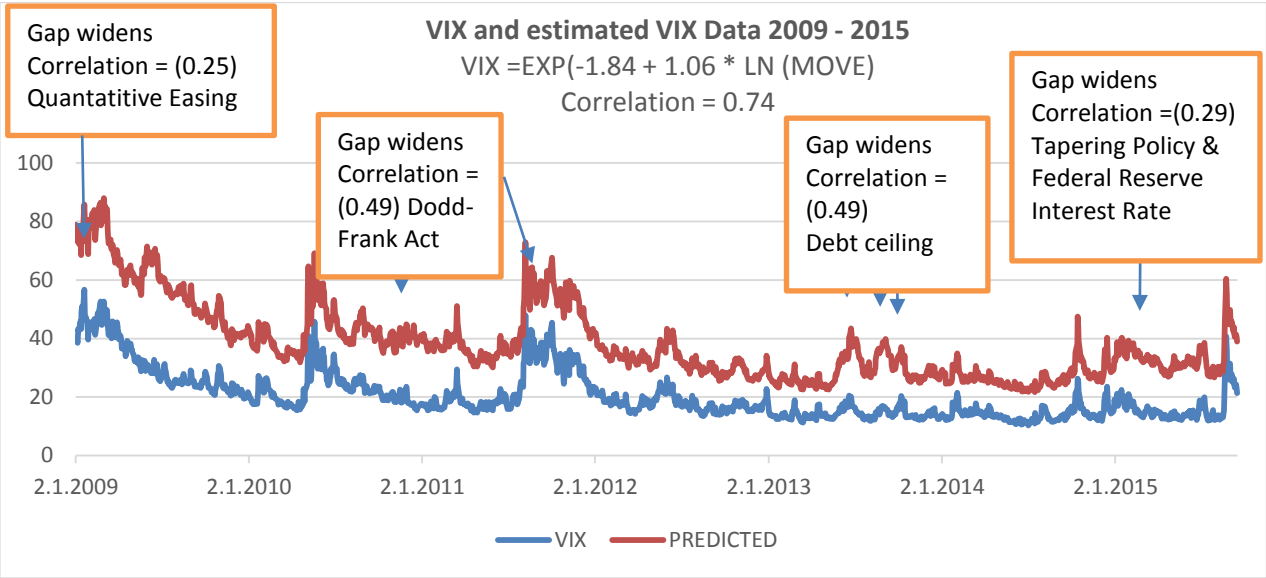
Table 2 Regression Statistics

Summary	coefficient		
Adjusted R Square	0.5525		
Standard Error	5.47		
Observations	1662		
		t-statistic	p-value
Intercept	1.34	3.06	0.002
MOVE variable	1.04	45.30	2.0443E-292

Though the regression analysis shows statistically significant signals of the two variables, what is noticeable is the correlation between these daily predicted VIX results are not consistent over the sample period. The correlations vary in magnitude

and direction at periods in the time series. Figure 7 displays these estimated predicted volatilities of the VIX index compared to the existing sample. The gaps are extenuated during periods of uncertainty. These gaps are also noticeable in Figure 1 between the MOVE and the VIX levels. In retrospect, these periods of uncertainty can be identified as: the Quantitative Easing policy of late 2009, the debt ceiling crisis of 2011 and low and stagnant Federal Reserve interest rate policy during late 2007-2015. During each of these events gaps between the equity and bond markets widened, most notably between the VIX and MOVE Indices. Periods fueled by events of high anxiety sentiment are shown in Figure 6. Different correlation coefficients between the indexes are identified in different phases.

Figure 6 Estimates volatilities of the VIX index compared to original VIX Index



Correlation coefficients in parentheses.

Source: Own adjustment based on Bloomberg data.

5. Results

The results indicate that implied volatility is substantial in magnitude and variation with significant time-varying correlation between equity and debt markets' implied volatility. The historical threat of US debt default momentously triggered a sustained period of restrictions on U.S. bank trading. In turn this increased capital reserve requirements imposed by the 2010 Dodd-Frank Act. Large banks and financial institutions were challenged to continue their previous big trading positions, resulting in dramatic reductions in liquidity in many markets. The capital and money markets were further impacted with the ending of U.S. quantitative easing, the debt ceiling crisis, the turbulence of world events including the Greek austerity crisis and Europe's sovereign debt crisis to Middle East conflicts, China's equity markets debacle and devaluation of the yuan. This was further compounded with the collapse of global commodity prices which resulted in slower economic growth and record-low global interest rates. From

the data observation analysis, the volatility of financial markets, and particularly the implied volatility of the bond market, are experiencing historic variability not seen since 1987. With a decade of near zero U.S. Federal Reserve Bank interest rate and the uncertainty of its imminent rise, compounded by the lack of liquidity in the U.S. bond market, the signals of the bond and equity future markets are singing different songs. The implied volatilities of the equity and bond markets are measures of the markets' preparedness for risk protection. The lower the indices, the less demand for risk protection and vice versa. Yet the two indices show different forecasts. The record-low interest rates and the reluctance of the Reserve to change rates may have cowered equity market movements, in contrast to the activity of the bond market implied volatility. The relationship between the VIX and MOVE over the last decade or so has been historically different with less positive correlation than previously observed.

Results and empirical analysis show that the volatility in the treasury market MOVE Index can forecast volatility in the equities market VIX Index, though not unfailingly. Clearly spillovers between the markets are justified based on the mutual availability of better-quality information which will simultaneously affect expectations of both markets, but divergences in the market can happen due to cross-market hedging. Portfolio managers often shift funds from stocks into bonds and vice versa due to new information arrival that alters their expectations about stock or bond returns. In this manner, a shock in one market is transferred to the other market due to trading activity and this is maybe consistent with the present VIX and MOVE divergence.

Future research of the impact of spillovers of each implied volatility market (and other implied volatility markets) can reveal more empirical justification of the behavior the markets and their forecasts. One of the more popular models for future volatility forecasting is the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Model (Bollerslev, et al., 1992). Recent studies by Dajcman, (2012), Erderington & Guan, (2013), and Ubukata & Watanabe, (2015) use conditional volatility models to measure the efficiency of conditional volatility using parametric measures like the DCC-EGARCH. The DCC-EGARCH and other multivariate GARCH models such as the diagonal VECH, the constant Conditional Correlation and the diagonal BEKK models all facilitate the analysis of spillover effects (see Brooks, 2014).

6. Conclusion

In conclusion, implied volatility of in the treasury market MOVE Index can forecast the implied volatility of the equities market, though not always reliably. The signals between the VIX and MOVE Indexes in the last ten years has changed and the gap between these markets has widened. The contributing factor to this widening gap is the greater volatility experienced by the MOVE Index compared to its VIX counterpart. Future econometric research of market spillovers can further clarify their empirical relationship.

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