



Equity Market Valuation, Systematic Risk,  
and Monetary Policy

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## EQUITY MARKET VALUATION, SYSTEMATIC RISK, AND MONETARY POLICY

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### ABSTRACT

This study examines the relationship between equity market valuation and risk indicators that portend economic downswings. The indicators are implied options volatility, TED spread, and exchange rate. While implied volatility captures market risk in that it reflects the fear factor embedded in the price of an option, the TED spread reflects the default risk premium that is priced into a key short-term credit instrument. Equity markets often show a tendency to reflect the incidence of these risk factors. And because they provide valuable information about the health of the economy, many have argued that equity market valuation be taken into account in the formulation of monetary policy. Results of this study not only show a statistically significant inverse relationship between the stock market and the risk factors, but also evidence of a co-integration. In a variance decomposition of the series, we find that equity valuation is a major contributor to the forecast error variances of each of the risk indicators, a finding that lends tacit support to the argument that equity market changes be considered in monetary policy decisions.

**Keywords:** *equity valuation, risk, monetary policy, co-integration, variance decomposition*

## **Introduction**

In modern portfolio theory (MPT), market risk is the key factor influencing the pricing of equities. Market risk is unavoidable even if an investment is well diversified. It is possible to construct an efficient set of portfolios that offers the maximum possible expected return for a given level of risk (Markowitz, 1952). Sharpe (1964) and Lintner (1965), in extending the MPT, present the capital asset pricing model (CAPM), arguing that because market risk cannot be diversified away, it is the only risk that is rewarded in the pricing of a financial asset. Consequently, the price volatility of financial assets is relevant only if the source of risk is macroeconomic. Incidentally, these are the risk factors that impinge on a central bank's monetary policy decisions (Bernanke, 2006). This study examines the empirical relevance of recent arguments as to whether central banks should be additionally concerned with equity market valuation in the formulation of monetary policy. The research investigates the relationship between equity market pricing and a set of systematic factors that embody market and credit risk. The direction of the risk indicators often foretells the direction of the economy and therefore, the stance of monetary authorities on money supply decisions.

Credit risk is the risk that a borrower defaults on a loan. It also includes the risk that an insurer, fails to meet a payment obligation when a claim is filed. Financial risk indicators such as TED spread, which captures the incidence of default risk in the money market, and credit default swap indices, which gauge the ability of borrowers to repay their debt, are well known in their capacity to capture the risk of financial leverage. These risk indicators tend to rise as investor confidence deteriorates. In their 2006 study, Abid and Naifar examine the bivariate distributions of credit-default swap rates and equity return volatility. They find that the impact of equity returns volatility on credit-default swap rates is higher for the lowest rating class, a suggestion that default risk premiums tend to reflect implied market risk.

Many researchers have wondered whether the sensitivity of the stock market to global risk should encourage central banks to also consider asset price behavior in their policy initiatives; in addition to the traditional focus of controlling inflation, reducing unemployment, and maintaining a stable economic growth (Bernanke & Gertler, 1999; Ludvigson & Steindel, 1999; Borio et al, 1994; Summers, 1986; Fischer & Merton, 1984; Blanchard & Watson, 1982). Bringing inflation under control through targeting the size and growth of money supply has been the key goal of monetary policy for years (Fischer & Merton, 1984). With inflation largely under control in recent years but with increasing volatility in the pricing of financial and real assets, it is conceivable that policy makers might begin to give more attention to asset valuation or at least the factors influencing changes in asset values. Of particular interest is the

study by Borio, Kennedy and Prowse (1994) which document the emergence of major boom-bust cycles in equity and real asset prices in the 1980s. Additionally, Bernanke and Lown (1991) are among many that attributed the U.S. recession of the early 1990s to the decline in the prices of commercial real estate. That event led to a considerable downturn in the equity market.

The 2008 global financial crisis, which was triggered by the collapse of the U.S. housing market, created upheavals in equity markets around the world prompting monetary authorities to intervene in order to stem global economic collapse. The central banks around the world were forced to employ drastic and novel measures to contain what was becoming an economic catastrophe. Although signs of the crisis appeared earlier in the first half of 2007, the downturn in the U.S. stock market actually began in September of that year. Many of the actions taken by the Federal Reserve to stem the credit crunch – such as buying commercial papers from financial institutions, guaranteeing bank-to-bank transactions, raising deposit insurance coverage, and injecting massive liquidity into the system – were reactive to the event; not proactive. Yet, in spite of its fairly late response in September 2007, the equity market was sufficiently foreboding in its warning of the impending economic recession.

Controlling excess market volatility is important in regulating the financial market system and preserving investor confidence. Volatility indicators in the financial markets include implied options volatility, which gauges investor fear in the trading of derivatives; and the Treasury-Eurodollar (TED) spread, which captures the risk premium priced into interbank loans in the international money market. Economic events that influence the behaviors of these indicators are obviously the same events that influence monetary policy actions. Therefore, if monetary authorities must consider equity market valuations or their volatilities, it would be prudent to first gauge the degree to which economic events impact changes in equity valuation through their effects on the risk indicators. To this end, this study uses a multivariate framework to examine the response of the US equity market to risk factors believed to portend economic downswings. The factors include implied options volatility, TED spread, and exchange rate. We also include an indicator variable that measures interest rate change announcements by the Federal Reserve.

## **Literature**

Debates as to whether the Federal Reserve System should extend the basis for its monetary policy decisions beyond inflation targeting and money growth have existed as long as the central bank itself. Studies that explore the linkages between macroeconomic variables typically considered in monetary policy decisions and equity market valuations have appeared in various literature. Examples, which

include citations elsewhere on this paper, are Bernanke and Gertler (1999); Ludvigson and Steindel (1999); Borio et al (1994); and Chen et al (1986).

Bernanke and Gertler (1999) explore the implications of asset price volatility for the management of monetary policy. By simulating different monetary policy rules, they conclude that asset valuation is essential only to the extent that it signals potential inflationary or deflationary forces. They insist that rules that exclusively target asset prices appear to have undesirable monetary policy side effects.

Earlier, Chen, Roll, and Ross (1986) discuss the relationship between macroeconomic risk and stock prices. The risk factors specified in their well known arbitrage pricing theory (APT) include the spread between long- and short-term interest rates, unanticipated changes in inflation and industrial production, and the spread between high and low grade bond yields. Their results show evidence that such macroeconomic variables are risk factors that are priced into equity securities.

Veronesi (1999) present a theoretical framework that formalizes the relationship between economic uncertainty and stock market volatility. The study presents evidence that investors are more sensitive to news during periods of high uncertainty, which in turn increases asset price volatility. Veronesi's study especially points to the relationship between macroeconomic factors and stock market volatility. Unfortunately, the study did not go further to identify ways to control the impact of such volatility-driven news events.

Flannery and Protopapadakis (2002) provide a path to identify the effects of macroeconomic announcements on asset price volatility while Jones et al (1998) focus on the impact of such events on the pricing of fixed income securities. In the same vein, Andersen et al (2003) show how these events impact the valuation of currencies. Using dummies for days on which important economic announcements were made, the results of these empirical studies show evidence of a linkage between macroeconomic news events and asset price volatility.

A study that directly confronts the controversy of incorporating asset price fluctuations in the formulation of monetary policy is by Cecchetti et al (2000, 116). The authors state in part that "central banks concerned with both hitting an inflation target at a given time horizon, and achieving as smooth a path as possible for inflation, is likely to achieve superior performance by adjusting its monetary instruments not only to inflation (or its inflation forecast) and the output gap, but to asset prices as well." In this way, they argue, monetary authorities would be able to reduce the likelihood of asset price bubbles and the risk of

boom-bust investment cycles. While not necessarily advocating that policy makers target asset prices exclusively, they indicate that asset price bubbles create distortions in consumption and investment which sometimes result in undesirable changes in both real output and inflation.

The position of Cecchetti et al (2000) is influenced by the evidence in Poole (1970) which shows that moderating changes in asset prices reduces fluctuations in economic activity. The second intuitive argument by Cecchetti et al is based on a model presented by Kent and Lowe (1997) in which the notion of asset price misalignments is discussed. Bernanke and Gertler (2001) disagree with Cecchetti et al, arguing that central banks should not respond to stock market bubbles over and above its reaction to inflation and the output gap. Using a modified version of their 1999 model, Bernanke and Gertler maintain that reacting to share price misalignments is counterproductive except where asset price volatility affects inflation forecast.

Batini and Nelson (2000) use a framework similar to Cecchetti et al (2000) to look at whether central banks should react to asset price changes when setting interest rates. The financial asset examined in their study is foreign currency. Crucially, they presume that policymakers are unable to distinguish whether financial or real shocks are the source of exchange rate movements. While their results are inconclusive, they suggest that strictly reacting to exchange rate movements in the formulation of monetary policy may be counterproductive.

The purpose of this present study is to explore the linkages between equity valuation and the systematic risk factors that often shape the implementation of monetary policy. These risk factors are those that tend to reveal investor sentiments ahead of a market downturn. The global financial crisis that erupted in 2008 forced central banks around the world to aggressively move to ease credit in order to prevent a worldwide economic collapse. Equity markets around the world went on a tailspin in reaction to not only the inordinate credit risk in the financial markets but also the initial sluggish response by authorities to the severity of the crisis. In this regard, the ability of the stock market to anticipate the crisis begs the question as to whether it deserves a place in the formulation of monetary policy.

## **Data and Methodology**

In order to investigate the relationship between equity market performance on the one hand and a set of market and credit risk factors on the other, we specify the following multivariate model using daily data:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \varepsilon_t$$

where

Y = Stock returns (proxied by total returns on S&P 500)

X1 = Implied options volatility (proxied by CBOE's volatility index, VIX)

X2 = Dollar-euro exchange rate, expressed in U.S. dollars

X3 = TED spread

X4 = 1, if interest rate change occurred at end of FOMC meeting; 0 if not

The Sample period is from January 2004 to February 2009. Data sources are as follows: S&P 500 is from CRSP, implied options volatility is from the Chicago Board Options Exchange, exchange rates are from the Oanda database, and TED spread is from the Bloomberg market site. All data are utilized in their natural logarithm. To verify the existence of a long-run relationship between the variables, we employ the method of cointegration in the sense of Johansen (1991). The vector error correction (VEC) model is of the form:

$$\Delta Y_t = \alpha_0 + \alpha_1(Y_{t-1} - \delta X_{t-1}) + \sum c_i \Delta X_{t-i} + \sum d_i \Delta Y_{t-i} + \varepsilon_t$$

Naturally, if the series are cointegrated, an error-correction model becomes necessary to investigate the short-run dynamics of the cointegrated series. In its stead, we consider the variance decompositions of the series as a way to examine the short-run effects.

Implied volatility measures the expected market risk priced into an option contract. Because options are bets on future stock price movements, implied volatility serves as an indicator of near-term market anomaly, rising as uncertainty grows and falling as the market stabilizes. Ted spread is calculated by subtracting the yield on three-month U.S. Treasury bills from the three month dollar London Interbank Offered Rate (LIBOR). The latter is the short-term interbank lending rate for U.S. dollar deposits outside of the United States. The difference in the two rates represents the risk premium of lending to a bank rather than to the U.S. government. A rising spread implies growing risk aversion, as investors prefer short term Treasury bills.

As can be seen in [Figure 1](#), there was a negative correlation coefficient of -0.94 between equity valuation and implied volatility over the course of the 2008 financial crisis. In [Figure 2](#), we find that both implied volatility and TED spread, which are very closely aligned, peaked in the height of the financial crisis, in

October 2008. According to Duff and Phelps (2009), an improvement in the trend of these risk indicators serves as precursor to the recovery of the credit markets and the overall economy.

[INSERT FIGURES 1 AND 2 HERE](#)

## **Results**

A correlation matrix of all the variables is presented in [Table 1](#). The exchange rate variable, measured in dollar terms, has a positive correlation coefficient of 0.86 with the equity index. This suggests that a falling dollar is viewed favorably since U.S. exports are buoyed. Conversely, exchange rate, like the equity index, is negatively correlated with the two risk indicators. This suggests that as the dollar strengthens (weakens), the incidence of both market and credit risk rises (falls). This behavior is explained by the tendency of investors to flock toward dollar denominated assets as safe haven over the course of a global crisis.

[INSERT TABLE 1 HERE](#)

[Table 2](#) presents the results of a multivariate regression of market valuation against implied volatility, TED spread, exchange rate, and two indicator variables that capture market reaction to interest rate change announcements by the Federal Reserve. The F statistic for the entire regression is significant at any conventional level. The signs of the coefficients conform to what would normally be expected. For example, the negative sign for the dummy variable for rate increase reflects the market's pessimism as the cost of money rises. The reverse is true when the Fed announces a rate decrease. In all, the coefficient of determination suggests that almost 90 percent of the total variation in market performance is explained by the model during the sample period.

[INSERT TABLE 2 HERE](#)

Cointegration tests are performed on the differenced series since at their levels, the variables are nonstationary. The unit root test results (not reported) indicate that all variables are I(1). Both the maximum eigenvalue and trace tests reject the null hypothesis of no cointegration at the 5% level. The finding that the variables are cointegrated means that the short-run dynamics of their relationships may be specified as a vector error-correction (VEC) model.

In [Table 3](#), we present the results of the variance decompositions of the series. We find that as far as the forecast error variance of the U.S. market is concerned, implied volatility and exchange rate contribute no more than 5.3 percent and 6.2 percent, respectively. There is hardly any meaningful contribution from TED spread. On the other hand, the outcome is quite different in the case of implied volatility, exchange rate, and TED spread. In all of these cases, the contribution of the market is remarkably high, in the double digits. For example, with respect to the forecast error variance of implied options volatility, the market's contribution is over 64 percent even up to the tenth trading day. For all periods, shocks attributed to the market with respect to implied volatility exceed those to implied volatility itself.

[INSERT TABLE 3 HERE](#)

The nature of the results is fairly consistent regardless of the ordering of the variables. Because the market explains much of the performance of the risk indicators with none of them having much explanatory power on the market, one might conclude that market performance ought not to be ignored in policy matters geared toward economic stabilization. This is again because the market appears to have much to say about the behavior of these risk variables that often portend economic crises.

## **Conclusions**

Against the backdrop of the controversy that central banks consider equity market behavior in their monetary policy formulation, this study examines the relationship between equity market valuation and a set of risk indicators that often portend financial crises. The risk indicators are implied option volatility, a measure of market risk; and TED spread, a measure of credit risk. By their ability to show remarkable changes in advance of an economic downturn, the behavior of these risk variables often reflects the nature of money supply decisions that a central bank might make. For example, implied volatility typically rises as investor pessimism grows. As well, TED spread increases as the gap between the yield on Treasury bill and the London Interbank Offered Rate rises. Such increases in TED spread suggest rising financial risk in the market. In each case, increases in either implied volatility or TED spread are reflective of a decline in investor and consumer confidence, which often is a precursor to an economic downturn.

In a multivariate analysis of these variables, this study shows, as expected, that the two risk indicators are inversely associated with the market. An exchange rate variable is also introduced into the model. Measured in terms of the U.S. dollar, we find that during the course of the 2008 financial crisis, the U.S. equity market tended to fall with an increase in the value of the dollar, suggesting perhaps that since

domestic consumption had fallen off, the impact of international trade on economic growth had become preeminent. In this sense, a fall in the value of the dollar was important to aid exports. Results of a multivariate regression also show that an announcement of interest rate decrease by the Federal Reserve resulted in an increase in equity valuation. The reverse is the case when the announcement is for an interest rate increase. We believe that such a market response is intuitive since from a signaling standpoint, a fall in interest rate signifies a weakening economy and therefore efforts by the Fed to reduce the cost of money is viewed favorably by the market.

In a vector autoregressive analysis of the variables, we find that a long run relationship exists in that the series are cointegrated. With this outcome, we investigated results of the variance decompositions of the series. We note that in all cases, the contribution of equity valuation to the forecast error variance of all the variables is substantial throughout the period. Over 14 percent of the forecast error variance of the TED spread is attributed to the market in the longest period examined. This contribution rises to 23 percent and over 64 percent with respect to the forecast error variances of exchange rate and implied volatility, respectively. All this goes to show that since market behavior plays a significant role in the variation of key financial risk indicators, the argument that equity valuation be taken into account in the formulation of monetary policy may in fact be plausible.

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