Do Futures and Options Trading Increase Stock Market Volatility?

Abstract

This objective of this study is to assess the impact of introducing stock index futures and options contracts on the volatility of the underlying stock index in India. Numerous studies of the effects of futures and options listing on the underlying cash market volatility have been done in the USA. The empirical evidence thus far suggests that the introduction of derivatives does not destabilize the underlying market; there is either no effect or perhaps a small decline in volatility. The studies also show that the introduction of derivative contracts improves liquidity and reduces informational asymmetries in the market. Studies of a few other developed markets have reached similar conclusions. In the last decade, many emerging and transition economies have introduced derivative contracts, raising some very interesting issues that are unique to emerging markets. Emerging stock markets operate in very different economic, political, technological and social environment than do markets in the US, UK or other developed countries. It is interesting to explore the impact of the introduction of derivatives in an environment of high volatility, high inflation, political risk, corruption, poor legal infrastructure and poor corporate and stock market governance. Using data on stock index futures and options contracts traded on the S & P CNX Nifty (India), this study seeks to document the impact of listing derivatives on the volatility of the underlying stock index returns. The results of this study are especially important to stock exchanges and regulators in designing trading mechanisms and contract specifications for derivative contracts, thereby enhancing their value as risk management tools.

Introduction

In the last decade, many emerging and transition economies have started introducing derivative contracts. As exchange traded futures and options contracts have become more prevalent in emerging capital markets, it is interesting to explore the impact of the introduction of derivatives in an environment of high volatility, high inflation, political risk, corruption, poor legal infrastructure and poor corporate and stock market governance, as is characterized by emerging markets. It becomes imperative that we seek answers to questions like: What is the impact of derivatives upon market efficiency and liquidity of the underlying cash market? How do we address concerns about market manipulation and systemic fragility? To what extent do derivatives destabilize the financial system, and how should these risks be addressed? Can the results from studies of developed markets be extended to emerging markets?

Following the introduction of derivative contracts in developed markets like the US and UK, researchers have sought to analyze the impact of derivatives introduction on the volatility and efficiency of the underlying cash market. The empirical evidence is however quite mixed. Most studies summarize that the introduction of derivatives does not destabilize the underlying market; either there is no effect or perhaps only a very small decline in volatility. The impact however, seems to vary depending on the time period studied.

This paper seeks to contribute to the existing literature in many ways. This is the first study to examine the impact of financial derivatives introduction on cash markets in India. Further, this study improves upon the methodology used in prior studies by using a framework that allows for generalized auto-regressive conditional heteroskedasticity (GARCH) ie, it explicitly models the volatility process over time, rather than using estimated standard deviations to measure volatility. The study also tests an enhanced version of the basic model to explicitly take into account the effect of trading volume and open interest on volatility.

The results of this study are crucial to investors, stock exchanges and regulators. Derivatives play a very important role in the price discovery process and in completing the market. Their role in risk management for institutional investors and mutual fund managers need hardly be overemphasized. This role as a tool for risk management clearly assumes that derivatives trading do not increase market volatility and risk. The results of this study will throw some light on the effects of derivative introduction on the efficiency and volatility of the underlying cash markets.

The study is organized as follows. Section 1 summarized the existing literature, Section 2 details the model and the econometric methodology to be used and Section 3 outlines the data requirements for the study.

I. Survey of Literature

Nathan Associates (1974) was the first to study the impact of listing options on the Chicago Board of Exchange. He reported that the introduction of options seemed to have helped stabilize trading in the underlying stocks. This result has been supported by Skinner (1989) and also by other authors for the UK, Canada, Switzerland and Sweden. More recent work by Lamoureux and Pannikath (1994), Freund, McCann and Webb (1994) and Bollen (1998) have found that the direction of the volatility effect is not consistent over time. After 1987, the residual variance of both optioned stocks and stocks in a matched control group increased at the time of the option listing. This might be interpreted in two ways; viz. perhaps the listing has no true impact on volatility and there is some common unknown factor that is driving the magnitude of the idiosyncratic risk for different stocks. Or perhaps, there are spill over effects associated with listing options for some stocks, such that the dynamics of other stocks also changes. (Detemple and Jorion, 1991, and Cao 1999).

In looking at the effect on liquidity, Nathan Associates (1974) found that the trading volume did not change with option introduction. However, later studies have found that the volume in the underlying stock does increase after the introduction of options.

Recently Gulen and Mayhew (2000) study the impact of futures introduction in 25 countries and find that volatility increased in the US and Japan, was not affected in some, and in others lowered volatility. Examining the existing literature, summarized by Mayhew (1999), it appears that there is no consensus on the effect of derivatives trading on volatility in the cash market. Thus stock index futures and options introduction may be associated with increasing or decreasing volatility.

II. Model and Methodology

One of the key assumptions of the ordinary regression model is that the errors have the same variance throughout the sample. This is also called the homoscedasticity model. If the error variance is not constant, the data are said to be heteroscedastic. Since ordinary least-squares regression assumes constant error variance, heteroscedasticity causes the OLS estimated to be inefficient. Models that take into account the changing variance can make more efficient use of the data. There are several approaches to dealing with heteroscedasticity. If the error variance at different times is known, weighted regression is a good method. If, as is usually the case, the error variance is unknown and must be estimated from the data, one can model the changing error variance. The GARCH model assumes conditional heteroscedasticity, with homoscedastic unconditional error variance. That is, the model assumes that the changes in variance are a function of the realizations of preceding errors and that these changes represent temporary and random departures from a constant unconditional variance, as might be the case when using daily data.

The impact of stock index futures and option contract introduction is examined using a univariate GARCH model similar to the one used by Gulen and Mayhew (2000) and Glosten,

Jagannathan and Rundle (1993), also called the GJR-GARCH model. To test for the impact on volatility of introducing futures and options trading, I incorporate an additive dummy variable in the conditional variance equation. I also enhance the basic model by introducing trading volume and open interest as additional variables in the conditional variance equation.

The time series of daily returns on the S&P CNX Nifty Index is modeled as a univariate GARCH process. Following Pagan and Schwert (1990) and Engle and Ng (1992), we need to remove from the time series any predictability associated with lagged returns and/or day of the week effects. The following equation is estimated:

$$R_t = a_0 + a_1 R_{w,t-1} + \sum_{j=2}^{5} a_j DAY_j + u_t \qquad \textbf{Equation 1}$$

where R_t is the daily return on the S&P CNX Nifty Index $R_{w,t-1}$ is the lagged world market index return and DAY_j are day-of-the-week dummy variables for Tuesday to Friday. The lagged world market index return is used as an independent variable to remove the effects of worldwide price movements on the volatility of the Nifty Index return, since we want to isolate the impact of futures/options on the volatility. For example, if the Indian market is influenced by US markets, this will be reflected through the lagged world market portfolio.

Further to correct for spurious autocorrelation induced by non-synchronous trading, the following usual autocorrelation adjustment is done:

$$u_t = b_0 + \sum_{j=1}^{5} b_j u_{t-j} + e_t \qquad \textbf{Equation 2}$$

Using $\{e_t\}$ as the new return series, I now proceed to test for the effect of options/futures introduction on the conditional volatility of the spot market. In GARCH, the residuals $\{e_t\}$ from Equation 2 are assumed to be distributed $N(0, h_t)$ where the conditional volatility h_t is given by the following equation:

$$h_t = g_0 + g_1 h_{t-1} + g_2 e_{t-1}^2 + g_4 \max(0, -e_{t-1})^2 + g_5 D_t \qquad \textbf{Equation 3}$$

where D_t is a dummy variable that takes on a value of zero before the options/futures were introduced and a value of one after. A significant positive value for γ_5 would indicate that derivatives introduction increase the volatility of the underlying index.

The enhanced version of this model takes into account the effect of trading volume (VOLUME) and open interest (OPINT) on volatility. The conditional volatility for this enhanced model is given by the following equation:

$$h_t = \gamma_0 + \gamma_1 h_{t-1} + \gamma_2 e_{t-1}^2 + \gamma_4 \max(0, -e_{t-1})^2 + \gamma_5 D_t + \gamma_6 VOLUME + \gamma_7 OPINT$$

Equation 4

Section III. Data

The data required for this study include the following:

- Daily and Intraday returns on the S&P CNX Nifty Index
- Daily/Intraday data on the prices, trading volume, and open interest for the options/futures contracts, both for the index and the individual stocks for which options contracts were introduced.
- Daily/Intraday returns on the stocks comprising the Nifty Index, including trading volume, bid and ask prices, high/low price and any fundamental data available for each stock/company.
- A summary of the eligibility provisions for stocks that were chosen to have options/futures listed.
- Daily return data for a proxy world market portfolio; eg. Morgan Stanley world market index, or the US S&P 500/ Dow index.

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