Responses to the first and second Referees

Title: Stock Returns and Implied Volatility: A New VAR Approach.

Economics Discussion Papers, No 2012-51

Dear editors:

Thank you very much for providing us with your valuable comments. Although the second referee is skeptical about this paper, the first referee's report is quite favorable. We have revised the paper based on the first referee's report and re-submitted the revised paper. Now we are revising our paper again based on the second referee's report. We are sure that we can revise our paper accordingly and we believe that our revised paper will satisfy the first and second referees and editors. The second referee could only read the old (initial) version of this paper. Some of the second referee comments are already addressed in the revised version. In addition, we are willing to revise the paper again addressing the concerns of the second referee.

Second Referee's Comment 1:

"The only potential contribution of the paper is to quantify this asymmetric relationship in a better and robust way. The only evidence that the authors provided in this regard is the plot of impulse responses of volatility to positive and negative shocks of return in Pane B of Figure 1 and 2."

Response:

The contribution of this paper is not confined to the findings of the asymmetric volatility response. Since most of previous studies have used GARCH models, they could not examine the dynamic response and impulse response of the volatility. Bong Soo Lee (the first author of this paper) recently proposes a new identifying restriction for VAR in his seminal paper (Lee (2010), *Journal of Banking and Finance*) and applies it to the inflation shocks. Our paper is the first study that applies the new VAR identification method to examine the dynamic return-volatility relationship. No previous research in this field focuses on the dynamic impulse response of the volatility to examine the asymmetric volatility issue.

Further, we provide evidence of different patterns between the developed market (U.S. Market) and the emerging market (Korean Market). We explain this result by the unique market behavior of the KOSPI200 options market. For example, "*One possibility is that some of options buyers overreact to the market signal. Uninformed or less informed traders tend to overly buy call options in response to a positive return shock and this causes the additional increase of the call prices. The increase of call prices implies the increase of the implied volatility. If the magnitude of this increase is larger than that of decrease of the implied volatility that is caused by the positive return shock (as the asymmetric*

volatility theories suggest), we observe the initial increase of the volatility in response to the positive return shock as in Panel B of Figure 2. On the other hand, the traders might overly buy put options when they face a negative return shock. This leads to an additional increase of the put prices and implies an increase of the implied volatility. In this case, however, the direction of the volatility change is consistent with that suggested by the asymmetric volatility theories (i.e., the sharp increase of the volatility in response to a negative shock.).

Among market practitioners, it is widely believed that, in the KOSPI200 options market, domestic individual investors tend to regularly and overly buy the options and overreact in response to positive news of the underlying market (Kim and Ryu, 2012). Further, the existence of the special options accounts makes buying the KOSPI200 options more easily implementable than writing the options. Since the early period of the KOSPI200 options market, the Korea Stock Exchange (KRX) has promoted the options trading by inducing individual investors to open the special accounts that prohibit the investors from writing the options instead of requiring relatively lower level of margin account. Given that noisy individuals with little wealth and trading experience prefer to use the special accounts, they are more likely to overreact and be affected by the behavioral biases. This seems to result in somewhat different patterns in the VKOPSI responses compared to the U.S. market."

We will emphasize why our empirical findings are interesting and meaningful in the revised version. We will clearly motivate our paper in the Introduction section.

Second Referee's Comment 2:

"No confidence intervals qualifying significance of the responses are shown. No estimates of the structural VAR model itself are shown. Are the coefficients significant? Do their signs make sense? How do the residuals behaviour? Is the specified VAR model a good model for the considered data of return and volatility? How do the results in this paper shed light on the issue at hand in a better manner comparing to the existing literature?"

Response:

These comments are mainly econometric issues. We can address each of these comments. We have already estimated the confidence interval of the impulse responses using the method provided by Runkle (1989). Coefficients of the impulse responses are significant. However, we did not report it to save space. We can report the estimated results in the revised paper or send it to the referee. To examine the behavior of the residuals is an easy task. We can do it too. The advantage of this new VAR approach is already explained. In the revised paper, we can also clearly motivate why this new VAR approach is needed to examine the asymmetric volatility phenomenon.

Since previous studies employ the GARCH framework, the results are somewhat model driven and they fail to detect the different and unique dynamic pattern of the asymmetric volatility in the emerging market. While the Korean market is classified as an emerging market, the research on this market applying a rigorous new approach is needed considering the fact that the KOSPI200 options contract that determines the dynamics of the VKOSPI is the most actively traded derivative asset in the world. We also believe the use of the new VAR approach gives us new insights into this topic and this market. We will further explain this in a new revised version.

Second Referee's Comment 3:

"Moreover, the paper is written in an unclear fashion, which requires the effort of readers to understand. Without looking at the model specification in Lee (2010) I cannot understand the methodology since the description in the paper is not even correct. On page 3, the authors write that b110+b110=0, which is the identifying restriction assuming positive and negative shocks have the same magnitude with an opposite sign. This is the central piece of the methodology. However, it is wrongly specified. The correct restriction from Lee (2010) shall be b110+b120=0. And the most important results of the impulse response from negative and positive shocks are depicted in an unclear way. There is no notation for which response is from which shock in Figure 1 and 2. As a reader I have to make a deduction by myself."

Response:

Yes. We admit our mistake in the initial version. This was a typo. We are very sorry for that. We noticed this and have already corrected this typo in the revised version in response to the first referee's comment. We will carefully revise our paper again. We added the footnotes and clear explanation in all Figures and Tables. We will further revise our paper to make it more reader-friendly. We make a separate section to explain the models and background, the reasons that we use the new VAR model, and the advantage of our model. We will also provide more related literature for the potential readers of this article.

For your convenience, I attach how we have revised and improved our paper in response to the first referee's report.

Based on your comments, we have extensively revised the paper. In addition to addressing the referee comments, we have added some references and rewritten some sentences/footnotes. Further, we have also discussed why the suggested topic is important and it is needed to be investigated in the KOSPI200 options market and the VKOSPI in Sections 1 and 2 of the revised paper. Following the referee suggestion, we have also rewritten some vague expressions and typos. As a result, we believe

that the paper has been significantly improved.

We have revised the paper as follows:

1. We have added Section 2 ("The KOSPI200 Options Market and the VKOSPI") to explain why the suggested topic is important by providing some motivations of this study. Section 2 shows the unique characteristics of the KOSPI200 options market and the VKOSPI that may result in the different empirical results from the U.S. market.

In Section 2, we also explain that the VKOSPI is not a noisy measure and it has been tested in some previous studies. To reflect the referee's comment, we suggest some future research topics in the Conclusion section.

For example, in the revised paper, "*For the identification of the dynamic and asymmetric return-volatility relation under the framework discussed in the previous section, implied volatility will be more appropriate than realized or historical volatility because implied volatility can gauge the expectation and sentiment of market participants. On the other hand, realized or historical volatility contains little information on investors' expectation of future states and market sentiments. Therefore, the analysis based on the implied volatilities will provide rich implications on the corresponding market.*

Among implied volatility candidates, a model-free implied volatility is known to have more explanatory power than those candidates dependent on option pricing models such as the Black-Scholes or Heston models. The most widely used model-free implied volatility indicator is VIX, which represents the volatility index implied by the S&P500 option prices. The S&P500 options market and the volatility index (VIX) implied by the S&P500 options have been covered by numerous academics papers. Therefore, the characteristics of the VIX of the U.S. market are fully analyzed and well-known to academicians and market practitioners. On the other hand, only a handful of studies have analyzed the KOSPI200 options, the most actively traded options in the world. Further, to the best of our knowledge, only two published articles (Ryu, 2012; Han et al. 2012) examine the VKOSPI. Given that the KOSPI200 index options are top-tier options products in terms of high trading volume and investors' interest, there is a good reason for research efforts using the model-free implied volatility of the emerging market.

Since the Korea Exchange introduced the KOSPI200 index options in 1997, the trading volume of the KOSPI200 options has sharply increased. Now, the KOSPI200 options market is the most liquid derivatives market in the world. From its early stage, highly speculative individuals dominated the options market. Although the trading volume of professional and experienced investors has steadily increased and their trading activity now accounts for a significant portion of the total trading volume,

the speculative traders and/or domestic individual investors are still major market players in the KOSPI200 options market.

Inspired by the great success of the KOSPI200 options market, the KRX recently published VKOSPI, the official volatility index for the KOSPI200 stock index, at April 13, 2009. The VKOSPI is calculated from the KOSPI200 index and options prices based on the model-free method. Therefore, the VKSOPI reflects the market sentiment and investors' expectation embedded in the market prices of KOSPI200 options. Further, this VKOSPI can be regarded as a representative market index to describe the Korean market in that the transaction of the stocks underlying KOSPI200 index and the KOSPI200 index options account for a dominant portion of the total transactions in the Korean financial market.

Ryu (2012) and Han et al. (2012) also confirm that the VKOSPI has desirable qualities as a stock market indicator and contains significant and meaningful information contents on the Korean financial market. They also report that the VKOSPI captures the major shocks to the global economy and shows movements similar to the VIX, which is a major U.S. market indicator. In addition, its elaborate logic presented in the construction equations (see Ryu (2012)) also makes the VKOSPI as a less noisy indicator and as an appropriate fear-gauge for the Korean market."

2. As the referee suggests, we minimize the use of vague expressions such as "dynamic". We use the term only when it is necessary to use.

3. We have added some detailed discussions about the reason we get the unique patterns of the implied volatility response in the Korean market. We attribute it to the characteristics and option market behavior of the KOSPI200 options market.

For example, in the revised paper, "*We attribute this unique pattern observed in the Korean market to the characteristics of the KOSPI200 options market and the trading behavior in the Korean financial market.*

One possibility is that some of options buyers overreact to the market signal. Uninformed or less informed traders tend to overly buy call options in response to a positive return shock and this causes the additional increase of the call prices. The increase of call prices implies the increase of the implied volatility. If the magnitude of this increase is larger than that of decrease of the implied volatility that is caused by the positive return shock (as the asymmetric volatility theories suggest), we observe the initial increase of the volatility in response to the positive return shock as in Panel B of Figure 2. On the other hand, the traders might overly buy put options when they face a negative return shock. This leads to an additional increase of the put prices and implies an increase of the implied volatility. In this case, however, the direction of the volatility change is consistent with that

suggested by the asymmetric volatility theories (i.e., the sharp increase of the volatility in response to a negative shock.).

Among market practitioners, it is widely believed that, in the KOSPI200 options market, domestic individual investors tend to regularly and overly buy the options and overreact in response to positive news of the underlying market (Kim and Ryu, 2012). Further, the existence of the special options accounts makes buying the KOSPI200 options more easily implementable than writing the options. Since the early period of the KOSPI200 options market, the Korea Stock Exchange (KRX) has promoted the options trading by inducing individual investors to open the special accounts that prohibit the investors from writing the options instead of requiring relatively lower level of margin account. Given that noisy individuals with little wealth and trading experience prefer to use the special accounts, they are more likely to overreact and be affected by the behavioral biases. This seems to result in the slightly different patterns in the VKOPSI responses compared to the U.S. market."

4. We have added some footnotes to Figures and Tables to improve their readability.

For example, in the revised paper, "

This figure shows the impulse responses of stock market return and volatility to positive and negative return shocks (e_{1t} and e_{2t}) for the U.S. market. The VAR model used to calculate the impulse response is as follows: $Y_t=B(L)e_t$, where $Y_t=[Y_{1t}, Y_{2t}]^T$, $e_t=[e_{1t}, e_{2t}]^T$, and L is lag operator. Y_{1t} is the log return of the S&P500 index price and Y_{2t} is the firs-order difference of the VIX level. Panel A shows the impulse responses of the stock market return to its positive and negative return shocks, and Panel B shows the impulse responses of the VIX change to the positive and negative return shocks. The X-axis represents the passage of time after the shock (in terms of the trading days) and the Y-axis represents the magnitudes of coefficients of the impulse responses in each time interval.

This figure shows the impulse responses of stock market return and volatility to positive and negative return shocks (e_{1t} and e_{2t}) for the Korean market. The VAR model used to calculate the impulse response is as follows: $Y_t=B(L)e_t$, where $Y_t=[Y_{1t}, Y_{2t}]^T$, $e_t=[e_{1t}, e_{2t}]^T$, and L is lag operator. Y_{1t} is the log return of the KOSPI200 index price and Y_{2t} is the firs-order difference of the VKOSPI level. Panel A shows the impulse responses of the stock market return to its positive and negative return shocks, and Panel B shows the impulse responses of the VKOSPI change to the positive and negative return shocks. The X-axis represents the passage of time after the shock (in terms of the trading days) and the Y-axis represents the magnitudes of coefficients of the impulse responses in each time interval.

This table presents the forecast error variance decomposition of stock market returns and the decomposition of the implied volatilities.

The VAR model used to calculate the coefficients is as follows: $Y_t=B(L)e_t$, where $Y_t=[Y_{1t}, Y_{2t}]^T$, $e_t=[e_{1t}, e_{2t}]^T$, and L is lag operator. Y_{1t} is the log return of the S&P500 or KOSPI200 index price and Y_{2t} is the firs-order difference of the VIX or VKOSPI level. The table presents the percent of each variance attributable to each orthogonal shock (e_{1t} or e_{2t}) during the period that spans from the current date (time t) to 10 days-ahead from the current date. Panel A shows the results of the U.S. market, and Panel B shows the results of the Korean market. ”

5. Following the referee’s comments, we have added some future direction of the further studies in this area. And we explain that the VKOSPI is not a noisy measure.

For example, in the revised paper, “*This study is expected to be a stepping-stone for further empirical research on the VKOSPI and other implied volatility indices of global financial markets. Some possible extensions are as follows. To describe the volatility dynamics, one might decompose the VKOSPI into observed and unobserved components based on steady space models (e.g., Kalman filtering). Or one can apply the signal noise filtering technique to eliminate the noise that might be embedded in the VKOSPI. Recently, the KRX is preparing to launch some derivatives underlying the VKOSPI (e.g., VKOSPI futures and VKOSPI options). The asymmetric volatility may show different patterns after these VKOSPI-related derivatives are actively traded.*”
“*However, considering the desirable properties and elaborateness of the VKOSPI that we have explained in Section 2, these kinds of possibility can be relatively low.*”

6. We have revised and corrected many sentences to explain our claims more clearly.

Thank you very much for your valuable comments!