CHAPTER - 5
FINDINGS, SUGGESTIONS AND CONCLUSION

5.1 Findings
The previous chapter dealt with data analysis and interpretation of the study. Data analysis comprises of descriptive statistics of daily trading volume, return of underlying and stock futures. Tested the specification of Hemler and Longstaff model. Assessed the pricing performance of all the three pricing models for both individual stock futures and indices. Shapiro-Wilk test has been used to test normality of spot and futures return. Regression analysis has been used to test the specification of HLM and impact of various factors on Absolute Pricing Errors (APE). Independent t test and Kormogorov- Smirnov Z test has been used to test the hypothesis of MAPE statistics, obtained from each model are statistically different from each other.

In this chapter findings, suggestions and conclusions of the study will be presented. The findings of the study are classified in to five different groups based on the analysis and interpretation of the study as under.

A. Descriptive statistics of daily trading volume and return of spot and futures market.
B. Results of regression analysis -Testing the specification of Hemler and Longstaff Model
C. The pricing performance of all the three pricing models for both individual stock futures and stock index futures
D. Results of Independent t test and Kormogorov- Smirnov Z test - The MAPE statistics, obtained from each model are statistically different from each other.
E. Results of regression analysis - Impact of various factors on Absolute Pricing Errors (APE).
A. Descriptive statistics of daily trading volume and return of spot & futures market

i. The Shapiro-Wilk statistics for all the individual stock futures and index futures are found significant at 1% level. It implies that the return series of all the 41 individual stock futures and three stock index futures are not normally distributed.

ii. The Shapiro-Wilk statistics for all the underlying stocks and indices are found significant at 1% level. It implies that the return series of all the 41 underlying stocks and three underlying indices are not normally distributed.

iii. The average daily trading volume is substantially larger for CNX Nifty index futures (442492), followed by Bank Nifty index futures (52007) and CNX IT index futures (305).

iv. The highest average daily trading volume of more than 10000 can be observed for 8 stock futures in the descending order - Reliance Industries (35108) followed by SBIN (28710), ICICI Bank (23134), Tata Steel (17490), Larsen &Toubro (13312), Cairn India (12627), Tata Motors (12483) and Axis Bank (10210).

v. The lowest average daily trading volume of less than 2000 can be observed for 8 stock futures in the descending order - UltraTech Cement (770), followed by Lupin (1338), Grasim Industries (1349), Dr. Reddy's Laboratories (1587), Ambuja Cements (1672), Sun Pharmaceutical Industries (1762), GAIL (1781) and BPCL (1957).
B. Testing the specifications of CCM and HLM

i. The analysis of testing the specifications CCM and HLM using Hemler and Longstaff regression framework for three stock index futures and forty-one individual stock futures found that the regression results of two stock index futures - CNX Nifty & CNX IT index futures and as well as eighteen individual stock futures [Bharti Airtel, BHEL, BPCL, GAIL, HCL Technologies, HDFC, HDFC Bank, ICICI Bank, Jaiprakash Associates, Kotak Mahindra Bank, Lupin, M&M, ONGC, Reliance Industries, Sun Pharmaceutical Industries, Tata Motors, Tata Power and TCS] support neither the specifications of the CCM or nor the Hemler& Longstaff equilibrium model.

ii. The regression results of Bank Nifty index futures and remaining twenty three individual stock futures [ACC, Ambuja Cements, Axis Bank, Bank of Baroda, Cairn India, Cipla, Dr. Reddy's Laboratories, Grasim Industries, Hero MotoCorp, Hindalco Industries, HUL, IDFC, Infosys, ITC, Jindal Steel & Power, Larsen & Toubro, Maruthi Suzuki India, PNB, Ranbaxy Laboratories, SBI, Tata Steel, UltraTech Cement, WIPRO] are consistent with the empirical implications of the H & L equilibrium model and support HLM.
C. Pricing performance of all three futures models

Pricing performance of three stock index futures

i. CCM overprices all the three stock index futures – Nifty futures, Bank Nifty futures and CNXIT futures contract by an average of -0.1484%, -0.1460% and -0.1620% respectively. HLM overprices two stock index futures – CNX Nifty and IT by an average of -0.0243% & -0.0298% respectively. Additionally, HLM underprices Bank Nifty futures by an average of 0.0054%. Further, HWM underprices all the three stock index futures Nifty, Bank Nifty and IT index by an average of 0.0093%, 0.0088% & 0.0075% respectively.

ii. The study found that, the MAPE of HWM provides the best and more accurate pricing performance (0.1611%, 0.1811%, & 0.2032%) than the CCM & HLM for all the three stock index futures – CNX Nifty, Bank Nifty & CNXIT respectively.

iii. The study found that the MAPE of HLM provides best pricing performance (0.2440%, 0.2701%) than the CCM for CNX Nifty and Bank Nifty index futures. The MAPE of HLM provides worst pricing performance (1.3148%) for CNX IT index futures than other models.

iv. In cases indices, CNX Nifty index futures which has highest trading history and average trading volume during the sample period has the lowest Mean Absolute Error (MAPE) than the Bank Nifty and CNX IT index futures for all the three futures pricing models – CCM, HLM and HWM.

Pricing performance of individual stock futures

i. The result of analysis found that for 32 individual stock futures, the MAPE of CCM is significantly lower than the HLM and only nine individual stock futures [ACC, BHEL, CIPLA, Hero MotoCorp, HUL, Infosys, Maruthi Suzuki
India, Tata motors and UltraTech Cement], the MAPE of HLM is slightly better than the CCM.

ii. The pricing performance of HWM provides better and more accurate pricing performance than the CCM and HLM. The MAPE of HWM is significantly lower than the CCM for 40 individual stock futures and only one stock futures [Jindal Steel] the MAPE of CCM is lower than the HWM. Finally, the MAPE of HWM is significantly lower than the HLM for all the 41 individual stock futures.

**Overall pricing performance of both stock and index futures**

i. Overall, the study found that HWM which incorporates price expectation parameter, assume that capital markets are imperfect and an argument of incomplete arbitrage mechanism provides the best and more accurate pricing performance than the CCM and HLM for all the three stock index futures and 40 individual stock futures.

ii. The CCM with an assumption of capital markets are perfect and no arbitrage argument provides slightly better pricing performance than HLM for individual stock futures and one index futures (CNX IT). The CCM does not provide better pricing performance in two stock index futures – CNX Nifty, Bank Nifty.

iii. The HLM with an assumption that capital markets are perfect incorporates market volatility and risk free interest rate, provides marginally better pricing performance than the CCM for two stock index futures (CNX Nifty and Bank Nifty). Overall, it provides worst pricing performance than the HWM and CCM for individual stock futures.
D. Results of Independent t test and Kormogorov- Smirnov Z test

i. The results of Independent t test and Kormogorov- Smirnov Z test for stock index futures found that the MAPE statistics obtained from each model (CCM & HLM, CCM & HWM and HLM & HWM) are statistically significant at 1% level for all the three stock index futures. Thus, it implies that the MAPE values obtained from CCM & HLM, CCM & HWM and HLM & HWM are statistically different for all the three stock index futures - CNX Nifty, Bank Nifty and CNX IT.

ii. The results of Independent t test for individual stock futures found that the MAPE statistics obtained from each model (HLM & HWM and CCM & HWM) is statistically significant at 1% level for all the forty one individual stock futures. Thus, the MAPE values ascertained from HLM & HWM and CCM & HWM are statistically not equal. Further the study found that the MAPE statistics obtained from CCM & HLM is significant at 1% for 37 individual stock futures, significant at 10% for only one stock futures (HCL) and is statistically insignificant for three individual stock futures (HDFC, Lupin and BHEL).

iii. The results of Kormogorov- Smirnov Z test for individual stock futures found that the MAPE statistics obtained from each model (HLM & HWM, CCM & HWM and HLM & CCM) is statistically significant at 1% level for all the individual stock futures except one individual stock futures (HUL) which is significant at 5% level for CCM & HWM. Thus, the MAPE values ascertained HLM & HWM, CCM & HWM and HLM & CCM are statistically not equal.
E. Impact of various factors on Absolute Percentage Errors of futures pricing models for stock index futures

i. All the three stock index futures for CCM, HLM & HWM, and the coefficients of absolute percentage errors of 1 day lags ($\beta_1$) are found positive and statistically significant at 1% level. This implies that there is a strong impact of previous day’s mispricing on present day’s mispricing.

ii. All the three stock index futures for CCM and HLM, the coefficients of absolute percentage errors of 2 day lags ($\beta_2$) are found positive and statistically significant at 1% level. It implies that there is a strong impact of previous two day’s mispricing of CCM and HLM on present day’s mispricing of stock index futures.

iii. More interestingly, for HWM which incorporates price expectation parameter, assume that capital markets are imperfect and an argument of incomplete arbitrage mechanism, the $\beta_2$ is found negatively significant for one index futures (CNX IT), and found insignificant for two stock index futures (CNX Nifty & CNX IT). Overall, it implies that there is no impact of previous two day’s mispricing of HWM on present day’s mispricing.

iv. All the three stock index futures for CCM and HWM, two stock index futures for HLM, the coefficients of time to maturity ($\beta_3$) are found positive and significant. Additionally, one index futures for HLM, the coefficients of time to maturity ($\beta_3$) are found insignificant. Altogether from all the three pricing models 8 out of 9 stock index futures, $\beta_3$ is found positive and significant. Thus, there is an impact of time to maturity on Absolute Percentage Errors (APE) of stock index futures. Due to uncertainty in dividend payment, market volatility and arbitrage opportunity, Absolute Percentage Errors (APE) increase with the time to maturity.
Only one index futures for CCM, the coefficients of futures trading volume ($\beta_4$) are found positive and significant. Further, one index futures for CCM and HLM, the $\beta_4$ is found negative and significant. Additionally, 4 stock index futures, $\beta_4$ is found insignificant. Altogether from all the three pricing models 4 out 9 indices found negatively significant, 1 out of 9 found positively significant and 4 out of 9 found insignificant. Overall the results found that there are conflicting argument with respect to the nature of relationship between trading volume and absolute percentage errors. The sign of the coefficient of futures trading volume ($\beta_4$) in the overall sample for stock index futures gives the mixed results and difficult to interpret and conclude the nature of relationship between trading volume and absolute percentage error.
Impact of various factors on Absolute Percentage Errors of futures pricing models for individual stock futures

i. 40 stock futures for CCM, 41 stock futures for HLM and 39 stock futures for HWM, the coefficients of absolute percentage errors of 1 day lags ($\beta_1$) are found positive and significant. Additionally, only 3 stock futures (1 CCM, 2 for HWM), the $\beta_1$ is found insignificant. From all the three pricing models altogether 120 out of 123 stock futures, the coefficients of absolute percentage errors of 1 day lags ($\beta_1$) are found positive and significant. This implies that there is a strong impact of previous day’s mispricing on present day’s mispricing.

ii. 39 stock futures for CCM and 38 stock futures for HLM, the coefficients of absolute percentage errors of 2 day lags ($\beta_2$) are found positive and significant. Additionally only 3 stock futures $\beta_2$ is found insignificant. It implies that there is a strong impact of previous two day’s mispricing of CCM and HLM on present day’s mispricing of stock futures.

iii. Further, for the HWM, the coefficients of absolute percentage errors of 2 day lags ($\beta_2$) are found positive and significant for 23 stock futures, negative and significant for 4 stocks and insignificant for 14 stocks. It implies that, the sign of the coefficient of absolute percentage errors of 2 day lags ($\beta_2$) in the overall sample of HWM gives the mixed result and difficult to interpret and conclude whether previous two day’s mispricing of HWM impact on present day’s mispricing of stock futures.

iv. The coefficients of time to maturity ($\beta_3$) for 39 stock futures of CCM & HWM and 38 stock futures for HLM are found positive and significant. Further one stock futures for CCM & HWM and 2 stock futures for HLM, $\beta_3$ is found negative and significant. Additionally, only 3 stock futures, $\beta_3$ is found insignificant. Altogether from all the three pricing models 116 out of 123 stock futures, the coefficients of time to maturity ($\beta_3$) are found positive and significant. Thus, there is an impact of time to maturity on
absolute percentage error (APE) of individual stock futures. Due to uncertainty in dividend payment, market volatility and arbitrage opportunity, Absolute Percentage Errors (APE) increase with the time to maturity.

v. Altogether from all the pricing models 50 out of 123 stock futures (14 for CCM, 16 for HLM and 20 for HWM), the sign of the coefficient of futures trading volume (β₄) is found positive and significant. Further, altogether 16 out of 123 stock futures (5 for CCM, 3 for HLM and 8 FOR HWM); (β₄) is found negative and insignificant. Additionally, 57 out of 123 stock futures, β₄ is found insignificant. Overall the results found that there are conflicting argument with respect to the nature of relationship between trading volume and absolute percentage errors. The sign of the coefficient of futures trading volume (β₄) in the overall sample for stock futures gives the mixed results and difficult to interpret and conclude the nature of relationship between trading volume and absolute percentage error.
## Findings Summary

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<th>SI No.</th>
<th>Objectives of the study</th>
<th>Null Hypothesis</th>
<th>Findings</th>
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<tbody>
<tr>
<td>1</td>
<td>To assess the behavior of individual stock futures &amp; stock index futures prices of selected stocks and indices in National Stock Exchange of India.</td>
<td>Futures and spot returns of both individual stocks and indices are normally distributed</td>
<td>• Futures and spot returns of both individual stocks and indices are not normally distributed.</td>
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| 2      | To examine the futures pricing models | --- | • The regression results of two stock index futures - CNX Nifty & CNX IT and as well as 18 individual stock futures support neither the specifications of the CCM or nor the HLM.  
• The regression results of Bank Nifty index futures and remaining twenty three individual stock futures are consistent with the empirical implications of the H & L equilibrium model and support HLM. |
| 3      | To compare the pricing performance of futures pricing models for selected individual stock futures & index futures and determine the best futures pricing model. | There is no significant difference in Mean Absolute Percentage Error (MAPE) statistics obtained from CCM, HLM and HWM for stock index futures. | • Mean Absolute Percentage Error (MAPE) statistics obtained from CCM, HLM and HWM are statistically not equal for all the three stock index futures.  
• The HWVM provides best pricing performance than the CCM & HLM for all the three stock index futures.  
• The HLM provides best pricing performance than the CCM for CNX Nifty & Bank Nifty index futures and provides worst pricing performance for CNX IT Index futures than other models.  
• In case of performance of indices, CNX Nifty index futures has the lowest MAPE than the Bank Nifty and CNX IT index futures for all the three futures pricing models.  
• The mean pricing error ascertained from each model is statistically not equal for all the 41 individual stock futures. |
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<td><strong>There is no significant difference in Mean Absolute Percentage Error (MAPE) statistics obtained from CCM, HLM and HWM for individual stock futures.</strong></td>
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<td><strong>Overall, the study found that HWM provides the best and more accurate pricing performance than the CCM and HLM for individual stock futures.</strong></td>
<td><strong>The F values are indicating that the given regression model explains major proportions of variations in Absolute Percentage Error of pricing models for both the individual stock futures and stock index futures.</strong></td>
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<td><strong>The CCM with an assumption of capital markets are perfect and no arbitrage argument provides slightly better pricing performance than the HLM for individual stock futures.</strong></td>
<td><strong>There is a strong impact of previous day’s mispricing on present day’s mispricing for both individual stock futures and stock index futures.</strong></td>
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<td><strong>The HLM incorporates market volatility and risk free interest rate provides worst pricing performance than HWM and CCM for individual stock futures.</strong></td>
<td><strong>There is a strong impact of previous two day’s mispricing of CCM and HLM on present day’s mispricing of stock futures for both individual stock futures and stock index futures.</strong></td>
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<td><strong>To analyze the impact of various factors on Absolute Pricing Errors of futures pricing models for selected individual stock futures and indices.</strong></td>
<td><strong>There is no impact of explanatory factors on the Absolute Pricing Error of three futures pricing models (CCM, HLM and HWM) for all the stock index futures and Individual stock futures.</strong></td>
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<td><strong>There is no impact of previous two day’s mispricing of HWM on present day’s mispricing for all the three index futures.</strong></td>
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<td><strong>The HWM gives the mixed result and difficult to interpret and conclude whether previous two day’s mispricing of HWM impact on present day’s mispricing of individual stock futures.</strong></td>
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futures. Thus, absolute percentage error (APE) increases with the time to maturity.

- Overall the results found that there are conflicting arguments with respect to the nature of relationship between trading volume and absolute percentage errors for both individual stock futures and stock index futures.
5.2 Suggestions

1. All the stock index futures and individual stock futures have failed to support the specification of HLM. Thus, HLM may not provide better pricing performance in Indian futures markets. So the market participants should test the specifications of HLM before considering HLM to predict the futures prices in the market where they would like to participate.

2. The HWM with an assumption that capital markets are imperfect, an argument of incomplete arbitrage mechanism and incorporates price expectation, provides the best and more accurate pricing performance than the CCM and HLM. Therefore, in order to select futures pricing models to predict theoretical futures prices for individual stocks and stock index futures, the investors should determine the DOMI for the markets they would like to participate.

3. As HWM with implied method of price expectation provides lowest MAPE compared to CCM and HLM for all selected indices and stock futures, investors are suggested to use implied method to determine price expectation parameter. Further, investors are suggested to compare the pricing performance of HWM with other parameter estimation methods.

4. CNX Nifty index futures, which has highest average daily trading volume, and trading history, provides the best pricing performance in all the three pricing models compared to other indices. Thus, the trading volume can influence pricing performance. So the investors are suggested to consider trading volume and trading history in order to predict the prices for stock index futures.

5. Market participants are suggested to prefer CCM over HLM to predict futures prices of individual stock futures. In the case of stock index futures, investors are suggested to prefer HLM over CCM.

6. Though HLM incorporates market volatility, it unable to provide better pricing performance to the stocks and indices which have highest market volatility
during the sample period. Thus, the market participants are suggested not to give much importance to market volatility in order to predict stock futures prices in Indian markets.

7. Investors are suggested to analyze previous day’s mispricing to identify present day’s mispricing of all the three pricing models and persistent mispricing throughout the sample period for both stock and index futures.

8. Investors are suggested to analyze previous two day’s mispricing to identify present day’s mispricing of CCM & HLM and persistent mispricing throughout the sample period for both stocks and indices.

9. Investors are strongly suggested to use HWM because it provides best pricing performance and previous two day’s mispricing do not impact on present day’ mispricing when predicting futures prices of indices for individual stock futures.

10. Market participants are suggested not to invest in long term maturity futures contracts. Due to uncertainty in dividend payment, market volatility and arbitrage opportunity, absolute percentage errors (APE) increase with the time to maturity for both stock futures and indices.
5.3 Conclusion
The study examines how well the three futures pricing models (CCM, HLM & HWM) explain the behaviour of individual stock futures and stock index futures prices for Indian markets. Overall, in terms of pricing performance HWM which incorporates implied method of price expectation with an assumption of capital markets are imperfect and an argument of incomplete arbitrage mechanism provides the best & more accurate pricing performance than the CCM and HLM for all the stock index futures and individual stock futures.

The CCM with an assumption of capital markets are perfect and no arbitrage argument provides slightly better pricing performance than the HLM for individual stock futures. Additionally, The CCM provides no improvement over the HLM for the stock index futures. The HLM with an assumption of capital markets are perfect and incorporates market volatility & risk free interest rate provides marginally better pricing performance than CCM for stock index futures. Overall, it provides worst pricing performance than HWM and CCM for individual stock futures. Generally, HLM provides better pricing performance in the markets have higher volatilities, but it unable to provide better pricing performance even to the stocks which have highest volatility.

Overall, it implies that when selecting futures pricing model to predict theoretical futures prices for Indian markets, the investors should identify the DOMI for the markets they would like to participate.

The contribution of EWMA volatility is questioned because the HLM which incorporates market volatility has failed completely to provide better pricing performance than other two models for individual stock futures. But investors can consider market volatility when they would like to predict theoretical values of CNX Nifty and Bank Nifty index futures.

The APE of all the models are positively related to lagged errors for stock futures, stock index futures and suggest persistent mispricing during the sample period. Additionally, the APE of HWM not related two day lagged errors and suggest no mispricing. A long term maturity of futures contracts are positively related APE. Long term maturity contracts may create additional uncertainty regarding dividends and market volatility. Hence, APE increase with the time to maturity. Finally, from all the
three futures pricing models it imply that there are conflicting argument with respect to the nature of relationship between trading volume and absolute percentage errors and difficult to interpret and conclude the nature of relationship between trading volume and absolute percentage error.

**Scope for the future research**

The study suggests four direction for future research (1) Investigating the degree of market imperfection derived by Hsu and Wang (2004) and its impact on pricing performance of Indian futures markets. (2 ) Estimation of Hsu & Wang (2004) price expectation parameter ($u_a$) and market volatility ($V_t$) by developing other efficient methodologies and assess the pricing performance of HWM and HLM for Indian futures market respectively (3) Investigate to minimize persistent mispricing due to one day lagged errors. (4) Investigate the number & size of arbitrage for Indian stock futures markets by determination of no arbitrage boundaries.