Ideal Investment Protection in Optimistic Perceptions: Evidence From the Indian Equity Options Market

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Abstract

The study is an experiential assessment on the ability of the Indian equity options market to resist the adverse impacts that arise from unexpected changes in the underlying equity market, focusing on two distinct investor perceptions within optimistic dimension in the market, viz. the recovery phase and the growth phase, which were evident in the Indian market scenario post the period of financial upheavals due to global economic crisis during the latter half of 2000s. The risk mitigation capability of the options is examined in terms of long run integration and short run re-equilibrating relationship shown by near month calls and puts with varied stages of exercisability with their underlying equity segment in the National Stock Exchange of India. Further, the ideal hedge sizes of the options and the hedge gains resulting from affecting them in the investment profile are identified under minimum variance framework, using Diagonal BEKK GARCH. The results are indicative that all different options segments express to have the expected resistance ability during both bullish perceptions under consideration, and prove that optimal use of options with equity portfolio provides assured hedge gains in terms of reduction in un-anticipatable variances.

Keywords: ideal investment protection, hedge size, hedge gains, minimum variance hedge, diagonal BEKK GARCH, optimistic perceptions, Indian equity options market

1. Introduction

From the post financial crisis period spanning from the end of 2008, the Indian equity market expresses to have substantial expansion with a persistent bullish dimension, and a perceptional change is identifiable around November 2013, when the market regained its position prior to the steep fall caused by the crisis. As Figure 1 indicates, the first phase is a period of recovery from the upshots of global financial meltdown where the investors are stressed due to the risk implied in their positions that are far below an early optimistic level, and the second phase, which denotes a period of growth after the recovery stage, indicates a persisting optimism with less risk dimensions due to its new heights, probably backed by stubborn economic strength of the financial system. As the furtherance of development of any economic sphere is subject to its ability in attracting productive investments to its financial markets by facilitating resistance to undesirable market momentums, the responses of the system to the changes in the market perceptions gain standing in the empirical literature.
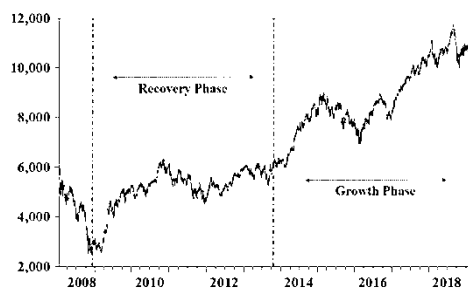

Figure 1. Historical movement of the NSE Nifty 50 index representing the recovery phase and the growth phase of the underlying market of Indian equity options

Considering risk perceptions and investment preferences of the market participants (Yang, Lee, & Ryu, 2017) in choosing either call or put options with varied levels of exercisability (Bond & Thompson, 1985), the study intends to explore the potential gains from hedging equity investments in the Indian capital market, using the financial options on them at an ideal size, with remarkable highlights on two different phases of bull domination in the market. The contributions of the present study to the finance literature are three-fold. First, it suggests a compilation of experiential methodologies for developing time series for the options market. Secondly, it estimates ideal proportions for holding diverse equity options so as to effect mitigation of uncertainties in the equity market to a maximum possible extent and the resulting gains from such hedges following minimum variance framework, instead of widely used approaches based on different options pricing models. Moreover thirdly, adding to the uniqueness of the study, it compares the efficacy of the equity options market to offer exploitable risk mitigation focusing two distinct perceptions in the bullish dimension of the equity market.

2. Review of Literature

An equity market is considered effectual when it is supported by active derivative markets for advanced risk mitigation (Ross, 1976), where derivatives are designed to transfer the effects of uncertain future events in the market to risk-lovers from risk-averters (Ederington, 1979). Amongst various derivatives, the options appeal to have effective risk reduction without compromising the benefits from profitable changes in the underlying market. Evaluations of the resistance raised by the options market to offset adverse trends in the stock market are based on the theory that a market is efficient when it does not allow the participants to gain abnormal and excess earnings from it (Fama, 1970), and the initial examinations were on the predictability of the options prices using various theoretical models (Evnine & Rudd, 1984). Other empirical methods for scrutinizing the ability of the options market to perform its fundamental function are assessments of internal market efficiency as well as cross market efficiency, where the former is measured in terms of no-arbitrage association prevailing within the options market (Aggarwal & Gupta, 2009; Zhang & Watada, 2019) and the latter is assessed with regard to the arbitrage free affiliations among the options and other markets (Kamara & Miller, 1995; Vipul, 2008; Mutum & Das, 2019). But these methods seldom validate the prime purpose of the options, as they fail to account for instantaneous simultaneity among the options market and its underlying spot market in reflecting substantial information (Chan, Chung, & Johnson, 1993), which leads to arbitrage earnings (Hentze & Seiler, 2000). Even though market frictions and other inconsistencies may cause these lead-lag relationships (Abhyankar, 1995), the pecuniary motivations from the options market, including greater flexibility, leverage and liquidity and lesser transaction costs (Fleming, Ostdick, & Whaley, 1996; Easley, O'Hara, & Sreenivas, 1998; Chakravarthy, Gulen, & Mayhew, 2004) find basis for nullification of a general notion that the options segment replicate only information already reflected in the equity market. Information share of the options market is owing to the informed participants who initially trade in the options to gain deliberate advantages (Kang & Park, 2014), and its cumulative effect develops the options market as an enhanced reservoir of information on further equity movements (Ryu, 2016). But Kim, Kim, and Nam (2009), Muravyev, Pearson, and Broussard (2013) and Mazouz, Wu, and Yin (2015) propose relative information absorption in the equity segment. Empirical evidences from India find no exemption in this, and remain inconclusive, where Srivastava (2003), Mukharjee and Mishra (2004), Debasish (2009) and Bagchi (2012) argue in favor of the options and Dixit, Yadav, and Jain (2010) and Shaikh and Padhi (2013; 2015) support initial reflection of information in the stock market.

The relative speed of reflecting information in the options segment and its underlying spot market are subject to various sensitive market circumstances (Ren, Ji, Cai, Li, & Jiang, 2019), and this temporal connections resulting from short run dynamism alone do not warrant that the options segment is suitable for facilitating the protection of investors from unwanted changes in the equity market, unless otherwise proved that both the markets move in tandem, easing the investors to offset the aftermaths of uncertainties in one market by reversing the position in the other market. When the pre-projected monotonous co-movements between the options and spot markets are violated, it is obvious that the former is unable to defuse the consequences of antagonistic movements in the latter (Bakshi, Cao, & Chen, 2000b). Thus, appropriateness of the options market for risk mitigation initiatives is evident when it expresses to maintain a long run co-movement with the underlying equity market (Hull & White, 2017). In other words, the important prerequisite for the options market to be able to minimize the effects of inexact deviations is the presence of integration between both the market counterparts. Therefore, the ability of the options market to raise resistance to the impacts of risk implied in the spot market is to be confirmed by estimating how effectively both the spot and derivative segments interact with each other to develop an equilibrating momentum between them, so as to invalidate the consequences of non-instantaneous informational absorption between both the streams (Kim, et al., 2009).

The knowledge on the usefulness of the options market in reducing the effects of risk exposure is worth only when it fetches out an ideal size at which the options facilitate lessening of the effects to a maximum possible extent (Choudhry, 2004), and the level of gain arising from such hedging strategies using the ideal size denotes the efficacy of the options market and becomes a benchmark for decision making (Cao & Huang, 2007; Hull & White, 2017). The identification of a risk dilution strategy that uses options on the spot at an ideal size is contingent upon the risk perceptions of the investors (Bond & Thompson, 1985), but surely is capable of enhancing the efficacy of the strategy (Kamara & Siegel, 1987). Modes for assessing the 'hedge gains' are also momentous for the practitioners (Brailsford, Corrigan, & Heaney, 2001), and amid minimum variance hedge (Ederington, 1979) and utility maximization hedge (Cecchetti, Cumby, & Figlwiski, 1988), the latter tends to converge in to the former, which considers hedging as formation of a perfect trade-off between risk and return, when both derivatives and spot markets expresses to have joint normality, especially for extended hedging horizons (Chen, Lee, & Shrestha, 2003; 2008). Empirical studies propose various methods for computation of ideal hedge size. The conveniently adoptable conventional method is oridinary least square (OLS) regression (Ederington, 1979), but its empirical consistency is interrogated as it does not consider co-integration among the market counterparts and short run dynamics among them in the estimation (Lien D.-H. D., 1996). The use of vector autoregression and error correction models are also questioned owing to their inability to screen the effects of dynamism among the markets (Lien & Tse, 1999; Floros & Vougas, 2006; Kenourgios, Samitas, & Drosos, 2008). But the Autoregressive Conditional Heteroskedasticity (ARCH) based dynamic models result in better estimation of ideal hedge size (Park & Switzer, 1995a; 1995b; Lien & Tse, 1999; Floros & Vougas, 2006), as an improved hedging performance is expected from the incorporation of conditional heteroskedasticity in to the estimation (Bai, Pan, & Liu, 2019). François, Gauthier, and Godin (2014) and Zhipang and Shenghong (2017) propose the use of Diagonal BEKK-GARCH model for estimating an ideal hedge size. Evidences from the futures market in India also support GARCH models in the estimation (Kumar, Singh, & Pandey, 2008; Bhaduri & Durai, 2008; Gupta & Singh, 2009; Lagesh & Padhi, 2009; Singh, 2017). Pragmatic literature on the options holds that ideal hedge size is an integral part of various pricing models (Bakshi, Cao, & Chen, 1997; 2000a; Dumas, Fleming, & Whaley, 1998; An & Suo, 2009). But, following Rao and Thakur (2008) who find the outperformance of hedge sizes proposed by Ederington (1979) and Black and Scholes (1973) in Indian derivative segments, DeMaskey (1995), Bakshi, et al. (2000a), Butterworth and Holmes (2001), Alexander and Nogueira (2007) and Hull and White (2017) hold that the minimum variance approach is appropriate for the estimation of hedge gains. However, the empirical evaluations on the hedging performance of options are studied from an option trader's perspective (Alexander & Nogueira, 2007; Hull & White, 2017), signifying the scope of the current study to focus on investor perspectives.

3. Methods

The data used to represent the Indian equity and equity options markets are daily closing values of NSE Nifty 50 index and of implied index computed from actual values of options on the index (Debasish, 2009). Manaster and Rendleman (1982) proposed the idea of implied stock level to indicate the value of the underlying asset perceived from the actual options prices. The implied index levels for all options considered in the study are determined by inverting the Black and Scholes (1973) model using the Newton-Raphson process. From the transaction data on simultaneously traded multiple options, time series is formed by selecting one contract having utmost trade volume on a trade day from near month options alone with at least one transaction on a day (Dixit, et al., 2010), but with a shift to subsequent maturity cycle before eight days to expiration (Debasish, 2009), after filtering for violations of arbitrage boundaries (Jiang & Tian, 2011) and classifying in to at-the-money (ATM), out-of-the-money (OTM), in-the-money (ITM), deep-out-of-the-money (DOTM) and deep-in-the-money (DITM) (Yang, Lee, & Ryu, 2017) call and put options.

Following the examination of fundamental properties of the data, the resistance capacity of the options market to vagaries in the stock market is scrutinized by examining the integration of the options market with its underlying equity market, using Trace and maximum Eigen value tests in the Johansen's cointegration framework (Holowczak, Simaan, & Wu, 2006), based on the relationship given equation (1).

$$P_{j,t} - \hat{\beta}_0 - \hat{\beta}_1 P_{s,t} = \hat{\epsilon}_{o,t} \tag{1}$$

The strength of the risk reduction ability of the options markets is analyzed from the short run dynamic association of the options market with the equity market using vector error correction model (VECM) (Holowczak, et al., 2006), using equation (2) and (3).

$$r_{s,t} = \alpha_1 + \alpha_s \hat{e}_{j,t-1} + \sum_{k=1}^{n} \alpha_{11}(k) r_{s,t-k} + \sum_{k=1}^{n} \alpha_{12}(k) r_{j,t-k} + \hat{\epsilon}_{s,t} \tag{2}$$

$$r_{j,t} = \alpha_1 + \alpha_j \hat{e}_{j,t-1} + \sum_{k=1}^{n} \alpha_{21}(k) r_{s,t-k} + \sum_{k=1}^{n} \alpha_{22}(k) r_{j,t-k} + \hat{\epsilon}_{j,t} \tag{3}$$

After scrutinizing the heteroskedasticity of the data series using ARCH-LM test, variances in the daily returns of the options and the equity markets and covariance of the both are estimated by Diagonal BEKK GARCH model (Zhipang & Shenghong, 2017), using equation (4).

$$H_t = \begin{pmatrix} H_{ss,t} & H_{so,t} \\ H_{os,t} & H_{oo,t} \end{pmatrix} = C'C + \sum_{k=1}^{p} A'_k \epsilon_{t-k} \epsilon'_{t-k} A_k + \sum_{k=1}^{p} B'_k H_{t-k} B_k \tag{4}$$

Finally, the ideal hedge size and the hedge gains from them are assessed under minimum variance framework (Ederington, 1979; Lien D., 2009) using equations (5) and (6) respectively.

$$Ideal\ Hedge\ Size = \frac{Cov(\Delta S_t \Delta O_t)}{\sigma^2_{\Delta O_t}} \tag{5}$$

$$Hedge\ Gain = \frac{\sigma^2_{\Delta S_t} - (\sigma^2_{\Delta S_t} + H^2_{t-1}\sigma^2_{\Delta O_t} + 2H_{t-1}Cov(\Delta S_t \Delta O_t))}{\sigma^2_{\Delta S_t}} \tag{6}$$

4. Empirical Analysis and Discussion

4.1 Do the Options Protect Equity Investments?

The movements of the call and put options markets are found to be related with that of the equity market by comparing their historical movements throughout both the phases under consideration, and close co-movements that suggest long run integration amongst the options-spot market pairs in each of the circumstances (Bakshi, et al., 2000b) are identified. While proceeding to advanced econometric assessments, the data structure, which is identified to have nonconformities with the general expectations, is reframed (Alexander & Nogueira, 2007). Further, the stationarity checks prove the general anticipation that the price series may have inducements from their own past (Kim, et al., 2009), inclining again potential integration among the market pairs (Holowczak, et al., 2006). [The results of unit root tests for stationarity are given as Appendix A1.]

The options market can help investors to resist the unfavorable effects from price changes in the spot market, only when it has close long run integration with the spot counterpart. Table 1 explains the level of integration present among different equity options segments under the study with their underlying equity market, for both the recovery and growth phases of the Indian stock market. In line with the general expectation formed from the preliminary analysis, all the options, viz. ATM, OTM, ITM, DOTM and DITM calls and puts markets are integrated with the equity market, and the results, given in Table 1, do not get changed in correspondence with the shift in the risk perception of the investors, as Trace and Maximum Eigen-value tests in the Johansen's framework reject the premises of no cointegration and fail to reject that of one cointegration among each of the options-spot pairs.

However, mere presence of integration among the options markets and their underlying spot market cannot guarantee that the derivative segment can be efficiently used for risk mitigation, since the integration measures only the long-run co-movement without considering the short run deviations of the markets from the equilibrium. Table 2 explains the level of promptness of both the markets to readjust itself to the integration with the other market, under both times under consideration. The VECM results highlight that the deviations are readjusted back within a short span of time, and the market system is in a dynamism that does not allow the component markets to deviate far from the equilibrating affiliations.

During the recovery phase, even though, the equity market in correspondence with the ITM and DITM call options and ATM, OTM, ITM, DOTM and DITM put options tends to lead in the readjustment process taking 117, 76, 55, 42, 21, 88 and 34 days respectively, it is found that such processes are not significant to denote a leading role from the equity market. But from the options market, it is clear that the price rebalancing process takes place within it and the processes are statistically significant. It is also noteworthy that ATM, OTM, ITM, DOTM and DITM call options markets take only 13, 14, 6, 5 and 4 trade days respectively to regain the integration with the equity market, and ATM, OTM, ITM, DOTM and DITM put options markets regain the equilibrium within 9, 11, 3, 7 and 2 days respectively. Post the dimensional shift, during the growth phase, the equity market that correspond with the ATM and OTM call options and all the put options markets show slight tendency to regain the equilibrium state, but such efforts are not able to mark significant results, except in the case of the DITM put options. The number of days expected by the spot markets of ATM and OTM calls and ATM, OTM, ITM, DOTM and DITM puts are 87, 137, 96, 62, 69, 102 and 9 days. Comparing the above with the informational role of the options segments, it is found that the

price rebalancing role played by them is significant in the ten situations. It is also noted that the number of days required by the options segments are extremely lower than those required by the spot markets. The ATM, OTM, ITM, DOTM and DITM call options markets take 5, 7, 4, 3 and 5 days respectively to regain the integration with the equity market, and the time taken by the ATM, OTM, ITM, DOTM and DITM put options markets for rebalancing themselves towards the equilibrium are 7, 9, 4, 3 and 2 days respectively. Thus the results undoubtedly confirm the ability of the equity options market in India to protect the equity investments from unforeseen price fluctuations irrespective of the differences in the continuing momentum of the underlying market.

Table 1. Integration among the stock and the options markets

	No. of CE(s)	The Recovery Phase				The Growth Phase			
		Trace	Prob.	Max-Eigen	Prob.	Trace	Prob.	Max-Eigen	Prob.
Panel A: Call Options									
ATM	None *	53.450	0.000	46.827	0.000	110.998	0.000	108.567	0.000
	At most 1	6.623	0.386	6.623	0.386	2.431	0.119	2.431	0.119
OTM	None *	34.616	0.003	27.464	0.003	61.926	0.000	59.829	0.000
	At most 1	7.151	0.329	7.151	0.329	2.097	0.148	2.097	0.148
ITM	None *	78.837	0.000	71.017	0.000	158.598	0.000	156.224	0.000
	At most 1	7.820	0.267	7.820	0.267	2.374	0.123	2.374	0.123
DOTM	None *	86.210	0.000	79.070	0.000	141.535	0.000	139.547	0.000
	At most 1	7.140	0.330	7.140	0.330	1.988	0.159	1.988	0.159
DITM	None *	135.611	0.000	128.824	0.000	144.723	0.000	142.407	0.000
	At most 1	6.787	0.367	6.787	0.367	2.316	0.128	2.316	0.128
Panel B: Put Options									
ATM	None *	50.802	0.000	44.030	0.000	75.954	0.000	73.564	0.000
	At most 1	6.773	0.369	6.773	0.369	2.389	0.122	2.389	0.122
OTM	None *	46.028	0.000	39.513	0.000	43.855	0.000	41.981	0.000
	At most 1	6.514	0.398	6.514	0.398	1.874	0.171	1.874	0.171
ITM	None *	100.966	0.000	93.499	0.000	129.091	0.000	126.724	0.000
	At most 1	7.467	0.298	7.467	0.298	2.367	0.124	2.367	0.124
DOTM	None *	70.320	0.000	63.640	0.000	101.683	0.000	99.880	0.000
	At most 1	6.680	0.379	6.680	0.379	1.803	0.179	1.803	0.179
DITM	None *	100.981	0.000	92.870	0.000	200.633	0.000	198.211	0.000
	At most 1	8.112	0.243	8.112	0.243	2.422	0.120	2.422	0.120

Source: Calculations of the researcher

Note: 'No. of CE(s)' stands for 'number of cointegrating equations'. 'Trace' and 'Max-Eigen' stand for 'Trace Statistics' and 'Maximum Eigenvalue Statistics', the tests used to empirically evaluate the null hypothesis that 'there is no cointegrating equation' or 'there is at most one cointegrating equation' as the case may be.

Table 2. Short run dynamics between the stock and the options market

| | The Recovery Phase | | | | The Growth Phase | | | |
| | Spot | | Options | | Spot | | Options | |
	EC Coeff.	Prob.	EC Coeff.	Prob.	EC Coeff.	Prob.	EC Coeff.	Prob.
Panel A: Call Options								
ATM	0.021	0.518	-0.077	0.022	-0.012	0.529	-0.221	0.000
OTM	0.008	0.755	-0.070	0.003	-0.007	0.601	-0.135	0.000
ITM	-0.009	0.817	-0.159	0.000	0.005	0.820	-0.225	0.000
DOTM	0.011	0.487	-0.204	0.000	0.007	0.444	-0.346	0.000
DITM	-0.013	0.634	-0.232	0.000	0.021	0.223	-0.196	0.000
Panel B: Put Options								
ATM	-0.019	0.564	-0.108	0.009	-0.010	0.585	-0.137	0.000
OTM	-0.024	0.362	-0.089	0.006	-0.016	0.315	-0.111	0.000
ITM	-0.047	0.404	-0.325	0.000	-0.015	0.653	-0.289	0.000
DOTM	-0.011	0.567	-0.149	0.000	-0.010	0.356	-0.321	0.000
DITM	-0.030	0.788	-0.517	0.000	-0.115	0.050	-0.538	0.000

Source: Calculations of the researcher

Note: 'EC Coeff.' stands for the error correction coefficient in the VECM. The number of trade days required by each market segment to correct the disequilibrium is computed by the formula, No. of days = 1/EC Coeff.

4.2 Prospective or Existing Investors: Who Bags More Gains?

Mere evidence on the ability of the options market to support the equity investors may misguide them by an inherent appeal for naïve hedging, where the hedge portfolio is suggested to have equal number of spot asset and options contracts. The ideal hedging proposes to have an improved assortment of assets and instruments, which results in maximum probable savings from undesirable influences of the uncertain spot movements, but with minimal additional cash outlay for inclusion of options into the portfolio. The minimum variance hedge intimates a ratio for conception of an ideal spot-options portfolio that reduces the unforeseen variances to its minimum possible extent (Ederington, 1979), and the level of variance reduction explains the relative effectiveness of the market that support the hedge portfolio (Cao & Huang, 2007; Hull & White, 2017). Even when the market shares an upbeat momentum, both existing as well as prospective investors are subject to the risk exposure, as the market may move further unexpectedly upward or downward. In general, the willingness of investors with ample financial resources to lay out the same consistent with their predispositions on uncertainties determine the investment preferences, and therefore, the efficiency of a spot-options portfolio, shaped for risk dilution drives, tends to vary according to the perceptions of investors (Chuang, Wang, Yeh, & Chuang, 2015). Furthermore, the decision on selection of the options for achieving effective hedge depends on the tradeoff between the perception of investors towards probable uncertainties and their preparedness to pay initial financial outlay (Ederington, 1979; Bond & Thompson, 1985).

Table 3 explains an ideal hedge size under minimum variance framework for all the call and put options markets under consideration during the recovery as well as the growth dimensions of the market. [The results of ARCH-LM tests and D-BEKK GARCH estimation are given as Appendix A2 and A3.] Even though both dimensions share common upbeat trend, the perceptional shift seems to influence the required hedge size of the options and the risk reduction efficacy of the options segments. The recovery phase presumes to be riskier than the growth facet, as the former is subject to a pressure to recapture its earlier position whereas the latter strives to grow further to new historical peaks. Further, calls and puts are supportive to the proposed or the existing long positions, respectively, in the underlying market, and they can be used either separately or collectively for the hedging purposes. Considering the moneyness level of the options, ATM options are chosen by those who do not expect the underlying market to move further in either directions in the short run without incurring further cash outlay to book superfluous profits, whereas those expect further favorable changes in the level of underlying asset may opt to trade ITM options that

fetch assured profits but with higher financial outlay. OTM options are chosen by those expect the market to move unfavorably, so that they can protect the value of their asset at minimal financial outlay. The DITM and DOTM options are suitable for extreme risk takers who are desirous of either utilizing the profitability or protecting the risks at any cost.

Table 3. Optimal hedge size and hedging gains

Option Type	Moneyness	The Recovery Phase		The Growth Phase	
		Optimal Hedge Size	Hedging Gain	Optimal Hedge Size	Hedging Gain
Call Options	ATM	0.82	74.05%	0.41	39.67%
	OTM	0.72	53.08%	0.31	19.93%
	ITM	0.81	72.20%	0.53	38.12%
	DOTM	0.29	19.67%	0.06	05.03%
	DITM	0.57	40.97%	0.30	11.90%
Put Options	ATM	0.73	89.98%	0.55	71.61%
	OTM	0.70	85.92%	0.51	63.29%
	ITM	0.74	80.65%	0.57	56.88%
	DOTM	0.52	62.20%	0.14	18.83%
	DITM	0.80	76.92%	0.85	78.33%

Source: Calculations of the researcher

4.2.1 Changing Perceptions and Prospective Investors

Whenever the market shows a recovery trend after a deep fall owing to any reason, the call options assist the prospective buyers. When the market is expected not to make further sharp changes, the investors can reduce their exposure by a variance reduction of 74.05%, if they hold ATM calls at a ratio of 0.82 for the estimated investments. If the expectation is that the price level in the equity market is yet to increase, the use of OTM calls at an ideal hedge size of 0.72 can provide an average hedge gain of 53.08%. When the prospective investors wish to take maximum advantage from the expected growth in the price level, the advanced long position in the ITM calls at an ideal level of 0.81 will draw 72.20% variance reduction in the return of future portfolio, but with enhanced cash outlay, whereas the DITM calls provide only 40.97% hedge gains from its ideal size of 0.57. The DOTM calls are also less effective as they provide only 19.67%, but from an optimal hedge size of 0.29.

In line with the general expectation that a still-to-be-developed stock market, like Indian scenario, will move upward in the long run, the investors can make use of the information on the nature and behavior of the options market for reducing their exposure to the maximum possible extent by replicating the hedge portfolio of the growth phase. In this phase, the holding of ATM options at the suggested ideal hedge size of 0.41 to protect the potential investment opportunities from further rise in the price level may provide a hedge gain of 39.67%, and use of OTM calls for the purpose at an ideal level of 0.31 protect the investment only up to 19.93%, whereas DOTM calls at their optimal size of 0.06 provides only negligible risk reduction of 05.03%. When the market keeps its upward pace, the future buyers can take at most advantages by opting to long in ITM or DITM calls, based on their capability for initial financial outlays, and holding them at a ratio of 0.53 or 0.30, as the case may be, may result in an average hedging gain of 38.12% or 11.90%, respectively.

4.2.2 Strategic Compositions for Existing Investors

For the existing investors, ideal investment protection is possible from formation of portfolios composed of options along with the existing equity assets. The analysis on the recovery stage elaborates, on an average, how either the equity or single stock options market is expected to behave in similar market circumstances. With an anticipation that the market will remain stagnant, at least for some time, inclusion of ATM put options in to the existing equity portfolio at rate of 0.73 reveals to generate an average hedge gain of 89.98%. If the intention of the investors using

options is to limit the effects caused from unexpected falls, opting OTM puts at an ideal level of 0.70 will result in 85.92% hedge gains, and the DOTM puts are expected to result in a variance reduction of 62.20% from its optimal hedge size of 0.52. When the intention of the existing investors is to have guaranteed gains even from the corrective downtrends in the equity market, the use of ITM puts having moderately high financial outlay as well as DITM puts having extremely high financial outlay, at their corresponding optimal levels of 0.74 and 0.80 is expected to provide approximate hedging gains of 80.65% and 76.92%, respectively.

The investors with long position in the equity market are not subject to greater risks, since they expect the market to continue its upbeat momentum. When they are not expecting huge ups and downs in the market in the short run, they can update their equity portfolio by including ATM put options in to it at an ideal size of 0.55 so that it is expected to provide an approximate hedge gain of 71.61%. Even in the growth phase, unexpected down fall in the price level can be expected due to corrective nature of the financial markets, and for limiting the effects of such drop, the use of OTM put options at an ideal level of 0.51 fetches an average hedge gain of 63.29%. Further, for the investors with extreme pessimistic outlook, the DOTM put options may provide 18.83% hedge effectiveness, if used with the equity assets at a ratio 0.14. Investors who are ready for trading in equity options for assured profits can opt for ITM or DITM options, as per their willingness to pay for the hedge, to be included in the portfolio to be hedged at an optimal hedge size of 0.57 or 0.85, respectively, expecting an approximate hedge gain of 56.88% and 78.33%, respectively.

5. Conclusion

The prime focus of the current study is to compare the resistance level of the Indian equity options market to protect the current as well as the potential investments from detrimental consequences of undesirable changes in the underlying equity market, in respect of two diverse optimistic dimensions, the first one being a recovery trend and the other being a growth phase. Post confirming the ability of both the call and put options markets with different levels of exercisability by establishing the presence of integration of the market pairs and by estimating the time required by the market segments for regaining the integration from deviances due to asymmetric informational absorption, ideal hedge sizes and the resulting hedge gains are evaluated for both recovery and growth dimensions, following minimum variance framework.

The study figures out that the call options in the recovery phase prove to have relatively higher hedging gains while the risk reduction from ideal hedging using calls in the growth phase is lesser, denoting that when the market trend expresses to have endeavors to regain its earlier price level, the prospective investors can protect the effects from the price hikes by opting to long in the call options market. The ideal hedging using put options result in fairly higher gains both in the recovery period and the growth phase, signifying that the equity options are attractive for the existing investors in a bullish equity market as they provide an assured protection from the effects of unanticipated collapses in the price level. It is also noteworthy that the hedging gains are comparatively larger in the recovery phase than in the growth phase. As the recovery phase handles more risk than the growth phase, where the former attempts to regain a lost position whereas the latter tries to move further upward to reach new heights, the equity options market is supportive to the market participants by facilitating more efficient risk reduction from ideal hedging practices. In both the market sentimentalities under consideration, DOTM calls and puts provide only reduced hedge gains, indicating that the extremely un-exercisable options cannot provide greater hedging effectiveness, but it should also be noted that the optimal risk reductions from them are possible by using either calls or puts at a nominal hedge size.

Even though the futures segment in India reportedly offers higher hedge gains (Gupta & Singh, 2009; Lagesh & Padhi, 2009; Jose & Lazar, 2015; Singh, 2017), the study proposes that the investors who are eager to mitigate their risk exposures to greater extents, without compromising the profits from fortunate market momentum, can choose blends of futures and options to result in a better hedge portfolio, as indicated in Ryu and Yang (2017) and Ahn, Bi, and Sohn (2018), but such probabilities remain open for further realistic investigations. Considering the fact that an upbeat market is always subject to corrective movements, the current study further leaves an avenue for future empirical analysis to reflect the market on such corrective trends. An inclusion of such varying trends during a day would also have been a greater assistance to the investors for assuring at most profitability from their enlightened decisions.

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Appendix A

Results of Preliminary Analysis and GARCH Estimation

Table A1. Results of unit root tests for the data from the stock and options markets

	ADF				PP			
	Level		Diff.		Level		Diff.	
	t	p	t	p	t	p	t	p
Part 1 – The Recovery Phase								
Panel A: Actual index								
Spot	-2.24	0.46	-34.26	0.00	-2.22	0.48	-34.25	0.00
Panel B: Implied index for Call options								
ATM	-2.26	0.46	-36.44	0.00	-2.20	0.49	-36.46	0.00
OTM	-2.24	0.47	-36.86	0.00	-2.19	0.49	-36.86	0.00
ITM	-2.25	0.46	-35.67	0.00	-2.23	0.47	-35.68	0.00
DOTM	-2.63	0.27	-24.44	0.00	-2.53	0.31	-41.18	0.00
DITM	-2.25	0.46	-34.71	0.00	-2.23	0.47	-34.71	0.00
Panel C: Implied index for Put options								
ATM	-2.55	0.30	-36.92	0.00	-2.44	0.36	-37.03	0.00
OTM	-2.55	0.30	-36.64	0.00	-2.45	0.35	-36.75	0.00
ITM	-2.48	0.34	-37.03	0.00	-2.39	0.39	-37.11	0.00
DOTM	-2.47	0.34	-39.91	0.00	-2.56	0.30	-40.30	0.00
DITM	-2.35	0.41	-36.93	0.00	-2.27	0.45	-36.96	0.00
Part 2 – The Growth Phase								
Panel A: Actual index								
Spot	-2.66	0.25	-33.51	0.00	-2.49	0.33	-33.41	0.00
Panel B: Implied index for Call options								
ATM	-3.13	0.10	-42.24	0.00	-2.93	0.15	-46.15	0.00
OTM	-1.56	0.50	-39.50	0.00	-1.27	0.65	-42.34	0.00

ITM	-2.66	0.25	-36.75	0.00	-2.51	0.32	-37.00	0.00
DOTM	-1.27	0.64	-13.85	0.00	-2.54	0.11	-78.88	0.00
DITM	-2.59	0.28	-36.74	0.00	-2.58	0.29	-36.74	0.00
Panel C: Implied index for Put options								
ATM	-1.74	0.41	-38.56	0.00	-1.58	0.49	-39.23	0.00
OTM	-1.78	0.39	-27.77	0.00	-1.66	0.45	-37.20	0.00
ITM	-2.76	0.21	-40.10	0.00	-2.68	0.24	-40.41	0.00
DOTM	-2.22	0.20	-28.01	0.00	-2.35	0.16	-70.13	0.00
DITM	-2.61	0.27	-36.65	0.00	-2.56	0.30	-36.70	0.00

Source: Calculations of the researcher

Table A2. Results of ARCH LM tests for heteroskedasticity in the data from the stock and options markets

	Recovery Phase				Growth Phase			
	F Stat.	Prob.	Obs.*R-squared	Prob. (Chi Sq.)	F Stat.	Prob.	Obs.*R-squared	Prob. (Chi Sq.)
Panel A: Actual index								
SPOT	2.97	0.09	2.97	0.09	3.19	0.07	3.19	0.07
Panel B: Implied index for Call options								
ATM	6.40	0.01	6.38	0.01	1.58	0.06	26.61	0.06
OTM	2.02	0.02	22.02	0.02	1.52	0.08	25.62	0.08
ITM	3.10	0.05	6.18	0.05	0.58	0.45	0.58	0.44
DOTM	3.00	0.05	5.98	0.05	4.01	0.02	7.99	0.02
DITM	2.27	0.02	18.01	0.02	1.01	0.32	1.01	0.32
Panel C: Implied index for Put options								
ATM	8.49	0.00	8.45	0.00	3.13	0.00	18.61	0.00
OTM	9.52	0.00	9.46	0.00	1.99	0.06	11.90	0.06
ITM	7.25	0.01	7.22	0.01	2.19	0.04	13.06	0.04
DOTM	98.58	0.00	91.53	0.00	269.69	0.00	224.19	0.00
DITM	7.27	0.01	7.24	0.01	2.19	0.09	6.57	0.09

Source: Calculations of the researcher

Table A3. Results of D-BEKK GARCH estimation

	ATM		OTM		ITM		DOTM		DITM	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
Part 1 - The Recovery Phase										
Panel A: Call Options										
C1	0.00	0.10	0.00	0.14	0.00	0.03	0.00	0.03	0.00	0.08
C2	0.00	0.28	0.00	0.25	0.00	0.02	0.00	0.90	0.00	0.01
M(1,1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M(1,2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M(2,2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A1(1,1)	0.19	0.00	0.18	0.00	0.26	0.00	0.23	0.00	0.31	0.00

A1(2,2)	0.16	0.00	0.09	0.00	0.21	0.00	0.15	0.00	0.22	0.00
B1(1,1)	0.98	0.00	0.98	0.00	0.96	0.00	0.97	0.00	0.94	0.00
B1(2,2)	0.98	0.00	0.99	0.00	0.97	0.00	0.98	0.00	0.95	0.00
Panel B: Put Options										
C1	0.00	0.25	0.00	0.22	0.00	0.66	0.00	0.23	0.00	0.36
C2	0.00	0.21	0.00	0.16	0.00	0.38	0.00	0.07	0.00	0.23
M(1,1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M(1,2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M(2,2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A1(1,1)	0.20	0.00	0.21	0.00	0.17	0.00	0.24	0.00	0.23	0.00
A1(2,2)	0.18	0.00	0.19	0.00	0.12	0.00	0.20	0.00	0.15	0.00
B1(1,1)	0.97	0.00	0.97	0.00	0.98	0.00	0.97	0.00	0.96	0.00
B1(2,2)	0.98	0.00	0.97	0.00	0.99	0.00	0.97	0.00	0.98	0.00
Part 2 - The Growth Phase										
Panel A: Call Options										
C1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
C2	0.00	0.09	0.00	0.12	0.00	0.00	0.00	0.93	0.00	0.07
M(1,1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
M(1,2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M(2,2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A1(1,1)	0.21	0.00	0.22	0.00	0.26	0.00	0.22	0.00	0.19	0.00
A1(2,2)	0.10	0.00	0.08	0.00	0.17	0.00	0.41	0.00	0.07	0.00
B1(1,1)	0.96	0.00	0.96	0.00	0.94	0.00	0.96	0.00	0.97	0.00
B1(2,2)	0.99	0.00	0.98	0.00	0.96	0.00	0.62	0.00	0.98	0.00
Panel B: Put Options										
C1	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
C2	0.00	0.04	0.00	0.04	0.00	0.01	0.00	0.60	0.00	0.01
M(1,1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M(1,2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M(2,2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A1(1,1)	0.14	0.00	0.15	0.00	0.21	0.00	0.25	0.00	0.54	0.00
A1(2,2)	0.10	0.00	0.11	0.00	0.18	0.00	0.35	0.00	0.47	0.00
B1(1,1)	0.97	0.00	0.97	0.00	0.95	0.00	0.95	0.00	0.70	0.00
B1(2,2)	0.98	0.00	0.98	0.00	0.96	0.00	0.64	0.00	0.73	0.00

Source: Calculations of the researcher

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