Report on Bachelor / Master Thesis

Institute of Economic Studies, Faculty of Social Sciences, Charles University in Prague

Student:	**Viktor Chrobok**
Advisor:	**Option Pricing Methods**
Title of the thesis:	**PhDr. Petr Gapko**

OVERALL ASSESSMENT *(provided in English, Czech, or Slovak):*

The thesis is a work of average length on application of 6 option pricing models, with 10 pages on the option basics, 15 pages on the models description and 46 pages on the empirical application. Besides the endeavor of the student to perform his own calculations the work has a number of substantial shortcomings.

The first chapter postulates thesis and objectives. Some of the objectives are set vaguely (e.g. on page 2 *„The core of the fourth chapter is to find notifiable facts in various subsets. "* What kind of facts? Where is student going to look for them?) Some objectives on the other hand are set; but analysis leading to conclusion on the objectives does not occur in the rest of the work (e.g. on page 2 *„We shall find out if any of the described option pricing techniques was affected by the crisis so badly that it is impossible to use it in its traditional state anymore.*" There is only a sentence in the conclusion Chapter, which is not based on any preceding analysis (see later). Moreover this objective does not give any sense. How can option pricing techniques be affected by the crisis? What is the „traditional state" of the techniques anyway?).

As the preceding examples shows (and there is lot of other evidence throughout the thesis) the student uses **inapproriate language** as if he is not well familiarized with the option valuation terminology. The poor terminology knowledge strikes throughout whole document (see further comments).

Chapter 2 is unnecessarily long; it contains notoriously known basic facts on options (any discussion on theoretical option price as an introduction to the next chapter is totally absent). E.g. Greeks (page 7) are defined even though not used in the empirical part. On the other hand some definitions of the applied methods are missing (see the point about the volatility).

In the theoretical part of the thesis (Chapter 3) student did not introduce any essential framework for option pricing techniques (such as risk neutral valuation); the broader setting of the models is completely omitted and the discussion on the performance of the techniques in the literature is again missing (e.g. the Barone-Adesi, Whaley model belongs to the group of stochastic volatility models, and is discussed in Heston and Nandi, 2000: A closed-form GARCH option valuation model, The review of financial studies, Vol. 13, No.3 or in Bakshi, Cao,Chen,1997: Empirical performance of alternative option pricing models, the Journal of Finance, Vol.52; amongst others).

Another Chapter 3 problem relates to the fact that student picked up 6 models for option pricing; but did not explain why these particular models (out of multitude of existing techniques) were tested. Moreover the methods are rather old and well discussed in literature.I do not see the point in this work. It would be reasonable to choose one older model as a benchmark and compare it with rather new approaches, alter any approach, or develop completely new approach.

The most serious shortcoming is related the empirical part. I appreciate the endeavor of the student to apply techniques and perform own computations. However the advancement has severe methodological defects.

First, models developed for European-type options are used to price American-type options and conclusions are drawn from this application. **However none of the results can testify to any of the hypothesis while the techniques were misused.**

Second problem relates to the use of the data – only one single day is used to test the models while another one is used to assign the implied volatility (page 28). Such testing is inappropriate, while the

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volatility may differ between these two days significantly. **Author cannot really draw any conclusions based on the analysis of 2 trading days even though the number of observations is sufficiently large, specifically when the results are compared no matter on the type of the underlying**. On page 33 student remarks that he has to guess parameters for the jump diffusion model because he has not have the underlying price time series. **This did not preclude him to apply the model on the random sample of options on different underlying assets.** Student estimates the number of jumps for all options on all underlying assets together from some other data available (moreover the datasets used are not well described).

Student´s third violation of statistical hypothesis testing is that he uses **different samples for the different methods** (applies BS model on whole data set but then chooses other samples randomly); and uses several datasets for the testing inside the moneyness and time to maturity categories. Moreover the detailed advancement is rather obscured(on page 32 *„The criteria for choosing the data was based on the RAND() function in MS Excel and specific requirements on the datasets."* What data? The subsets do not have any names so we actually do not know which dataset is used for which chapter and/or model. What is meant by the specific requirements on the datasets?). Data preprocessing is insufficiently described (on page 29 *„It was needed to omit some options from the dataset becuse of incomplete information."* What kind of incomplete information?*).* We even do not know what are the underlying assets of the options – pure share options or index options or even FX options?

Further methodological shortcomings are listed below:

- Student uses historical and implied volatility but doesn´t define neither of them.
- **The basic statistic methods for the performance evaluation are absent, while no tests are performed** (for example on page 47 – *„ The bid ask spread is 0.52 USD, which is not statistically significant difference from the value of the full dataset since the standard deviation of the original bid ask spread is 0.75 USD"***, thus author is not able to distinguish between models at all or draw any conclusions about model performance.**
- The conclusions are drawed without proper consideration of the causes and eventual attempt to test on the deduction (for example - on page 35 *„On the other hand the Jump-Diffusion model is the worst fit, this could be caused by the fact that the additional parameters were chosen laxly without proper consideration."* It does not give any sense to compare results based on such application of valuation technique. On page 32 *„The section showed that the Black-Scholes formula or the European option works quite well even for the American options."* This conclusion is based purely on histogram of errors and uncannily defined undepriced and overpriced option share from the dataset, see later.)
- **The part related to the volatility smile** (chapter 4.4.4.) **seems to lack any sense** – student has chosen one option randomly to show that it exhibits volatility smile. The explanation how does this contribute to the hypothesis of the thesis is missing.
- **Student concludes or alleges facts and does not show corresponding references** (e.g. on page 46. *„but also because in the money options are expected to have higher volatility".* Why? Is there any reference for this?)
- **Student claims some statistical results but fails to interpret them** (e.g. on page 62 *„The kurtosis is much higher for the first group than for the second one. …."* What does this fact tell us?)

Some other inaccuracies (not all of them) are listed below:

- on page 1 *„...expected development of underlying asset."* Of its volume, open interest, owner´s status or price?

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- on page 14 *„... the binomial model is usually used to determine prices of American type options, ...“* Why? Any reference is missing
- Throughout the equations the definition of X,t is missing. Author uses different notation for the same quantity
- on page 17 *„...there are two ways to estimate volatility from data“.* Definitely false statement. There are definitely more than two ways how to estimate volatility from data and there is abundance of literature on this topic.
- On page 30 – where does the definition of the boundary of 50 USD come from? An intuition? The number of such defined overpriced or underpriced options is nonsense.
- What were the boundaries for the moneyness and time to maturity categories taken from? Is there any reference that would support this categorisation?

As for conclusion Chapter, **student draws conclusions that are due to the above mentioned defects not based on proper analysis** (see e.g. on page 74 *„The result shows the clean picture of the robustness and the suitability of all analysed methods in various situation.“* None of the claims in these sentences are true. Or on the same page: *„The paper….could save a lot of work for prospective investors“.* How? No evaluation of hedging strategies was performed. Or on the same page: *„The first crucial finding of this thesis is the fact that it does not matter so much if an American option is priced as an European one.“* Once more, no real analysis was performed to claim such strong statement which actually refutes contemporary scientific opinion.)

With regard to the literature **most of the listed literature** (even if it is listed in the basic literature!) **is not referenced to in the work.** Then the references shrink to few pieces and; moreover; do not include the most recent literature.

Based on the facts mentioned above I conclude that the student lacks any deeper understanding of option valuation techniques that would be adequate for the student´s level of studies. I am convinced that such scope is insufficient for the work of the diploma thesis character. **I strongly do not recommend this thesis for the defense, with grade 4.**

SUMMARY OF POINTS AWARDED *(for details, see below):*

CATEGORY		**POINTS**
Literature	*(max. 20 points)*	5
Methods	*(max. 30 points)*	0
Contribution	*(max. 30 points)*	0
Manuscript Form	*(max. 20 points)*	5
TOTAL POINTS	*(max. 100 points)*	**10**
GRADE	**(1 – 2 – 3 – 4)**	**4**

NAME OF THE REFEREE: Michaela Baruníková

DATE OF EVALUATION: 18.10.2010

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Referee Signature

EXPLANATION OF CATEGORIES AND SCALE:

LITERATURE REVIEW: *The thesis demonstrates author's full understanding and command of recent literature. The author quotes relevant literature in a proper way.*

Strong	*Average*	*Weak*
20	*10*	*0*

METHODS: *The tools used are relevant to the research question being investigated, and adequate to the author's level of studies. The thesis topic is comprehensively analyzed.*

Strong	*Average*	*Weak*
30	*15*	*0*

CONTRIBUTION: *The author presents original ideas on the topic demonstrating critical thinking and ability to draw conclusions based on the knowledge of relevant theory and empirics. There is a distinct value added of the thesis.*

Strong	*Average*	*Weak*
30	*15*	*0*

MANUSCRIPT FORM: *The thesis is well structured. The student uses appropriate language and style, including academic format for graphs and tables. The text effectively refers to graphs and tables and disposes with a complete bibliography.*

Strong	*Average*	*Weak*
20	*10*	*0*

Overall grading:

TOTAL POINTS	**GRADE**		
81 – 100	**1**	= excellent	= výborně
61 – 80	**2**	= good	= velmi dobře
41 – 60	**3**	= satisfactory	= dobře
0 – 40	**4**	= fail	= nedoporučuji k obhajobě