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Topics for MSc theses in Finance – a.y.2017/18

1) Asset Pricing Models and Pricing and Hedging of Derivatives

There is an ongoing research on alternative models for asset prices, including bonds, equities, indexes, commodities. The course Applied Numerical Finance (code 20247) briefly introduces some of them. More specifically, you can look at the most recent papers published in Journal of Derivatives, Review of Derivatives Research, Risk, Quantitative Finance, Journal of Finance, and the papers in the finance area of Management Science and Operations Research.

The questions that can be addressed in a master thesis are:

a) Is the suggested model tractable and flexible as it is usually (by the authors) claimed to be?
b) Consider an exotic derivative whose payoff structure can be suitably evaluated within the framework of the proposed model. Develop a MatLab or VBA code to price the derivative and compare the results you get with more traditional models for the underlying assets.
c) Compute the hedging strategy of the exotic derivative.
d) Provide a critical financial and numerical discussion of the results that you get, their robustness, and the tractability of the model.

Prerequisites: The course Applied Numerical Finance (code 20247) develops the basics to deal with the more sophisticated topics suggested for the thesis. The course is therefore a mandatory prerequisite.

Readings

- J. Casassus and P. Collin-Dufresne : Stochastic Convenience Yield Implied from Commodity Futures and Interest Rates, Journal of Finance, Vol. LX, N. 5, 2005.
- A. Van Haastrecht, R.Lord, A.Pelsser and D. Schrager: Pricing long-maturity equity and fx derivatives with stochastic interest rates and stochastic volatility. Insurance: Mathematics and Economics, 45(3), 2009.

2) Real and American options

American options can be exercised at any time during the life of option. Usually the optimal exercise policy is the hitting time of the underlying security at a critical barrier, called the critical price or the free boundary. Unfortunately, the free boundary does not have any closed-form representation in general. Therefore it is important to investigate its qualitative and numerical behavior. When the option is a real option, whose underlying is a non traded financial security, the evaluation problem becomes more interesting, because the underlying dynamics departs from the general no-arbitrage restrictions.

The questions that can be addressed in a master thesis are:

a) There are recent approximation techniques for the free boundary of put/call options. Is the suggested approach tractable and flexible? Can it be applied when dividends are paid? When the option is near to expiry, does the approximation coincide with the usual asymptotic results?
b) If the underlying asset is a real asset that exhibits mean reversion or seasonality, what is the impact on the free boundary of the option?

Prerequisites: The course Applied Numerical Finance (code 20247) develops the basics to deal with the more sophisticated topics suggested for the thesis. The course is therefore a mandatory prerequisite.

Readings

- A. Battauz. M. De Donno and A. Sbuelz: Real options and American derivatives: Tthe double continuation region, forthcoming on Management Science, 2014.
- W. J.Hahn, and J. S. Dyer: Discrete time modeling of mean-reverting stochastic processes for real option valuation, European Journal of Operational Research 184 (2008) 534–548.
- J. Cheng and J. E. Zhang: Analytical pricing of American options , Review of Derivatives Research (2012) 15:157–192.

3) Cancellable American options

Cancellable American (or Israeli) options can be exercised by the holder at any time during the life of the option, and can be terminated by the writer at any point in time for a fixed penalty amount paid directly to the holder. In a discrete-time setting Kifer (2000) provides the backward recursion to evaluate the option, and characterizes the optimal stopping times for the writer and the holder. In a continuous time Black and Scholes setting, Kyprianou (2004) evaluates the perpetual Game-style put option on a non-dividend paying asset. Emmerling (2012) extends the valuation to the case of a dividend paying asset.

The questions that can be addressed in a master thesis are:

a) Use the recursion of Kiefer to analyze numerically the double free boundary in the discrete-time setting. When the maturity of the option is large, how far is the discrete-time output from the perpetual closed form solution?
b) If the underlying asset is a real asset that exhibits mean reversion or seasonality, what is the impact on the free boundary of the option?
c) Apply the technology of Israeli options to evaluate a callable convertible bond.

Prerequisites: The course Applied Numerical Finance (code 20247) develops the basics to deal with the more sophisticated topics suggested for the thesis. The course is therefore a mandatory prerequisite.

Readings

- Kifer, Y. 2000. Game Options, Finance and Stochastics, 4, 443-463.
- Kyprianou, A., 2004. Some Calculations for Israeli Options, Finance and Stochastics, 8, 73-86.
- T.J. Emmerling: Perpetual Cancellable American Call Option, Mathematical Finance, Vol. 22, No. 4, October 2012, 645-666

4) Negative interest rates and financial derivatives

Interest rates are usually assumed to be non-negative.

The long lasting negative interest rate phenomenon in the Euro area has determined an increasing interest on its impact on the optimal decision making of financial institutions/agents.

In particular, negative interest rates have a significant impact on the optimal exercise of American derivatives. American derivatives allow the holder to decide the exercise date during the life of the contract. The vast majority of traded put (resp. call) options are of American type. Even in the simplest Black-Scholes framework, there are no closed form solutions for American option prices, unless the option is perpetual. In the standard case of non-negative interest rates, the American put (resp. call) option is optimally exercised as soon as the underlying asset price falls below an upper (resp. lower) barrier, called critical price. The critical price does not admit a closed form representation, but can be carefully approximated at maturity, where the time-to-maturity effect on the derivative price is more dramatic.

Battauz, De Donno and Sbuelz (Management Science, 61(5):1094-1107, 2015) have studied the surprising implications of constant negative interest rates on the early exercise of American call and put options on a lognormal underlying asset. If the interest rate is constantly negative, a non-standard lower (resp. upper) critical price appears for the American put (resp. call option). Surprisingly, American options are not excercised if the underlying asset is too deeply in the money. Intuitively, when interest rates are negative, 1 euro tomorrow is better than 1 euro today, thus originating a preference for postponement. Under suitable conditions, if today the underlying asset is deeply in the

money, the risk of being driven towards the out-of-the money region is negligible, and the postponement effect prevails. A non-standard continuation region appears.

The questions that can be addressed in a master thesis are:

- The evaluation of optimal exercise for American quanto options with domestic negative interest rates;

- American option in the local volatility CEV model;

- Numerical evaluation of American equity options with Vasicek interest rates;

Prerequisites: The course Applied Numerical Finance (code 20247) develops the basics to deal with the more sophisticated topics suggested for the thesis. The course is therefore a mandatory prerequisite.

Readings

- A. Battauz, M. De Donno and A.Sbuelz. Real options and American derivatives: The double continuation region, Management Science, 61(5):1094-1107, 2015.