Stochastic Methods for Finance: Report 2

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Abstract

We want to study the implied dividends at different time of maturity and deduce the term structure.

1. Introduction

We chose a dividend paying asset at fixed maturity T, considered a box spread and found the discount factor for maturity T. We used the put call parity with and at the money options to deduce the implied dividends. We repeated for different maturities and deduced the term structure.

2. Intel Corporation (INTC)

We chose to work on Intel Corporation options. Intel Corporation engages in the design, manufacture, and sale of computer products and technologies worldwide. The company operates through CCG, DCG, IOTG, Mobileye, NSG, PSG, and All Other segments. It offers platform products, such as central processing units and chipsets, and system-on-chip and multichip packages; and non-platform or adjacent products, including accelerators, boards and systems, connectivity products, graphics, and memory and storage products. The company also provides high-performance compute solutions for targeted verticals and embedded applications for retail, industrial, and healthcare markets; and solutions for assisted and autonomous driving comprising compute platforms, computer vision and machine learning-based sensing, mapping and localization, driving policy, and active sensors. In addition, it offers workload-optimized platforms and related products for cloud service providers, enterprise and government, and communications service providers. The company serves original equipment manufacturers, original design manufacturers, and cloud service providers. Intel Corporation has a strategic partnership with MILA to develop and apply advances in artificial intelligence methods for enhancing the search in the space of drugs. The company was incorporated in 1968 and is headquartered in Santa Clara, California.

Previous Close	51.83
Open	51.36
Bid	50.65 x 1400
Ask	50.66 x 2900
Day's Range	50.60 - 51.40
52 Week Range	43.63 - 68.49
Volume	9,885,430
Avg. Volume	39,784,168
Market Cap	206.715B
Earnings Date	Apr 28, 2022
Ex-Dividend Date	Feb 04, 2022
Forward Annual Dividend Rate	1.46
Forward Annual Dividend Yield	2.83%

3. Box Spread and discount factor

The study is done on March 29, 2022. This is important since we used the knowledge we had until that day. In order to deduce the discount factor $D(0,T)$ we needed to implement a box spread strategy. The box spread strategy consists in buying four options with the same maturity: one call in the money with strike price K1, one put out of the money with the same strike price, one call out of the money with strike price K2 and a put in the money with the same strike price. Starting with T of one month maturity, precisely May 6, 2022, we chose the call

in the money INTC220506C00049000 with strike price $K1 = 49$ and mid price $ck1 = 3.975$; the call out of the money INTC220506C00054000 with $K2 = 54$ and $ck2 = 1.375$; the put in the money INTC220506P00054000 with $K2 = 54$ and $pk2 = 3.975$; the put out of the money INTC220506P00049000 with $K1 = 49$ and $pk1 = 1.415$. Now we can deduce the discount factor with the formula

$$D(0,T) = \frac{ck1 - ck2 + pk2 - pk1}{K2 - K1} \approx 1.032$$

4. Implied dividends for maturity T

We chose a call option at the money INTC220506C00051000 with strike price $K = 52$ and $ck = 2.61$ and a put option at the money INTC220506P00051000 with the same strike price and $pk = 2.225$. Now we can exploit the put call parity formula to compute the implied dividends at maturity T, which are given by

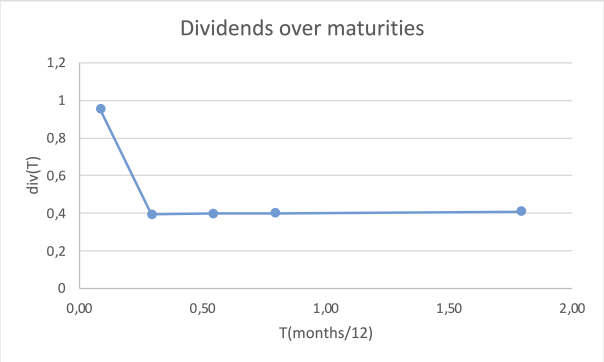
$$q = -\frac{1}{T} \ln\left(\frac{ck - pk + KD(0,T)}{S}\right) \approx 0.953$$

Let e^{qT} be the definition of div(T), now we can repeat the procedure for different maturities.

5. Table of results and conclusions

In the following table we show the results for different maturities recalling that the day of this study is March 29, 2022. In the second column it is reported the T used in the calculations.

Maturities	T/12	D(0, T)	div(T)
May 6, 2022	1m	1.032	0.953
July 15, 2022	3.5m	2.509	0.394
October 21, 2022	6.5m	2.493	0.397
January 20, 2023	9.5m	2.480	0.399
January 19, 2024	21.5m	2.42	0.408



As we can see in the picture above the divides tends to stabilize after a first leap. The result we obtained is near the expectation. The errors are due also to the construction of the box spread. As we said before it is constructed with European options and we are using American options.

References

"Arbitrage Theory in Continuous Time", Tomas Björk, 4th Edition, Oxford Univeristy Press 2020.

"Options, Futures, and Other Derivatives", John C. Hull, 11th Edition, Pearson 2022.