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Table of Contents

Introduction.....	4
Part A. A brief history of the chosen company.....	4
a. A high level overview of Uber.....	4
Overview of the company.....	4
Company's business.....	4
Company's target market	4
Company's USP.....	5
b. The key reasons for Uber to go public.....	5
c. Comment on Uber's proposed valuation of the company based on its S-1 filing and operating risks.....	6
Part B. Quantitatively review the share price performance of Uber.....	7
a. Uber's price performance.....	7
b. Calculate the compound annual growth rate (CAGR), comparing it to an appropriate index.....	8
c. Calculate and comment the Sharpe and Treynor ratios.....	9
Part C. A second listed company that has exchange trade options.....	10
a. For an at the money call option graphically show the derivative contract's payoff.....	10
b. For an at the money put option graphically show the derivative contract's payoff.....	11
c. Discuss the construction of either a strangle or straddle.....	11
Part D. For the period January 2023 to December 2023.....	12
a. Discuss the performance of the 10Y note.....	12
b. Discuss the impact of changes in the yield of this note upon consumer debt	13
Conclusion.....	14
Reference list.....	15
Appendix A. Uber's share price performance over the past one year.....	19
Appendix B. Equations.....	22

Index of Figures

Figure 1. Uber's one year trade price.....	8
Figure 2. Uber's five year trade price.....	8
Figure 3. The model of call option derivative contract's payoff.....	10
Figure 4. Apple's call option derivative contract's payoff.....	10
Figure 5. The model of put option derivative contract's payoff.....	11
Figure 6. Apple's put option derivative contract's payoff.....	11
Figure 7. The model of payoff and profit of straddle.....	11
Figure 8. Apple's straddle contract's derivative payoff.....	11
Figure 9. The performance of the 10Y note in 2023.....	12
Figure10. Mortgage rates and treasury yields.....	13

Index of Tables

Table1. Uber's CAGR.....	9
Table 2. Uber's Sharpe ratio.....	9
Table 3. Uber's Treynor ratio.....	9
Table4. Apple Inc.'s call options contract on 20th Jun, 2025.....	10
Table5. Apple Inc.'s put option contract on 20th, Jun, 2025.....	11

Introduction

This article provides a brief analysis of Uber's main reasons for going public and operational risks, along with calculating Uber's CAGR, Sharpe ratio, and Treynor ratio. Furthermore, this article explores Uber's innovation not only in ride-sharing services but also as a pioneer in the sharing economy. Additionally, the article introduces concepts and models of at-the-money call options; at-the-money put options, and straddle options using Apple Inc. options contracts as examples. In the final section, the article discusses the performance of the US 10-year Treasury bond in 2023 and the impact of the 10-year Treasury bond on consumer debt.

Part A. A brief history of the chosen company

a. A high level overview of Uber

Overview of the company

Uber Technologies, Inc., abbreviated as Uber, was founded in 2009 and is headquartered in San Francisco, California, USA. Uber is a technology company that develops and operates various services and applications on its platform. Currently, Uber operates in approximately 70 countries and over 900 cities worldwide, with more than 150 million active users and 6 million active drivers and couriers each month. Uber is one of the earliest companies to embrace and define the concept of the "sharing economy," creating a digital marketplace that serves both drivers and passengers (markets.ft.com, 2024).

Company's business

Uber has built a vast marketplace through its network technology platform, aiming to connect individuals and businesses needing transportation services with those providing such services. Uber operates through three main divisions:

- 1) Mobility: The Mobility division represents its flagship ride-hailing business. It connects consumers with drivers who provide transportation services.
 - 2) Delivery: This encompasses food, groceries, and other small-item delivery services. Uber's delivery business provides consumers with a platform to search for food, discover local restaurants, place orders, and either pick up meals at restaurants or have them delivered. In some areas, this service also includes delivery of groceries, alcohol, convenience store items, and other selected goods.
 - 3) Freight: The Freight division provides a platform connecting carriers with shippers. It offers carriers transparent pricing and the ability to book freight services in advance. This division also includes transportation management and other logistics services.
- (finance.yahoo.com, 2024)

Company's target market

Uber's target market includes both passengers who order ridesharing services and drivers who provide transportation services. Uber's passenger audience is vast, covering a wide range of geographic areas, demographics, behaviors, and psychological characteristics. The target market for Uber passengers spans from ages 16 to 65, with the youngest demographic (16 to

24) being the most popular. In the United States, 27% of Uber users belong to the top 25% income bracket, while 44% belong to the middle-income bracket. As of 2022, Uber operates globally in most regions, covering 10,000 cities. Although Uber operates in both urban and rural areas, it is particularly popular in the world's largest cities. In fact, 22% of Uber trips come from just five major metropolitan areas, including New York City, Los Angeles, Chicago, London, and São Paulo. In 2020, Uber bookings in these cities generated \$5.85 billion in revenue (Start.io, 2022).

Company's USP

USP stands for Unique Selling Proposition, which is a distinguishing factor for a brand, product, or service that sets it apart from competitors, and is a key element that makes a company's product or service stand out in the competition (Bishop, 2023).

Despite the sharing economy now being seen as a trend, Uber initially created a business miracle with its unique concept and operational model. Uber's biggest competitive advantage is its accumulated network economy. Network effects enhance the experience and value of the service with each new member joining. Uber operates a two-sided marketplace through its network platform, connecting drivers with passengers. Uber's strategic goal, as stated in its S-1 IPO filing in 2019, is to create the largest network in each market, harnessing maximum liquidity network effects and deriving profit advantages (Sec.gov, 2019). At its peak, Uber aggressively expanded into nearly all global markets, making it costly for potential entrants to incentivize drivers and passengers to gain meaningful market share. Another benefit of Uber's network effect is its ability to cross-sell other products and services to customers. Since 2014, Uber has been operating its food delivery division (Eats), and has since expanded into the freight sector. Uber can integrate multiple services under one platform to reduce costs and share existing customers for faster business expansion.

Additionally, Uber, as a pioneer in the sharing economy, disruptively implemented a light asset strategy. As a ridesharing company, Uber does not own any vehicles but quickly assembled a globally distributed and flexible workforce of drivers to meet the needs of customers almost anywhere. Uber's rapid expansion proved the immense attractiveness of this innovative business model to investors. In 2010, Uber secured \$2.5 billion in venture capital, and in 2011, raised an additional \$320 million in Series B financing to expand its operations from the United States to European and Middle Eastern markets (Alonso, 2023).

b. The key reasons for Uber to go public

IPO stands for Initial Public Offering, which is a method for private companies to raise funds by issuing stocks to investors that can be traded on a stock exchange. In an IPO, a private company lists its shares on a stock exchange for public purchase (Ashford, 2021). In addition to allowing early investors in a company to cash out their investments, the purposes of an initial public offering can include:

a) Fundraising: Companies raise substantial capital through an IPO and subsequent financings to fund general corporate operations, growth opportunities, research and development, marketing, and capital expenditures.

b) Acquisition Financing: When valuations are high, an IPO can provide additional cash or reduce reliance on stock swaps to facilitate corporate acquisition transactions. Proceeds can be used for acquisitions through IPO proceeds or future stock offerings. Successful acquisitions can lead to synergies and growth in company revenue and profitability.

c) Debt Reduction: Publicly listed companies can use proceeds from an IPO or subsequent stock issuances to repay debt, reducing interest costs and improving cash flow and debt-to-equity ratios.

d) Corporate Image Maintenance and Increased Visibility: Companies going public are more likely to gain recognition and attention from potential customers and strategic partners through press releases and coverage in financial media. Publicly listed companies are more transparent as they are required to publicly disclose information, including financial results.

e) Employee Attraction: Companies can attract certain risk-averse employees through stock grants and public stock option plans. While startup employees may receive higher stock rewards as early pre-IPO investors, many employees prefer working for large publicly traded companies over startups (Ashford, 2021).

Uber's decision to go public clearly met the requirements typical of most IPOs. Firstly, Uber faced significant financial pressure prior to its IPO. The company's prospectus revealed that its core ride-sharing business had experienced stagnant quarterly revenue growth. With intensifying competition, Uber continued to expend substantial capital to maintain its market share. Despite revenue growth, the company incurred operational losses exceeding \$3 billion in 2018 alone, totaling around \$12 billion in operational losses over five years. Moreover, Uber aimed to swiftly recoup previous substantial investments and expand its scale in ridesharing and food delivery services, potentially leading to further investment losses. Therefore, Uber urgently needed to raise large-scale, low-cost funding in the public market (Sec.gov, 2019).

Secondly, Uber's transition to a public company also served as a marketing measure. Prior to going public, Uber faced ongoing negative publicity, lawsuits, and executive turnover. In 2017, Uber's founder and former CEO Travis Kalanick was ousted following widespread criticism sparked by an article exposing gender discrimination at Uber. Kalanick's successor, Dara Khosrowshahi, pledged to reform Uber. Part of this transformation included taking the company public. This indicated that Uber was ready to make its operations more transparent and stabilize both internal and external operations (Hawkins, 2019), (Espanola, 2019).

c. Comment on Uber's proposed valuation of the company based on its S-1 filing and operating risks

1. The biggest risk facing Uber is lack of a sustainable competitive advantage. Competitive advantage is measured by profit share—a company's share of industry profits. This definition means that if an industry lacks profitability, it is impossible to gain a competitive advantage. According to Uber's financial results, there is no profit in the ride-sharing industry. Uber lost \$3 billion in 2018. The problem with ridesharing (a so-called two-sided market) is that there are low barriers to entry and low switching costs for both the supply side (drivers) and the demand side (consumers). As a result, the industry is characterized by "many players offering virtually identical services. They are engaged in a spending arms race to attract new drivers and consumers." A market share lead would be a Pyrrhic victory for Uber, which has lowered and may continue to lower fares or service fees in the past and would require significant

incentives to drivers and discounts and promotions to consumers, which would have a negative impact on Uber's finances. Adversely affect performance. At the same time, Uber's market has attracted large investments from various funding sources, and many of Uber's competitors will have more capital to compete with Uber and continue to drive down market prices (Sec.gov, 2019,P26-27) .

2. Uber's significant investments in new products and technologies carry substantial risks and may not yield any returns. Uber has allocated substantial funds towards autonomous vehicle technology, dock less electric bikes and scooters, Uber Freight, and Uber Elevate. In 2018 alone, the ATG (Advanced Technologies Group) project incurred \$457 million in research and development expenses, with Uber indicating continued investment. These ventures undertaken by Uber involve high risks, as these technologies are unproven, lack operational experience or experimental data. Moreover, the development and experimentation processes may involve substantial costs, regulatory challenges, and other risks, with the possibility that these investments may never materialize into marketable products with returns. For instance, Uber's car leasing business, Xchange Leasing, proved to be a significant gamble for the company and ultimately resulted in substantial losses (Korosec, 2017). If these new products or technologies fail to commercialize and achieve expected returns on investment, Uber's business, financial condition, operating performance, and prospects could be adversely affected. Additionally, the development of new products poses heightened challenges for company management, as new R&D initiatives divert management's attention away from core business activities, potentially impacting existing operations negatively. (Sec.gov, 2019, P34) .

3. The ongoing corporate scandals pose a significant challenge to Uber's reputation, which is crucial for maintaining and enhancing its brand image and business prospects. In 2017, Uber's brand and reputation were heavily impacted by extensive negative publicity and media coverage. This not only significantly diminished Uber's business value but also had highly adverse effects on retaining existing users and attracting top talent. Through social media platforms alone, the #DeleteUber campaign prompted 'hundreds of thousands' of consumers quitting Uber app within days (Leskin, 2019). Additionally, Uber faced data security vulnerabilities and investigations into its software platform fees, along with being embroiled in multiple government lawsuits. Despite taking significant measures to restore its brand reputation, maintaining a good reputation, minimizing safety incidents, and improving the work environment require continued investment of funds and manpower. If circumstances similar to those in 2017 were to occur again, Uber's future would be exceptionally challenging, which could be catastrophic for the company's development. (Sec.gov, 2019, P31-32)

Part B. Quantitatively review the share price performance of Uber

a. Uber's price performance



Figure 1. Uber's one year trade price
(Source: uk.finance.yahoo.com, 2024)



Figure 2. Uber's five year trade price
(Source: uk.finance.yahoo.com, 2024)

Uber's IPO in 2019 garnered significant attention, but its first day of trading on the New York Stock Exchange saw a decline of 7.6% (Feiner, 2019), indicating investor skepticism towards Uber's business model.

However, in recent years, Uber's performance has improved, leading to increased interest from potential investors. As shown in Figure 2, Uber's stock price has experienced rapid growth since 2021, contrasting sharply with its dismal performance at the time of its public listing in 2019. By 2024, Uber's stock price had raised by nearly 150%, largely due to cost-cutting initiatives by Uber's new CEO, Khosrowshahi, who divested non-core businesses such as autonomous vehicles and found new revenue streams in areas like advertising. From 2016 to 2023, Uber's revenue grew from \$3.85 billion to \$37.3 billion, nearly a tenfold increase, equivalent to a compound annual growth rate of 38.30%. Operating expenses dropped significantly from 67% in 2016 to 15.5% in 2023, while research and development costs reduced from 22.5% of revenue to 7.9% during the same period. Consequently, Uber achieved a milestone of \$1.11 billion in profit in 2023 (Hung Tran, 2024).

Figure 2 and the data in Appendix 1 demonstrate Uber's rapid stock price increase over the past year, with a growth of nearly 45% from April 2023 to April 2024, reflecting the market's recognition of its operational growth. The stock experienced a maximum decrease of -5.68% and a maximum increase of 14.73% over the past year, with a standard deviation of 0.023 (Appendix 1). However, while the sustained rapid rise in Uber's stock price signals market confidence in its future prospects, it may also raise concerns among some investors about its valuation potentially being overestimated.

b. Calculate the compound annual growth rate (CAGR)

CAGR stands for Compound Annual Growth Rate. It measures the annual growth rate of an investment over time, taking into account the effect of compounding. It is commonly used to assess and compare the past performance of an investment or to forecast its expected future returns. The compound annual growth rate is a useful tool for comparing various investments over similar periods. One of the advantages of CAGR is that it is not affected by misleading percentage changes that can occur during the investment period. A disadvantage of CAGR is that it assumes growth remains constant throughout the entire investment period. For investments with high volatility, this smoothing mechanism can produce results that differ from actual outcomes. Another drawback of CAGR is that it does not take into account value changes caused by an investor's decision to further fund or liquidate assets (CFI, n.d.).

Based on the calculation formula for CAGR (Appendix B), we can determine Uber's CAGR as follows.

vfinal	76.81
vbegin	31.39
t	251
CAGR	0.0036

Table1. Uber's CAGR

(Source: LCMB7032_LON: Banking and Financial Economics, 2024)

While other factors and data should be considered when assessing a company's performance using CAGR, a value of 0.0036 does indeed represent a relatively low growth rate, indicating a slow annual growth rate for Uber. This figure may also reflect the low return on investment and intense competition within the ride-sharing industry.

c. Calculate and comment the Sharpe and Treynor ratios

The Sharpe Ratio is an indicator used to measure the risk-adjusted return of a portfolio, helping investors to evaluate the additional return obtained per unit of risk, and is used to compare the performance of different portfolios (Arnold and Lewis, 2024, p.292). A higher Sharpe Ratio indicates that a portfolio has achieved higher returns for the amount of risk taken.

Based on the calculation formula for the Sharpe Ratio (Appendix B), we can determine Uber's Sharpe Ratio as follows.

rp-rf	1.4169576
standard deviation	0.0226585
Sharpe ratio	0.4723192

Table 2. Uber's Sharpe ratio

(Source: LCMB7032_LON: Banking and Financial Economics, 2024)

The Treynor Ratio measures the return in excess of the risk-free rate divided by the beta value, to observe the excess return generated per unit of market risk. The Sharpe Ratio is the return in excess of the risk-free rate divided by the standard deviation (Arnold and Lewis, 2024, p.292).

Based on the calculation formula for the Treynor Ratio (Appendix B), we can determine Uber's Treynor Ratio as follows.

rp-rf	1.4169576
Beta	1.37
Treynor ratio	1.0342757

Table 3. Uber's Treynor ratio

(Source: LCMB7032_LON: Banking and Financial Economics, 2024)

The Sharpe ratio and Treynor ratios are both metrics used to assess the relationship between investment returns and market risk, providing evaluations of investment portfolios. Calculating the Sharpe ratio and Treynor ratio for Uber using the formulas in Appendix B, we obtain a Sharpe ratio of 0.4723 and a Treynor ratio of 1.0342.

While the Treynor ratio of 1.0342 suggests relatively good performance, but combining Sharpe ratio and comparing them against the current risk-free rate (such as U.S. Treasury bond rates) reveals that Uber's investment returns do not shine brightly in relation to the risks taken.

Part C. A second listed company that has exchange trade options

Option trading is a way for investors to speculate on the future direction of the entire stock market or individual securities, such as stocks or bonds. Option contracts give you the right (but not the obligation) to buy or sell the underlying asset at a specified price on a specified date. Options are tradable contracts that investors use to speculate on whether the price of an asset will be higher or lower at some future date, without the need to actually purchase the related asset. There are call options and put options. Call options give you the opportunity to purchase securities at a predetermined price before a specified date, while put options allow you to sell securities at a future date and price (Jackson, 2022).

Apple Inc. is a high-tech company founded in the United States in 1976 and went public in 1980, with the stock symbol AAPL (Levy, 2024). On April 11, 2024, at 11 a.m., the stock price of Apple Inc. was \$167.78 per share (Yahoo, 2024).

a. For an at the money call option graphically show the derivative contract's payoff

On June 20, 2025, Apple Inc.'s call options information is as follows:

Contract name	Last trade date	Strike	Last price
AAPL250620C00190000	2024-04-10 3:47PM EDT	190.00	12.85

Table4. Apple Inc.'s call options contract on 20th Jun, 2025

(Source: Yahoo, 2024)

Based on the profit model of at-the-money call option derivatives, we can obtain the profit graph of Apple Inc.'s call option contract one year later as follows.

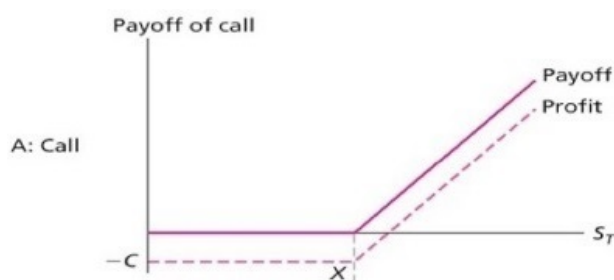


Figure 3. The model of call option derivative contract's payoff



Figure 4. Apple's call option derivative contract's payoff

(Source: LCMB7032_LON: Banking and Financial Economics, 2024)

b. For an at the money put option graphically show the derivative contract's payoff

On June 20, 2025, the information for Apple Inc.'s put option is as follows:

Contract name	Last trade date	Strike	Last price
AAPL250620P00190000	2024-04-08 3:08PM EDT	190.00	25.95

Table5.Apple Inc.'s put option contract on 20th, Jun, 2025

(Source: Yahoo, 2024)

Based on the profit model of at-the-money put option derivatives, we can generate the profit graph of Apple Inc.'s put option contract one year later.

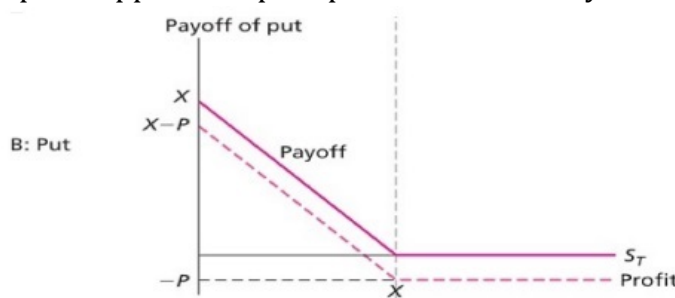


Figure 5. The model of put option derivative contract's payoff

(Source: LCMB7032_LON: Banking and Financial Economics, 2024)

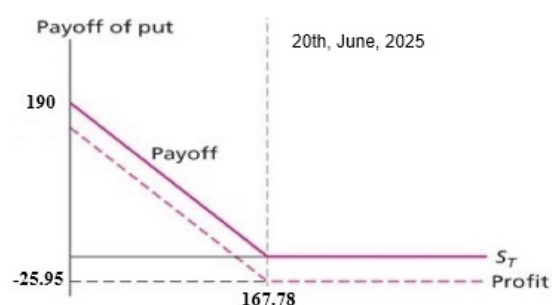


Figure 6. Apple's put option derivative contract's payoff on 20th, June, 2025

c. Discuss the construction of either a strangle or straddle

The construction of a straddle is an options trading strategy that involves an investor simultaneously buying and selling call and put options of the same underlying asset, with both options having exactly the same expiration date and strike price. By using this approach, investors can avoid losses regardless of the direction of the trade. In a straddle, investors profit from volatility rather than direction (Salvucci, 2022).

Based on the profit model of a straddle, we can generate the profit graph of Apple Inc.'s straddle contract one year later.

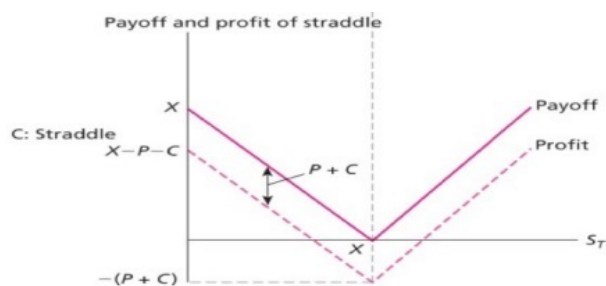


Figure 7. The model of payoff and profit of straddle

(Source: LCMB7032_LON: Banking and Financial Economics, 2024)

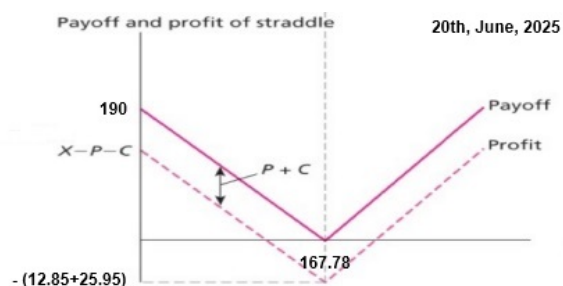


Figure 8. Apple's straddle contract's derivative payoff

The model (Figure 7) demonstrates that using a straddle offers the maximum advantage in risk mitigation, as investors can profit regardless of whether the stock price rises or falls in the future. Secondly, a straddle strategy can be employed when there is a predictable expectation of significant price movement but uncertainty about the direction of the movement, as the profitability of a straddle relies on "high volatility" rather than direction. Therefore, investors may choose a straddle before a company releases earnings reports, launches a new product, or before FDA announcements. However, due to the low-risk nature of straddles, profiting from using a straddle strategy requires high levels of investor experience and judgment, given the critical importance of timing entry into the market. Additionally, as time passes, volatility tends to decrease, leading to diminishing profits. Furthermore, compared to other options strategies, the upfront cost of a straddle is higher because investors need more capital to purchase both call and put options (Learn, 2023), (Plessis, Henry and Hysmith, 2023).

Part D. For the period January 2023 to December 2023

a. Discuss the performance of the 10Y note



Figure 9. The performance of the 10Y note in 2023
(Source: CNBC, 2023)

From Figure 9, it can be observed that the yield on the US 10-year Treasury bond experienced a fluctuating upward trend from January to November 2023. On October 23rd, after breaking through 5.00% for the first time in 15 years, the bond yield rapidly declined within a month to levels seen in June and July, reaching a low point on December 27th (3.69%). However, overall, the yield on the US 10-year Treasury bond remains relatively high. The yield on US Treasury bonds is influenced by various factors, including trends in US interest rates, monetary policy, economic conditions, global political risks, and more. The significant increase in US Treasury bond yields over the past year is attributed to the Federal Reserve's ongoing rate hikes and stronger-than-expected US economic recovery. There is an inverse relationship between bond prices and yields, as Treasury securities are considered low-risk investments with relatively low yields compared to other investment options in the market. Therefore, when bank interest

rates are higher and the economy performs strongly, investors tend to opt for higher-yielding investments, reducing demand for Treasury securities and necessitating higher yields to attract investors (Econ, 2000), (Chen, 2022).

b. Discuss the impact of changes in the yield of this note upon consumer debt

Consumer debt commonly referred to as consumer credit or personal debt, is the debt incurred by individuals for purchasing goods or services for their households. Consumer debt includes secured debt, unsecured debt, and revolving debt, among others. Some specific examples include mortgages, auto loans, credit card debt, and student loans (SHARKEY, 2023). The fluctuations in the 10-year Treasury bond yield are highly significant. On one hand, the yield on the 10-year Treasury bond reflects market confidence in the global economy. Additionally, these yields serve as benchmarks for other borrowing rates, such as mortgage interest rates. When the 10-year yield increases, mortgage rates and other borrowing rates also tend to rise. Conversely, when the yield on the 10-year Treasury bond decreases, other borrowing rates correspondingly decline (Baldrige, 2021).



Figure10. Mortgage rates and treasury yields
(Source: Gordon, 2023)

Changes in mortgage rates directly impact consumer debt. Typically, mortgage rates move in sync with the 10-year Treasury bond yield. As illustrated in figure10, when the yield on the 10-year Treasury bond increases, mortgage rates and other borrowing rates, including credit card rates, auto loan rates, and home loan rates, also rise. Higher mortgage rates signify increased borrowing costs for consumers (Gordon, 2023), thereby influencing consumer behavior and preferences. Faced with higher borrowing costs for consumption, consumers may opt for higher-yield investment options to achieve better returns.

Based on the above, it can be inferred that the trend of the 10-year US Treasury bond yield and total consumer credit is inverse. Specifically, when the 10-year Treasury bond yield raises, consumer credit declines, and when the 10-year Treasury bond yield falls, consumer credit tends to rise.

Conclusion

Uber, as a pioneer in the sharing economy, has accumulated significant network advantages. Through its IPO, Uber raised substantial funds enabling rapid global expansion. However, Uber's operations carry significant risks, primarily due to a lack of long-term competitive advantages and high-risk investments in new products and technologies, which have adversely affected its stock price. This article briefly introduces and analyzes options contracts using models of call and put options, using futures contracts for Apple Inc. as an example over the next year. It also discusses the execution and profitability patterns of option contracts and highlights the advantages and disadvantages of using a straddle strategy. Finally, the article describes the performance of the U.S. 10-year Treasury bond in 2023, analyzing its yield's impact on the economy and elucidating the perspective that the yield of the 10-year Treasury bond is inversely related to consumer debt.

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Appendix A. Uber's share price performance over the past one year

(Source: uk.finance.yahoo.com, 2024)

Date	Close	RETURNS	Date	Close	RETURNS	Date	Close	RETURNS
2023/4/4	31.39		2023/6/9	40.99	1.81%	2023/8/16	43.65	-0.98%
2023/4/5	31.12	-0.86%	2023/6/12	41.74	1.83%	2023/8/17	43.97	0.73%
2023/4/6	31.18	0.19%	2023/6/13	41.41	-0.79%	2023/8/18	44.69	1.64%
2023/4/10	31.74	1.80%	2023/6/14	41.27	-0.34%	2023/8/21	44.63	-0.13%
2023/4/11	31.12	-1.95%	2023/6/15	43.36	5.06%	2023/8/22	44.35	-0.63%
2023/4/12	30.59	-1.70%	2023/6/16	43.52	0.37%	2023/8/23	45.14	1.78%
2023/4/13	31.44	2.78%	2023/6/20	42.17	-3.10%	2023/8/24	44.68	-1.02%
2023/4/14	31.48	0.13%	2023/6/21	42.66	1.16%	2023/8/25	43.96	-1.61%
2023/4/17	32.08	1.91%	2023/6/22	42.81	0.35%	2023/8/28	44.15	0.43%
2023/4/18	31.73	-1.09%	2023/6/23	43.34	1.24%	2023/8/29	45.35	2.72%
2023/4/19	32.04	0.98%	2023/6/26	44.42	2.49%	2023/8/30	46.51	2.56%
2023/4/20	31.50	-1.69%	2023/6/27	43.83	-1.33%	2023/8/31	47.23	1.55%
2023/4/21	30.83	-2.13%	2023/6/28	44.24	0.94%	2023/9/1	47.04	-0.40%
2023/4/24	30.68	-0.49%	2023/6/29	42.58	-3.75%	2023/9/5	46.55	-1.04%
2023/4/25	29.59	-3.55%	2023/6/30	43.17	1.39%	2023/9/6	45.90	-1.40%
2023/4/26	29.68	0.30%	2023/7/3	43.09	-0.19%	2023/9/7	46.27	0.81%
2023/4/27	29.70	0.07%	2023/7/5	43.66	1.32%	2023/9/8	47.24	2.10%
2023/4/28	31.05	4.55%	2023/7/6	42.11	-3.55%	2023/9/11	48.94	3.60%
2023/5/1	32.74	5.44%	2023/7/7	42.91	1.90%	2023/9/12	47.92	-2.08%
2023/5/2	36.52	11.55%	2023/7/10	42.78	-0.30%	2023/9/13	48.16	0.50%
2023/5/3	37.84	3.61%	2023/7/11	44.36	3.69%	2023/9/14	48.32	0.33%
2023/5/4	37.49	-0.92%	2023/7/12	44.52	0.36%	2023/9/15	47.52	-1.66%
2023/5/5	37.75	0.69%	2023/7/13	45.64	2.52%	2023/9/18	46.51	-2.13%
2023/5/8	38.83	2.86%	2023/7/14	44.75	-1.95%	2023/9/19	47.59	2.32%
2023/5/9	38.19	-1.65%	2023/7/17	45.51	1.70%	2023/9/20	46.55	-2.19%
2023/5/10	38.79	1.57%	2023/7/18	47.41	4.17%	2023/9/21	44.60	-4.19%
2023/5/11	38.42	-0.95%	2023/7/19	47.12	-0.61%	2023/9/22	44.41	-0.43%
2023/5/12	38.45	0.08%	2023/7/20	46.57	-1.17%	2023/9/25	44.91	1.13%
2023/5/15	38.14	-0.81%	2023/7/21	47.23	1.42%	2023/9/26	44.27	-1.43%
2023/5/16	37.44	-1.84%	2023/7/24	47.32	0.19%	2023/9/27	45.14	1.97%
2023/5/17	37.84	1.07%	2023/7/25	47.17	-0.32%	2023/9/28	46.14	2.22%
2023/5/18	39.25	3.73%	2023/7/26	47.31	0.30%	2023/9/29	45.99	-0.33%
2023/5/19	39.18	-0.18%	2023/7/27	46.61	-1.48%	2023/10/2	45.68	-0.67%
2023/5/22	39.17	-0.03%	2023/7/28	48.14	3.28%	2023/10/3	44.51	-2.56%
2023/5/23	38.66	-1.30%	2023/7/31	49.46	2.74%	2023/10/4	44.94	0.97%
2023/5/24	37.96	-1.81%	2023/8/1	46.65	-5.68%	2023/10/5	44.61	-0.73%
2023/5/25	37.95	-0.03%	2023/8/2	46.96	0.66%	2023/10/6	45.78	2.62%
2023/5/26	38.45	1.32%	2023/8/3	45.91	-2.24%	2023/10/9	45.45	-0.72%
2023/5/30	37.56	-2.31%	2023/8/4	45.20	-1.55%	2023/10/10	46.63	2.60%
2023/5/31	37.93	0.99%	2023/8/7	44.95	-0.55%	2023/10/11	46.64	0.02%

2023/6/1	38.48	1.45%	2023/8/8	45.16	0.47%	2023/10/12	45.95	-1.48%
2023/6/2	39.73	3.25%	2023/8/9	44.11	-2.33%	2023/10/13	43.48	-5.38%
2023/6/5	40.42	1.74%	2023/8/10	44.60	1.11%	2023/10/16	44.71	2.83%
2023/6/6	40.25	-0.42%	2023/8/11	43.71	-2.00%	2023/10/17	44.38	-0.74%
2023/6/7	38.99	-3.13%	2023/8/14	44.85	2.61%	2023/10/18	43.00	-3.11%
2023/6/8	40.26	3.26%	2023/8/15	44.08	-1.72%	2023/10/19	42.72	-0.65%
2023/10/24	44.19	2.67%	2024/1/2	58.38	-5.18%	2024/3/11	77.47	-1.56%
2023/10/25	42.35	-4.16%	2024/1/3	58.25	-0.22%	2024/3/12	78.32	1.10%
2023/10/26	40.62	-4.09%	2024/1/4	57.80	-0.77%	2024/3/13	78.25	-0.09%
2023/10/27	41.23	1.50%	2024/1/5	57.58	-0.38%	2024/3/14	77.65	-0.77%
2023/10/30	42.73	3.64%	2024/1/8	59.01	2.48%	2024/3/15	76.07	-2.03%
2023/10/31	43.28	1.29%	2024/1/9	60.30	2.19%	2024/3/18	75.70	-0.49%
2023/11/1	43.83	1.27%	2024/1/10	62.41	3.50%	2024/3/19	77.08	1.82%
2023/11/2	46.48	6.05%	2024/1/11	63.47	1.70%	2024/3/20	78.64	2.02%
2023/11/3	47.75	2.73%	2024/1/12	63.20	-0.43%	2024/3/21	80.25	2.05%
2023/11/6	48.14	0.82%	2024/1/16	63.65	0.71%	2024/3/22	80.23	-0.02%
2023/11/7	49.92	3.70%	2024/1/17	63.12	-0.83%	2024/3/25	79.41	-1.02%
2023/11/8	49.50	-0.84%	2024/1/18	64.88	2.79%	2024/3/26	77.91	-1.89%
2023/11/9	50.05	1.11%	2024/1/19	65.11	0.35%	2024/3/27	78.11	0.26%
2023/11/10	51.58	3.06%	2024/1/22	64.55	-0.86%	2024/3/28	76.99	-1.43%
2023/11/13	52.24	1.28%	2024/1/23	64.32	-0.36%	2024/4/1	76.40	-0.77%
2023/11/14	53.88	3.14%	2024/1/24	63.76	-0.87%	2024/4/2	76.98	0.76%
2023/11/15	53.76	-0.22%	2024/1/25	66.00	3.51%	2024/4/3	76.81	-0.22%
2023/11/16	54.42	1.23%	2024/1/26	65.52	-0.73%			
2023/11/17	54.44	0.04%	2024/1/29	66.98	2.23%			
2023/11/20	54.75	0.57%	2024/1/30	66.84	-0.21%			
2023/11/21	54.85	0.18%	2024/1/31	65.27	-2.35%			
2023/11/22	55.37	0.95%	2024/2/1	66.73	2.24%			
2023/11/24	55.32	-0.09%	2024/2/2	68.07	2.01%			
2023/11/27	56.06	1.34%	2024/2/5	68.99	1.35%			
2023/11/28	56.21	0.27%	2024/2/6	70.47	2.15%			
2023/11/29	56.40	0.34%	2024/2/7	70.65	0.26%			
2023/11/30	56.38	-0.04%	2024/2/8	71.61	1.36%			
2023/12/1	57.35	1.72%	2024/2/9	70.91	-0.98%			
2023/12/4	58.63	2.23%	2024/2/12	69.12	-2.52%			
2023/12/5	57.97	-1.13%	2024/2/13	68.99	-0.19%			
2023/12/6	59.75	3.07%	2024/2/14	79.15	14.73%			
2023/12/7	60.98	2.06%	2024/2/15	81.39	2.83%			
2023/12/8	61.70	1.18%	2024/2/16	78.41	-3.66%			
2023/12/11	62.46	1.23%	2024/2/20	76.60	-2.31%			
2023/12/12	62.72	0.42%	2024/2/21	76.44	-0.21%			
2023/12/13	61.97	-1.20%	2024/2/22	78.03	2.08%			
2023/12/14	62.50	0.86%	2024/2/23	78.20	0.22%			
2023/12/15	61.86	-1.02%	2024/2/26	78.36	0.20%			

2023/12/18	61.73	-0.21%	2024/2/27	78.75	0.50%
2023/12/19	62.12	0.63%	2024/2/28	77.73	-1.30%
2023/12/20	60.68	-2.32%	2024/2/29	79.50	2.28%
2023/12/21	61.46	1.29%	2024/3/1	81.03	1.92%
2023/12/22	61.71	0.41%	2024/3/4	81.30	0.33%
2023/12/26	61.98	0.44%	2024/3/5	79.09	-2.72%
2023/12/27	63.28	2.10%	2024/3/6	78.64	-0.57%
2023/12/28	63.14	-0.22%	2024/3/7	79.41	0.98%
2023/12/29	61.57	-2.49%	2024/3/8	78.70	-0.89%

Appendix B. Equations

(Source: LCMB7032_LON: Banking and Financial Economics, 2024)

CAGR	$(\frac{v_{\text{final}}}{v_{\text{begin}}})^{\frac{1}{t}} - 1$
Sharpe Ratio	$\frac{r_p - r_f}{\sigma_p}$
Treynor Ratio	$\frac{r_p - r_f}{\beta_p}$