



COMPANY: TESLA INC

Equity Research Report on TSLA

Jiven Chana¹, Gursahib Matharu², Sarah Hassanali³, Saad Ahmed⁴, Shreya Mithani⁵ and Fatema Mahimwala⁶

* Stock outcome: BUY

Birmingham Investment & Finance Society, Asset Management Division

Introduction

This Equity Research Report on Tesla Inc. (TSLA) provides a forward thinking approach on equity research by integrating traditional financial analysis with advanced quantitative modeling. It caters to diverse investors, offering deep fundamental insights into Tesla's financial stability and strategic directions alongside novel quantitative analyses that refine performance forecasts. This dual approach not only sets new standards for investment analysis but also equips investors with essential insights for decision-making in a tech-driven market. By merging classic and modern techniques, the report showcases Tesla's potential and charts the future of investment research, where thorough data analysis supports strategic investment decisions.

Key words:

Geopolitical Risks, Supply Chain, EV (Electric Vehicle) Infrastructure, Competitive Analysis, Financial Leverage, Monte Carlo Simulations, Geometric Brownian Motion (GBM), Dynamic Regression, Kalman Filters

Market Profile

Company Overview

Founding and Evolution

Tesla, Inc. (NASDAQ: TSLA) was founded in 2003 with the mission to accelerate the world's transition to sustainable energy. Initially focused on electric vehicles (EVs), the company has since expanded into energy storage and solar solutions. Headquartered in Austin, Texas, Tesla operates a global network of manufacturing facilities, including Gigafactories in the U.S., China, and Europe, supporting its vertically integrated business model.

Key Products and Services

Electric Vehicles (EVs): Tesla's core automotive lineup includes the luxury Model S sedan, the affordable Model 3 sedan, the Model X SUV, and the compact Model Y SUV. The company recently launched the Cybertruck, marking its entry into the electric pickup segment, alongside the Tesla Semi, designed for commercial freight transport. Tesla's Full Self-Driving (FSD) software remains a key focus, aiming to achieve full autonomy through AI-powered

advancements (Tesla, 2025a).

Energy Solutions: Beyond EVs, Tesla has positioned itself as a major player in the energy sector. The Powerwall provides residential energy storage, while the Megapack is designed for large-scale grid applications, helping utilities and businesses integrate renewable energy more efficiently.

Solar Products: Tesla's solar division, bolstered by the acquisition of SolarCity in 2016, offers Solar Roof tiles and solar panels. These solutions complement its energy storage products, enabling a fully integrated clean energy ecosystem for residential and commercial users.

Leadership and Strategic Vision

Elon Musk, Tesla's CEO since 2008, has been instrumental in shaping the company's strategy (Tesla, 2025b). His vision emphasises innovation, cost efficiency, and vertical integration, allowing Tesla to control key aspects of production—from battery manufacturing to software development. Musk's leadership has propelled Tesla to the forefront of the EV market, driving

advancements in battery technology, autonomous driving, and AI integration.

Looking ahead, Tesla continues to invest in AI, autonomous driving, and robotics, with plans to launch a robotaxi service and further develop the Optimus humanoid robot (AI Root, 2025). With a strong foothold in both the automotive and energy sectors, Tesla remains a key player in the global shift toward sustainable technology.

Global Presence

Manufacturing and Distribution Hubs

Tesla's global presence is anchored by its network of Gigafactories, which serve as both manufacturing and distribution centres. These facilities enhance supply chain efficiency by enabling localised production, reducing shipping costs, and ensuring compliance with regional regulatory requirements.

In the United States, Tesla operates several key facilities. The Fremont Factory in California, Tesla's first major production site, manufactures the Model S, Model 3, Model X, and Model Y. Gigafactory Nevada specialises in battery production and energy storage solutions, while Gigafactory Texas in Austin plays a crucial role in Cybertruck production and Model Y assembly.

In Europe, Gigafactory Berlin-Brandenburg was established to supply European markets, reducing dependence on imports from the US and China. Meanwhile, in Asia, Gigafactory Shanghai—Tesla's first Gigafactory outside the US—serves as a crucial export hub for European and Asian markets. Additionally, Tesla is considering building a Gigafactory in India to tap into the growing EV market and benefit from government incentives.

Regional Production and Export Dynamics

Tesla's production strategy optimises regional supply chains while minimising exposure to tariffs and trade restrictions. In North America, the Inflation Reduction Act (IRA) incentivises Tesla's local production through a \$7,500 federal EV tax credit, while state-level programmes like California's Clean Vehicle Rebate Project (CVRP) and the Zero Emission Vehicle (ZEV) mandate further boost demand.

In Europe, Gigafactory Berlin supports localised production, reducing reliance on imports from the US and China. Tesla also benefits from EU subsidies, such as Germany's €4,500 EV incentive and France's €5,000–€7,000 grants. In China and the Asia-Pacific region, Gigafactory Shanghai enables Tesla to capitalise on China's New Energy Vehicle (NEV) quotas and tax exemptions. Although China is phasing out direct EV subsidies, Tesla benefits from lower operational costs and favourable regulatory policies. Expansion into Southeast Asia and India aims to diversify production capabilities and reduce dependence on China.

Role in Supporting EV Adoption Globally

Tesla's extensive global footprint significantly contributes to accelerating EV adoption by increasing accessibility to its vehicles. Beyond vehicle production, Tesla invests in charging infrastructure and energy solutions to support the transition to sustainable transportation.

The company's Supercharger network benefits from government-backed EV infrastructure initiatives, such as the US National Electric Vehicle Infrastructure (NEVI) programme and

the EU's Green Deal. The deployment of Supercharger V4 stations enhances charging efficiency and supports a wider range of EVs. Tesla also advances renewable energy solutions, with its solar panels and Powerwall battery systems leveraging incentives like the EU's Fit for 55 package and feed-in tariffs in countries such as Germany. Additionally, Tesla generates revenue through carbon credit sales, benefiting from programmes such as California's ZEV initiative and the EU's Emissions Trading System (ETS). Tesla Energy Ventures is also expanding into grid-scale battery storage projects to facilitate renewable energy integration.

Tesla's global presence through its network of Gigafactories strengthens its ability to meet growing demand while optimising production and distribution. By strategically placing manufacturing hubs in the US, Europe, and Asia, Tesla reduces costs and aligns with regional regulatory requirements, driving supply chain efficiency. Regional production incentives, such as the Inflation Reduction Act in North America and EU subsidies in Europe, further enhance Tesla's competitive edge. Additionally, Tesla's global network of Superchargers and energy solutions supports EV adoption by improving vehicle accessibility and integrating sustainable energy infrastructure. Through this expansive presence, Tesla is positioned as a key player in accelerating the global transition to electric vehicles.

Financial Performance

Revenue and Profitability Trends

Tesla's revenue growth over the years from 2019 to 2023 indicates a strong upward trend, demonstrating the company's successful expansion and increasing market penetration.

2019 to 2020

From 2019 to 2020, there was a revenue growth of 28.3% as shown in Figure 1, reflecting Tesla's improved production capacity, growing demand for its electric vehicles (EVs) and advances in scaling its Model 3 production during this period.

2020 to 2021

Then from 2020–2021 revenue jumped from \$31.54 billion to \$53.82 billion, a staggering 70.6% growth. This sharp increase can be attributed to significant growth in EV adoption globally, the launch and ramp-up of the Tesla Model Y, and Tesla's expansion into new markets, particularly in China, where Gigafactory Shanghai became operational and drove substantial sales volume.

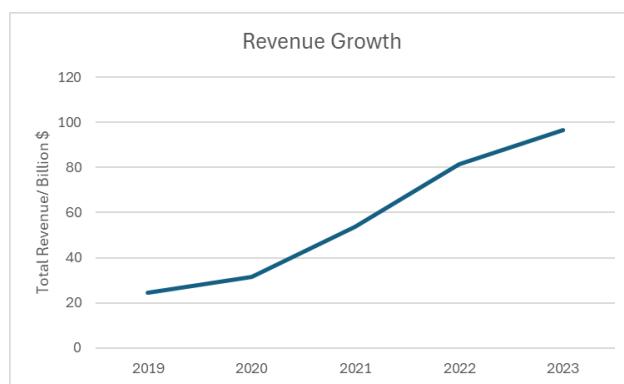


Figure 1. Total revenue growth from 2019–2023

The 51.3% growth from 2021 to 2022 marks record deliveries of Tesla vehicles, continued expansion of production facilities (Gigafactories in Texas and Berlin started operations) and strong demand for Tesla's full self-driving software subscriptions (FSD) and energy solutions.

2023

The lowest growth rate of 18.8% in 2023 suggests that Tesla may be reaching market saturation in some regions or facing stiff competition. Economic factors such as a global slowdown or supply chain disruptions may have further damped growth.

Segment Performance

Automotive Sales Growth

Tesla's automotive sales have shown remarkable growth, with 1.81 million vehicles sold globally in 2023, marking a 38% year-over-year increase from 2022. This growth is driven by the popularity of the Model Y, which accounted for 66% of total sales with 1.2 million units sold, making it the world's best-selling EV. The Model 3 followed with 529,287 units sold, further cementing Tesla's dominance. Regionally, the United States and China were Tesla's largest markets in 2023, with 654,888 and 603,304 vehicles sold, respectively, while Europe also performed strongly, with the Model Y leading EV sales at 155,219 units by September 2024. Looking ahead, Tesla aims to deliver 2.3 million vehicles by 2025, supported by Wall Street projections of 2.1 million vehicles. The company's growth is underpinned by increasing global EV demand, competitive pricing of the Model 3 and Y, and strategic expansion of manufacturing facilities like the Gigafactories in Berlin, Texas, and Shanghai. These factors reinforce Tesla's leadership in the rapidly growing EV market.

Energy Generation and Storage

Tesla's energy generation and storage segment has experienced significant growth, primarily driven by its Powerwall and Megapack products. In 2023, this division generated approximately \$6 billion in revenue, accounting for about 6% of Tesla's total revenue.

Diversification of Revenue Streams

The Megapack, designed for utility-scale applications, and the Powerwall, tailored for residential use, have been pivotal in this expansion. In the third quarter of 2024, Tesla's energy generation and storage revenue reached nearly \$2.4 billion, marking a 52% increase from the previous year. This growth underscores the rising demand for energy storage solutions, driven by factors such



Figure 2. Performance of TSLA models

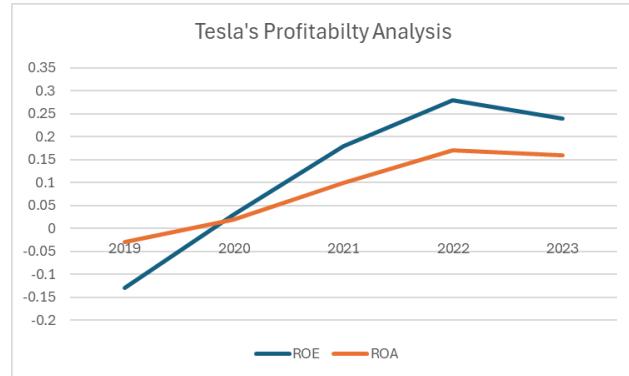


Figure 3. ROE and ROA for 2019–2023

as extreme weather events, electrification laws, and the increasing strain on municipal energy grids.

Beyond its core automotive and energy products, Tesla has diversified its revenue streams through various services and other offerings. In 2023, the company reported over \$8 billion in revenue from services and other segments..

This category encompasses multiple streams, including sales of trade-in vehicles, repair and maintenance services, insurance products, and merchandise sales..

These diversified services not only provide additional revenue but also enhance customer loyalty and brand engagement, contributing to Tesla's overall financial performance..

Key Financial Ratios and Metrics

ROE and ROA

The relationship between ROE and ROA, shown in Fig 3, provides valuable insight into Tesla's financial structure and performance. ROE measures the company's ability to generate returns for its shareholders by utilising equity, while ROA shows how effectively the company is using its assets to produce profits.

In 2019, Tesla's ROE was negative at -0.13, indicating that the company was unable to generate positive returns for its shareholders as Tesla faced challenges in scaling production and managing costs. Similarly, the ROA was also negative at -0.03, suggesting that Tesla was not effectively utilising its assets to generate profits. The negative values for both ROE and ROA reflected the difficulties Tesla encountered in turning its investments into meaningful returns.

In 2020, Tesla's financial situation began to improve and a positive trend emerged, by 2022 Tesla's ROE reached 0.28, reflecting the company's ability to leverage its equity base effectively, improve profitability and improve operational efficiency. The ROA also increased to 0.17, the rise in both metrics in 2022 signalled that Tesla was not only generating strong returns for shareholders but also making efficient use of its assets to achieve this profitability.

In 2023, Tesla's ROE decreased slightly to 0.24 and ROA also decreased marginally to 0.16. Despite this, the company continued to perform well and both ROE and ROA remained at healthy levels, suggesting that Tesla's profitability and asset management were still relatively strong.

interest coverage

The interest coverage ratio shown in Fig 4, is a key measure of a company's financial health, specifically its ability to pay interest on outstanding debt. A higher ratio indicates that a company is more capable of covering its interest payments, while a lower ratio suggests potential difficulty in managing debt obligations.

In 2019, the very low ratio of 0.03 indicated that Tesla's earnings were insufficient to cover its interest expenses, signaling the challenges the company faced in terms of profitability and debt management. The ratio suggests that Tesla had a high level of debt relative to its earnings, making it highly vulnerable to potential financial strain.

In 2021, Tesla's interest coverage ratio surged to 18.1, a remarkable improvement. This jump reflected the company's continued growth in profitability and its increasing ability to generate earnings from its core operations. The 18.1 ratio showed that Tesla could comfortably cover its interest expenses multiple times over, signaling that the company had become much more financially stable and less reliant on external financing. Tesla's ability to generate operating income had reached a point where debt was no longer a major concern, and the company's cash flow was strong enough to support its growth and operations without being heavily burdened by interest payments.

In 2023, while Tesla's interest coverage ratio decreased slightly to 64.93, it remained extremely strong. The company continued to be in a very healthy financial position, with its ability to cover interest payments remaining well above average. The decrease could reflect changes in debt levels or interest rate fluctuations, but it does not signal a significant deterioration in Tesla's ability to manage its financial obligations.

PEG ratio

Tesla's Price/Earnings to Growth (PEG) ratio (Fig 5) from 2019 to 2023 reveals interesting insights into how the market has valued the company's growth potential relative to its earnings. The PEG ratio is a valuation metric that takes into account a company's price-to-earnings (P/E) ratio and adjusts it for the company's earnings growth rate. A PEG ratio of 1 is generally considered to indicate that the stock is fairly valued in relation to its growth. A PEG ratio lower than 1 suggests that the stock is undervalued relative to its earnings growth potential, while a PEG higher than 1 suggests that the stock might be overvalued.

In 2019, Tesla's PEG ratio was 0.67, this low ratio reflected the market's skepticism about Tesla's future growth prospects during that time, despite the company's potential in the electric vehicle (EV) market. At the time, investors were uncertain about Tesla's

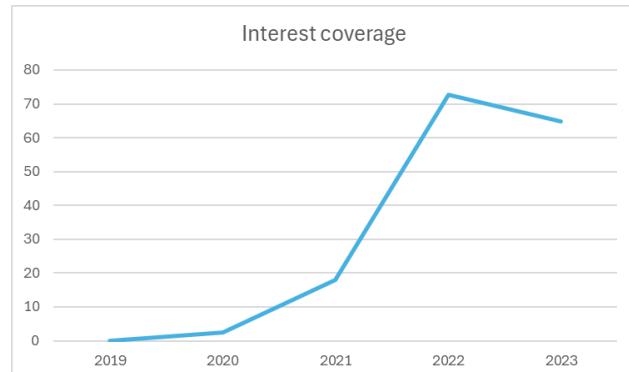


Figure 4. Interest Coverage for 2019–2023

ability to scale production, maintain profitability, and navigate the competitive pressures in the automotive industry. The low PEG ratio suggested that, even though Tesla was not yet fully profitable, the market believed its growth potential outweighed the risks.

However, in 2020, the PEG ratio rose to 1.19, indicating that the market began to view Tesla as a more promising investment. Despite the global economic challenges posed by the COVID-19 pandemic, Tesla's financial performance improved, and the company showed strong resilience and growth. The increase in the PEG ratio during this period suggests that investors started to price in more aggressive growth expectations for Tesla, as the company continued to expand its production capacity and reach new milestones in profitability.

In 2021, Tesla's PEG ratio surged to 2.32, reflecting an even more pronounced market optimism about the company's growth. Investors appeared to be pricing in very high future growth for Tesla, possibly driven by excitement surrounding the company's dominance in the EV market, expansion into new markets, and innovations in autonomous driving technology. This overvaluation, as indicated by a PEG ratio significantly above 1, could also reflect broader market trends in tech stocks, where high growth expectations sometimes lead to inflated valuations.

In 2022, the PEG ratio decreased to 0.81, returning to a more reasonable level. This decline reflected a market recalibration, as Tesla's earnings growth continued, but the stock's price became more aligned with its earnings growth rate. The drop in the PEG ratio suggested that investors were factoring in more realistic growth expectations, which could have been influenced by competition in the EV sector and concerns over supply chain issues.

In 2023, Tesla's PEG ratio skyrocketed to 4.61, the high PEG ratio suggests that the market was placing extremely high growth expectations on Tesla. This could be a reflection of both Tesla's continued success in the EV market and investor enthusiasm for the company's future plans. The steep increase in the PEG ratio also indicates that investors may have been overly optimistic about Tesla's growth prospects, potentially inflating the stock price beyond a reasonable reflection of its earnings growth rate.

Margin Ratios and Profitability Analysis

Margin ratios are essential indicators of a company's profitability and operational efficiency. The gross profit margin measures the efficiency of production by comparing revenue to the cost of goods sold (COGS). The operating margin evaluates management's efficiency by comparing revenue to operating expenses. Finally, the net profit margin assesses overall profitability by calculating

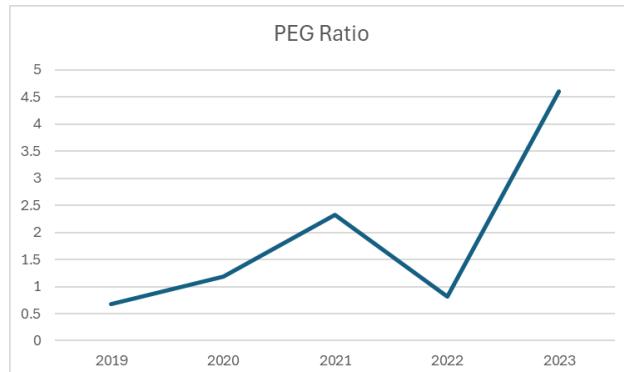


Figure 5. PEG Ratio from 2019–2023

the percentage of revenue remaining after all expenses, taxes, and interest are deducted.

The steady improvement in the gross profit margin (Table 1) from 2019 to 2022 reflects Tesla's growing operational efficiency, economies of scale, and higher production volumes driven by the success of the Model 3 and Model Y. The company's ability to manage manufacturing costs and leverage higher-margin software offerings (e.g., Full Self-Driving packages) likely contributed to this upward trend. In 2022, Tesla maintained a strong balance between revenue growth and production efficiency. The drop in gross profit margin in 2023 signals challenges: increased competition in the EV market forced Tesla to reduce vehicle prices. Margins partially recovered in the third quarter through reduced production costs.

The operating margin showed significant improvement from a negative -0.28% in 2019 to 16.76% in 2022, demonstrating better operational efficiency and cost management. In 2023, the operating margin declined to 9.19% due to increased expenses associated with the Cybertruck launch and investments in artificial intelligence.

The net profit margin, which was negative at -3.51% in 2019, turned positive in 2020 and rose steadily to 15.45% in 2022, reflecting strong profitability and effective cost control. The margin remained stable at 15.50% in 2023.

EV Industry Market Share

Competitive Landscape

Tesla's position as a global leader in electric vehicles (EVs) is deeply intertwined with its ability to leverage government policies, navigate international trade dynamics, and adapt to renewable energy regulations. This analysis explores the influence of EV incentives, trade policies, renewable energy initiatives, labor trends, and geopolitical factors on Tesla's operations, offering a detailed perspective on the challenges and opportunities the company faces.

EV Incentives and Emissions Standards

Tesla's success is significantly influenced by EV incentives and emissions standards in its key markets. In the United States, the **Inflation Reduction Act (IRA)** of 2022 reinstated the \$7,500 federal EV tax credit for vehicles assembled in North America, provided battery components and critical minerals are sourced domestically or from U.S. free-trade partners. Tesla's extensive manufacturing footprint in the U.S., including its Gigafactories in Nevada and Texas, enables it to fully capitalize on these incentives.

In Europe, Tesla benefits from robust subsidies and stringent CO₂ emission standards. Countries like Germany offer up to €4,500 for EV purchases, while France provides €5,000–€7,000, depending on income levels. The European Union's requirement for automakers to maintain average fleet-wide CO₂ emissions of 95g CO₂/km aligns with Tesla's all-electric portfolio, giving

Table 1. Historic Margin Ratios 2019–2023

Year	2019	2020	2021	2022	2023
Gross Profit Margin	16.6%	21.0%	25.3%	25.6%	18.25%
Operating Margin	-0.28%	6.23%	12.12%	16.76%	9.19%
Net Profit Margin	-3.51%	2.19%	10.26%	15.45%	15.50%

it a competitive advantage. Meanwhile, **China's New Energy Vehicle (NEV) quotas** and tax exemptions ensure Tesla remains competitive despite the ongoing phase-out of direct EV subsidies. These policies, combined with Tesla's localization efforts at its Shanghai Gigafactory, position the company as a dominant player in the Chinese market.

However, Tesla also faces increasing competition in accessing these incentives. Chinese automaker BYD benefits from strong government support, including research and development subsidies and favorable trade policies. Rivian, a U.S.-based competitor, qualifies for similar IRA credits but focuses on localized production to maintain compliance.

Trade Policies and Tariff Impacts

Tesla's global operations are deeply affected by U.S.–China and U.S.–EU trade policies, particularly tariffs and trade deficits. The U.S. imposes a 25% tariff on Chinese-made EVs, which restricts Tesla's ability to export vehicles from its Shanghai Gigafactory to North America. While this tariff does not apply to Shanghai exports to Europe, geopolitical tensions between China and Western nations pose risks to Tesla's reliance on its Chinese supply chain. Furthermore, the U.S. trade deficit with China, driven in part by reliance on Chinese-linked critical materials like lithium, cobalt, and nickel, underscores the need for Tesla to diversify its sourcing strategy.

Tesla's Shanghai Gigafactory plays a vital role in the company's export operations, shipping vehicles to Europe and other Asian markets. However, over-reliance on the Shanghai facility makes Tesla vulnerable to geopolitical risks, such as potential trade restrictions or sanctions on Chinese-made goods. In Europe, favourable trade policies have allowed Tesla to import vehicles tariff-free, though the U.S. emphasis on domestic manufacturing under the IRA could strain relations with EU nations seeking

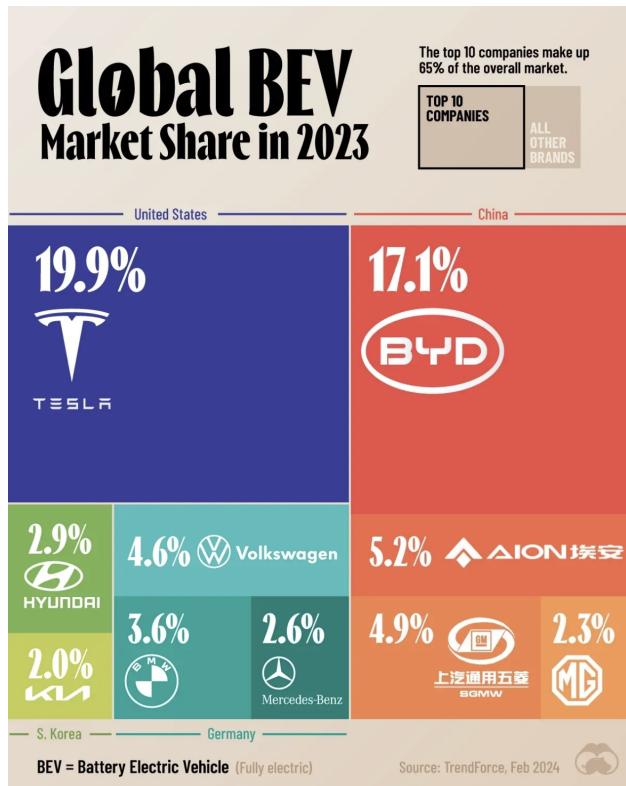


Figure 6. PEG Ratio from 2019–2023

similar incentives.

Renewable Energy and Emission Reduction Policies

Tesla's renewable energy divisions, including solar panels and battery systems, benefit from favourable government incentives worldwide. In the U.S., federal tax credits under the IRA and other programs encourage adoption of Tesla's Powerwall and grid-scale energy storage solutions. Similarly, the European Union's Fit for 55 package offers funding for renewable energy projects, while feed-in tariffs in countries like Germany incentives the adoption of solar installations.

Government investment in EV charging

infrastructure, such as the U.S. National Electric Vehicle Infrastructure (NEVI) program, further supports Tesla's Supercharger network expansion. The EU's Green Deal, which mandates EV chargers every 60 kilometres along major routes, aligns with Tesla's infrastructure strategy, enabling it to secure subsidies while enhancing consumer adoption.

Labor and Fiscal Policy Considerations

Labor trends and fiscal policies also shape Tesla's operations across regions. Rising labor costs in the U.S. and Europe, driven by inflation and high-tech skill shortages, create challenges for Tesla's profitability. Germany's stringent labor regulations further contrast with China's cost-efficient workforce, leading to regional cost disparities.

Geopolitical and Supply Chain Risks

Geopolitical tensions and supply chain constraints present significant risks to Tesla's operations. U.S.-China relations, characterised by tariffs and restrictions on key technologies, could disrupt Tesla's reliance on its Shanghai Gigafactory and Chinese suppliers. Similarly, the EU's emphasis on local EV production under initiatives like the Fit for 55 package may compel Tesla to further expand its European operations.

Tesla also benefits from government on-shoring investments, such as the Biden Administration's funding for domestic EV battery plants. These initiatives provide tax breaks and other incentives, allowing Tesla to strengthen its U.S. supply chain. Meanwhile, global efforts to diversify material sourcing and reduce reliance on China align with Tesla's long-term sustainability and localisation goals.

Competitive Analysis

Margin Comparison

BYD leads in gross profit margin at 21.90%, indicating better production cost efficiency compared to Tesla's 18.25%. However, Tesla demonstrates superior operational efficiency with the highest operating margin of 9.19%, outperforming BYD (6.38%), VW (7.00%), and GM (5.41%). In terms of net profit margin, BYD

Table 2. Competitive Margin Ratios 2019–2023

Company	Gross Profit Margin	Operating Margin	Net Profit Margin
TSLA	18.25%	9.19%	15.50%
BYD	21.90%	6.38%	20.21%
VW	18.75%	7.00%	4.97%
GM	18.23%	5.41%	5.84%

Table 3. Liquidity analysis 2019–2023

Year	2019	2020	2021	2022	2023
TSLA	1.1x	1.9x	1.4x	1.5x	1.7x
BYD	1.0x	1.0x	1.0x	0.7x	0.7x
VW	1.1x	1.2x	1.2x	1.2x	1.2x
GM	0.9x	1.0x	1.1x	1.1x	1.1x

edges ahead at 20.21%, followed by Tesla at 15.50%, while VW and GM trail significantly at 4.97% and 5.84%, respectively.

Tesla's performance overall is commendable, particularly in operational efficiency and profitability. To maintain its competitive edge, Tesla could focus on further reducing production costs through advanced technologies and renewable energy solutions, enhancing operational efficiency through continuous improvement strategies, and expanding into new markets while investing in innovation to drive revenue and profitability growth.

Liquidity Analysis – Current Ratio

The current ratio measures a company's ability to meet short-term liabilities with its short-term assets. A ratio above 1 indicates strong liquidity.

Tesla's current ratio improved from 1.1x in 2019 to 1.7x in 2023 (See Table 3), demonstrating stronger liquidity management compared to competitors. BYD's consistently low current ratio of 0.7x in 2023 indicates potential difficulties in managing short-term liabilities. VW and GM maintained relatively stable ratios around 1.1x–1.2x, reflecting balanced liquidity.

Tesla's liquidity position can be further strengthened by optimizing cash flow, inventory, receivables, and payables management while investing in advanced financial technologies to maintain its competitive advantage.

Financial Leverage – Debt-to-Equity Ratio

The debt-to-equity ratio measures a company's reliance on debt compared to its shareholders' equity. Lower ratios indicate reduced financial risk and a stronger equity position.

Tesla's debt-to-equity ratio significantly decreased from 1.78 in 2019 to 0.074 in 2023 (shown in Table 4), showcasing financial discipline and reduced reliance on debt. BYD and VW maintained higher leverage, with BYD's ratio increasing to 1.61 in 2023. GM had the highest reliance on debt, with a ratio of 1.91 in 2023.

Tesla's continued focus on disciplined debt management, strategic investments, and expanding equity through sustained profitability will help further solidify its financial health and maintain its strong market position.

Table 4. Debt-To-Equity Ratio analysis 2019–2023

Year	2019	2020	2021	2022	2023
TSLA	1.78	0.46	0.18	0.046	0.074
BYD	1.59	1.08	0.87	1.31	1.61
VW	1.65	1.60	1.46	1.24	1.32
GM	2.50	2.47	1.85	1.71	1.91

Monte Carlo Simulations

The Monte Carlo simulation is a method used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. In this report, we apply the Monte Carlo simulation to forecast TSLA stock price movements. The simulation accounts for randomness in stock price behavior, generating potential future price distributions for different time horizons.

Preliminaries

In preparing our Monte Carlo simulation to forecast Tesla's stock price movements, we utilize the Geometric Brownian Motion (GBM) model, a fundamental stochastic process widely applied in financial mathematics for modeling stock prices and other assets. This model effectively incorporates the randomness inherent in financial markets, offering a robust framework for our analysis.

The GBM model is represented by the following stochastic differential equation:

$$dS = \mu S dt + \sigma S dW \quad (1)$$

Where:

- S is the stock price.
- μ is the drift (average return).
- σ is the volatility (standard deviation of returns).
- W is a Wiener process (also known as Brownian motion).

Model Setup

For practical implementation, we translate the continuous GBM into a discrete approximation to facilitate our simulations. This approach allows us to model the day-to-day fluctuations in Tesla's stock price over various time horizons. The discrete version of the GBM is formulated as follows:

$$S_{t+1} = S_t \cdot \exp \left(\left(\mu - \frac{1}{2} \sigma^2 \right) \Delta t + \sigma \sqrt{\Delta t} \cdot Z \right) \quad (2)$$

Where:

- Z is a random variable drawn from a normal distribution.
- Δt is the time step.

This setup facilitates the execution of 10,000 iterative simulations to project future price distributions for Tesla over the next 3 months, 6 months, 1 year, and 5 years. The choice of these time horizons is designed to capture both short-term volatilities and long-term trends, providing a comprehensive overview of potential future trajectories under various market conditions.

By applying the Monte Carlo simulation method using the GBM model, our analysis does not merely speculate on single-point future values but rather develops a probability distribution of potential outcomes. This method acknowledges and incorporates the inherent uncertainties and dynamics of the stock market, offering a more nuanced tool for risk assessment and investment strategy development for Tesla's stakeholders.

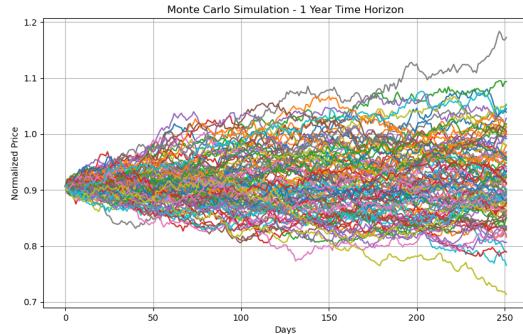


Figure 7. 1-Year price simulation

Results

Sensitivity heatmap

Monte Carlo simulations underscore a generally optimistic forecast for Tesla's stock over the coming one to five years, albeit shadowed by increasing uncertainty with extended timeframes. These projections indicate a rising trajectory for TSLA's share price, intertwined with significant volatility that escalates the risk of fluctuations, particularly over shorter spans such as one to three months. While these models offer valuable insights, they rely on the assumption of steady volatility—a simplification that may not hold against the complex dynamics of real-world markets.

Our sensitivity analysis, visualized through a detailed heatmap, meticulously evaluates how variations in market conditions could influence Tesla's key financial indicators, specifically the standard deviation affected by drift and volatility. This analysis illuminates the nuanced interplay between drift—the expected return minus random shocks—and volatility—the range of price variations over time—across various scenarios. The heatmap vividly delineates a risk-return gradient, providing investors with a clear depiction of potential financial outcomes under different market conditions.

The findings reveal that Tesla's financial health is more susceptible to changes in market volatility than to shifts in drift. This insight is pivotal for investors, as it underscores the inherent risks associated with Tesla's high-volatility sectors, including electric vehicles and renewable energy technologies. An increase in volatil-

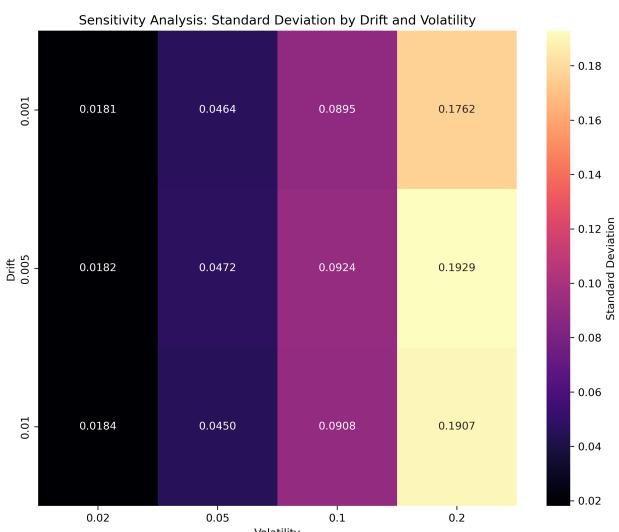


Figure 8. Sensitivity heatmap for μ , σ

ity correlates with an elevation in the standard deviation of returns, indicating both a higher potential for substantial gains and an amplified risk profile, which aligns with Tesla's bold market strategies.

Such market sensitivity suggests that Tesla's investment allure could vary significantly with shifts in global economic conditions and investor sentiment. For instance, in times of heightened market volatility, Tesla's shares could witness substantial price swings. These periods may offer lucrative opportunities for gains but also necessitate comprehensive risk management strategies to mitigate potential losses.

Moreover, the detailed granularity of this analysis emphasizes the necessity for adaptable investment strategies that can swiftly respond to market changes. This might include employing derivatives for risk management and leveraging advanced, real-time data analytics for informed decision-making. By capitalizing on Tesla's characteristic volatility, investors can potentially optimize returns while minimizing adverse impacts.

Integrating this analysis into an equity research report enhances the narrative around Tesla's financial robustness and investment potential, offering investors a well-rounded view that aids in making informed decisions in a volatile and evolving market. This strategic insight is indispensable for navigating the complexities of investing in a transformative sector like that of electric vehicles and renewable energy.

Distrubtion of simulated prices

The Monte Carlo simulation offers a probabilistic forecast of potential Tesla stock prices, depicted in Figure 9. This analysis confirms a \$450 target price as reasonable, residing within one standard deviation of the mean, highlighting its attainability within the current financial year given the existing market dynamics.

The presence of fat tails in the price distribution suggests the likelihood of achieving prices as high as \$480 or as low as \$380 is minimal, though such extremes are possible. This observation is crucial for investors who base their decisions on the normal distribution and might overlook the risks associated with less probable outcomes.

Setting a target price at \$450 is supported by the probabilistic models used, with the \$380–\$390 range acting as a practical risk management threshold. This insight allows investors to fine-tune their market entry and exit strategies, maximizing gains while protecting against significant losses.

However, the case of NVIDIA's recent stock performance serves as a poignant example of the market's volatility and the rapid shifts that can occur due to external factors. Following the backlash over its involvement with DeepSeek, NVIDIA's stock experienced a sharp decline, underscoring the impact of market sensitivity on stock values. This incident illustrates how quickly investor sentiment can shift, affecting stock prices and highlighting the need for robust risk mitigation strategies in volatile sectors like technology and electric vehicles.

For investors prioritizing stability or seeking to diversify within less volatile sectors of the electric vehicle market, Tesla's susceptibility to sharp market movements may represent a significant deterrent. The detailed analysis provided here should assist investors in making informed decisions, recognizing both the opportunities for substantial gains and the risks of abrupt value fluctuations in a rapidly evolving market landscape.

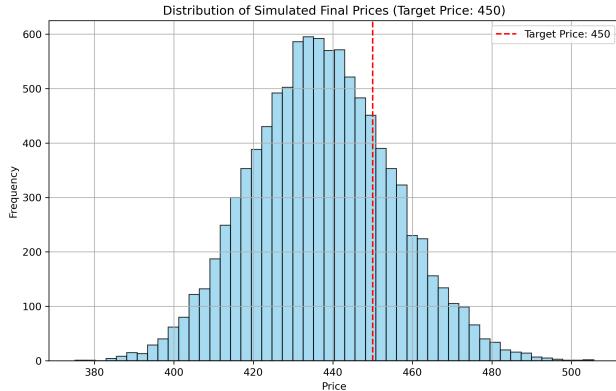


Figure 9. Baseline Simulation – Distribution of Simulated Final Prices

Validity of model

While the Monte Carlo simulation provides useful insights, there are several assumptions and limitations to be aware of:

- The assumption of constant volatility σ is often unrealistic in the real world, as market conditions change over time.
- The model assumes that returns are normally distributed, which may not fully capture extreme market movements (fat tails).
- The simulation does not account for real-world events such as market shocks or policy changes, which can significantly impact stock prices.
- The drift parameter μ is estimated based on historical data, and there is a risk that the future will deviate from historical trends.

These limitations should be considered when interpreting the results of the simulation.

Kalman Filter Model & Dependency analysis

Preliminaries

This section introduces the Kalman Filter Model, utilized for its adeptness in real-time predictive analysis of Tesla's stock. The model thrives in managing the volatility characteristic of Tesla's market by dynamically adjusting to changes, offering an insightful perspective into Tesla's stock behavior through rigorous time series analysis.

Our model integrates daily trading data from Tesla and a composite index (NDXL) crafted from several market indices: Nasdaq 100 (NDX), Global X Autonomous & Electric Vehicles ETF (DRIV), Consumer Discretionary Select Sector SPDR Fund (XLY), and Global X Lithium & Battery Tech ETF (LIT).

The preprocessing steps include normalization and scaling of the data using MinMaxScaler, ensuring that the inputs into the Kalman Filter are consistent and comparable. This careful preparation is essential for the detailed analytical work in the following sections, where market dynamics and stock sensitivity are explored further.

Model Setup

Market Proxy

The composite index, referred to as NDXL, is derived from a weighted combination of four major indices: NASDAQ (NDX),

Consumer Discretionary (XLY), Autonomous & Electric Vehicles (DRIV), and Global X Lithium & Battery Tech (LIT). Each index was chosen based on its relevance to Tesla's business model and sector. NDX provides a broad market exposure, reflecting general market trends that affect tech giants like Tesla. XLY covers consumer spending behaviors that directly impact Tesla's core products. DRIV focuses on the specific niche of electric and autonomous vehicles, directly correlating with Tesla's industry. LIT is included to account for the critical raw materials involved in battery production, which are central to Tesla's manufacturing capabilities.

Theoretical framework

The model's foundation is built on a dynamic regression approach, utilizing the Kalman Filter to refine our estimates continually.

Inputs

In our analysis, we developed two distinct models using the Kalman Filter for dynamic regression to estimate rolling alpha and beta values, capturing the relationship between Tesla (TSLA) and a composite index (NDXL). These models help in understanding Tesla's stock responsiveness to market changes from different analytical perspectives.

Model 1: Price-Oriented Dynamic Regression

This model integrates VWAP, volatility, and close prices, offering a comprehensive view of the market influences on Tesla's stock prices. By incorporating multiple price-related features, Model 1 provides a detailed snapshot of how Tesla's price dynamics correlate with broader market movements, allowing for nuanced insights into price behaviors and risk assessment.

Model 2: Return-Focused Dynamic Regression

Utilizing only the logarithmic returns, Model 2 offers a streamlined analysis that focuses on the rate of return over time. With minimal feature engineering, this model emphasizes the pure financial return aspect of Tesla's relationship with market indices, providing a clearer view of the stock's performance relative to market fluctuations.

Both models are crafted to highlight different facets of Tesla's market behavior, with Model 1 delivering a multi-dimensional perspective through various financial indicators, and Model 2 concentrating on the fundamental return metrics. Together, these models equip investors with a robust framework to gauge Tesla's stock sensitivity and adapt their investment strategies accordingly. Below all the equations used and their applications are listed.

VWAP (Volume-Weighted Average Price): This metric gives us a more accurate reflection of Tesla's stock price, weighted by volume, ensuring that our analysis considers the price points where substantial volumes have been traded. In this formula, P_i and V_i represent the price and volume at time i , respectively.

$$\text{VWAP}_t = \frac{\sum_{i=1}^t (P_i \cdot V_i)}{\sum_{i=1}^t V_i} \quad (3)$$

Volatility: We calculate rolling standard deviations of the logarithmic returns of the stock, which provides us with a measure

of how wildly the stock price can swing, an essential factor in risk assessment. Here, σ_t is the standard deviation of returns over a window of N days, r_{t-i} is the return at time $t - i$, and \bar{r} is the mean return over the window.

$$\sigma_t = \sqrt{\frac{1}{N} \sum_{i=1}^N (r_{t-i} - \bar{r})^2} \quad (4)$$

Close Prices: The daily closing prices of Tesla's stock are used to assess its market valuation at the end of each trading day.

Logarithmic returns: This formula helps normalize the percentage changes in prices, making them more manageable for statistical analysis. The use of logarithmic returns is especially common in cases where the comparison of returns over multiple periods is required, or when the returns are used in subsequent multiplicative calculations, such as in the calculation of the overall return of a portfolio over time. Below P_t and P_{t-1} represent the stock price at time t and $t - 1$, respectively.

$$r_t = \log\left(\frac{P_t}{P_{t-1}}\right) \quad (5)$$

DYNAMIC REGRESSION COMPONENTS: Rolling Alpha α (Intercept): This component of the model signifies the part of Tesla's return not explained by market movements. It's crucial for understanding how Tesla's stock behaves independently of the market.

Rolling Beta β (Market Sensitivity): Beta measures Tesla's stock price volatility relative to the swings in the market. A higher beta indicates greater volatility relative to the market, while a lower beta indicates less.

MODEL OPERATIONS: In the model, the Kalman Filter is employed to dynamically estimate the regression coefficients—alpha and beta—between Tesla's stock returns and a composite index of related assets. The coefficients are recalculated at each time step, reflecting the evolving relationship between Tesla and the market proxies, thus providing insights that are crucial for an investment strategy.

Prediction Phase

The model first predicts the next state (alpha and beta) and the error covariance:

- Predicted State Estimate:

$$\hat{x}_{k|k-1} = F_k \hat{x}_{k-1|k-1} + B_k u_k$$

Here, $\hat{x}_{k|k-1}$ represents the predicted state vector (alpha and beta), F_k is the state transition matrix assumed to be the identity matrix, implying that the previous state is the best prediction of the current state in the absence of new data, and u_k represents any control inputs which, in this case, are typically absent.

- Predicted Covariance Estimate:

$$P_{k|k-1} = F_k P_{k-1|k-1} F_k^\top + Q_k$$

$P_{k|k-1}$ is the predicted covariance matrix that quantifies the estimate's uncertainty, and Q_k represents the process noise covariance, indicating the expected noise in the prediction model.

Update Phase

The model then refines these predictions based on new market data:

- Kalman Gain:

$$\mathbf{K}_k = \mathbf{P}_{k|k-1} \mathbf{H}_k^\top (\mathbf{H}_k \mathbf{P}_{k|k-1} \mathbf{H}_k^\top + \mathbf{R}_k)^{-1}$$

The Kalman Gain, \mathbf{K}_k , balances the prediction and the measurement, optimizing the weight given to new data versus old data.

- Updated State Estimate:

$$\hat{\mathbf{x}}_{k|k} = \hat{\mathbf{x}}_{k|k-1} + \mathbf{K}_k (\mathbf{z}_k - \mathbf{H}_k \hat{\mathbf{x}}_{k|k-1})$$

This equation updates the state estimate with the new market data (\mathbf{z}_k), where \mathbf{H}_k translates the state estimates into the measured space.

- Updated Covariance Estimate:

$$\mathbf{P}_{k|k} = (\mathbf{I} - \mathbf{K}_k \mathbf{H}_k) \mathbf{P}_{k|k-1}$$

Finally, the covariance of the estimate is updated, reducing the uncertainty in the state estimate if the measurement is considered accurate.

These equations collectively allow the model to adapt to changes in Tesla's price behavior relative to the market, quantifying the strength and bias of the relationship via rolling estimates of beta and alpha. The rolling beta assesses the sensitivity of Tesla's stock returns to movements in the composite index, while alpha provides an intercept term, suggesting Tesla's performance relative to the market independent of market movements.

Using the Kalman Filter, the model updates its estimates of alpha and beta dynamically. This process involves calculating the expected state of these parameters given past information and then updating these expectations with new daily data on VWAP, volatility, and close prices.

The observation matrix in this model typically aligns the changes in Tesla's returns (in Fig 10) or prices (in Fig 11) with the returns of a market index, weighted by the previous estimations of alpha and beta, to adjust the model continuously based on incoming data.

OUTPUTS.. The primary outputs of this model are the updated values of alpha and beta. These outputs help in understanding how closely Tesla's stock movements are tied to the market (beta) and how it performs relative to the market's expectations (alpha).

Results: Prices model

The provided scatter plot (in Fig 10) exemplifies a dynamic regression model that meticulously tracks the interaction between Tesla's stock prices and the NDXL index, a composite representing pertinent market proxies. The progression of colors from dark blue to yellow, transitioning from historical to more recent data, illustrates the evolution of Tesla's responsiveness to changes in the NDXL index. This analysis reveals the fluctuations in Tesla's stock sensitivity to broader market trends over time, offering a granular view of its market behavior.

The analysis of rolling beta and alpha (Fig 11) between Tesla (TSLA) and the composite index (NDXL) provides significant insights into the stock's market behavior and individual performance

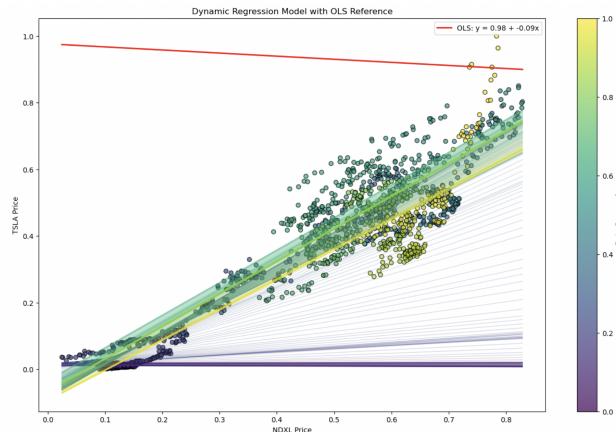


Figure 10. Scatterplot with OLS reference for prices model

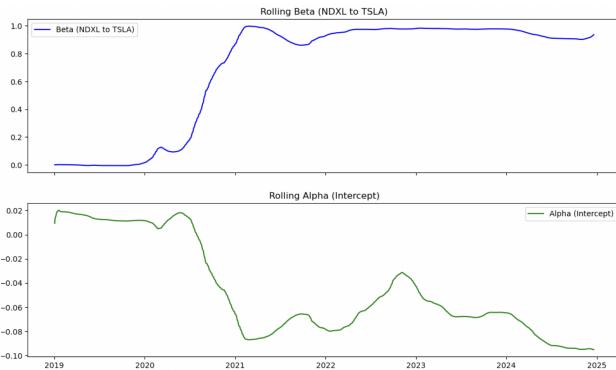


Figure 11. Alpha & Beta plot for prices model

nuances. The rolling beta reveals a pronounced rise from early 2021, reaching near unity by late 2022 and persisting through to 2025. This trend indicates that Tesla's stock movements are almost perfectly correlated with the broader market movements typically seen in technology-heavy indices like the NASDAQ-100. Also Tesla price movements are very correlated with the evolution of battery tech in the LIT ETF. This synchronization implies that Tesla, despite its unique position within the automotive and energy sectors, is heavily influenced by the same macroeconomic factors that drive the technology sector. Such a high beta typically denotes high volatility and, consequently, higher risk and return, which can be attractive in bullish market conditions but requires caution during downturns.

The rolling alpha presents a different perspective, showcasing a significant decline into negative territory starting from early 2019 and deepening in 2021. This negative alpha is indicative of Tesla's returns failing to meet the expectations set by its market risk level. Despite Tesla's aggressive expansion and technological innovation, the negative alpha suggests that these factors have not translated into excess returns over the market. This could reflect operational challenges (with the Gigafactory in Shanghai), increased competition, or market saturation impacts that may not be immediately visible through traditional financial analysis.

Results: Returns model

This visual analysis (Fig 12) underscores the increasing beta of Tesla's stock, reflecting a stronger correlation with market movements as time progresses. For investors, this pattern

suggests that Tesla's stock is becoming progressively reactive to the fluctuations of the tech-heavy index NDXL, emphasizing the need for vigilant market trend monitoring. The alignment of Tesla's stock behavior with market trends can offer predictive insights for strategic investment decisions, particularly for those looking to leverage market cycles. Investors should consider the implications of this heightened correlation in their portfolio strategy, potentially adjusting their risk management and diversification tactics to accommodate the increasing volatility associated with Tesla's shares. This detailed temporal analysis is crucial for understanding the broader implications of Tesla's market dynamics and formulating robust investment strategies.

The investigation of rolling beta and alpha using log returns between Tesla (TSLA) and the composite index (NDXL) as shown in Fig 13, offers valuable insights distinct from those derived through the price model. In this analysis, the rolling beta progressively ascends from early 2021, stabilizing around 0.4 by the study's end. This moderate beta value suggests that while Tesla's stock movements are influenced by broader market trends typical of tech-heavy indices, they retain a substantial degree of independence due to specific company or industry factors.

This moderate correlation might imply that Tesla shares only partially reflect broader market fluctuations, thus providing a buffer against widespread market downturns while also potentially not fully capitalizing on general market upswings. The strategic implication for investors is the potential benefit of including Tesla in a diversified portfolio, where its partial market correlation could serve as a hedge against more volatile tech stocks, potentially reducing overall portfolio risk.

Conversely, the rolling alpha presents an initially positive trend that sharply declines, stabilizing near zero and occasionally dipping into the negative. This trajectory indicates that Tesla initially outperformed market expectations but increasingly aligned with or underperformed against these expectations over time. The transition to a consistently low or negative alpha highlights potential concerns about Tesla's ability to sustain outperformance relative to market-adjusted risk. It suggests that while Tesla may have previously leveraged unique innovations or market conditions to generate superior returns, these advantages may be diminishing as the company and market dynamics evolve.

For investors, these findings underscore the importance of closely monitoring Tesla's ongoing business strategies, competitive position, and market developments. Maintaining vigilance on how Tesla's specific actions—such as new product launches, market expansion, and operational efficiencies—impact its financial performance relative to the broader market will be crucial. Furthermore, the need for periodic reassessment of Tesla's role within investment portfolios becomes apparent, particularly if its ability to surpass market expectations continues to wane.

Strategic Recommendations

The analysis from the two models employing the Kalman Filter dynamic regression to track Tesla's relationship with the NDXL reveals insights that are pivotal for forming strategic investment recommendations. The first model, which considers VWAP, volatility, and close prices, suggests that Tesla's stock movements closely mimic those of the broader market, as evidenced by the rising beta reaching near unity. This alignment indicates Tesla's susceptibility to broader economic forces, particularly those affecting the tech sector. While this high beta suggests potential for significant returns during bullish conditions, it also implies

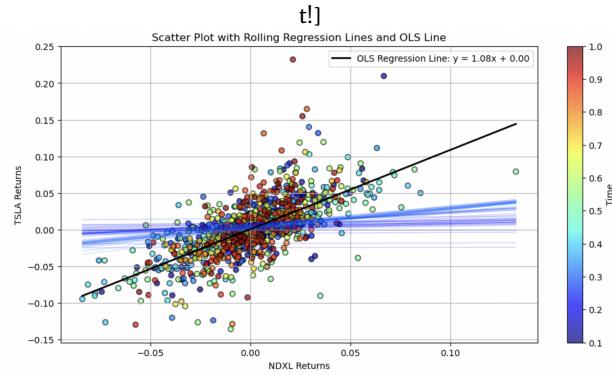


Figure 12. Scatterplot with OLS reference for returns model

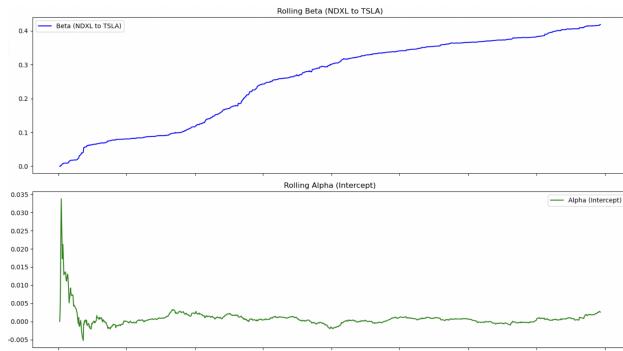


Figure 13. Alpha & Beta plot for returns model

greater risk during market downturns.

Conversely, the second model, focusing on logarithmic returns, shows a moderate but increasing beta, indicating a nuanced correlation with the market. Tesla shows some resilience against broad market swings, suggesting underlying factors at play that might buffer against market downturns or prevent full gains during upswings. This partial correlation is ideal for diversification strategies, offering a blend of market-driven returns and unique company-specific outcomes.

However, both models show an overall declining trend in alpha, particularly notable in the first model where it dips into negative territory. This trend is concerning as it suggests Tesla's market returns are not commensurate with its risk profile, potentially pointing to operational inefficiencies or competitive pressures not fully captured by market movements alone.

Strategically, investors should consider the following:

- **Dynamic Portfolio Adjustment:** The shifting nature of beta and alpha necessitates a responsive investment strategy. Investors should adjust their Tesla holdings based on ongoing assessments of these metrics, potentially reducing exposure if alpha continues to lag or if beta suggests excessive market sensitivity.
- **Enhanced Market Analysis:** Given Tesla's high beta, an understanding of broader market trends, particularly in the tech and automotive sectors, is crucial. This analysis should inform the timing of buy or sell decisions, aiming to capitalize on anticipated market movements.
- **In-depth Operational Review:** The negative alpha trend invites a deeper look into Tesla's operational strategies and market positioning. Investors should scrutinize Tesla's operational efficiencies, innovation pipeline, and market expansion efforts to pinpoint areas that could either be contributing to underperf-

mance or might signal potential for future outperformance.

- Risk Management:** The volatility implied by a high beta and the concerns raised by a negative alpha suggest a need for robust risk management strategies. This could involve using financial derivatives to hedge against downside risks or reallocating investments to balance Tesla's potential high returns with investments in lower-risk assets.

In summary of this section, while Tesla's stock offers significant market-aligned growth opportunities, its fluctuating beta and alpha underscore the importance of agile, informed portfolio management to mitigate risks and capitalize on potential gains. By continuously monitoring these metrics and aligning investment strategies accordingly, investors can more effectively navigate the complexities of investing in a high-profile, high-volatility company like Tesla.

Strategic Analysis

Porter's Five Forces Analysis

1. Threat of New Entrants: Low

Capital Investment: The automotive and energy industries require significant capital for infrastructure, research and development (R&D), and manufacturing capabilities. Tesla's Gigafactories, such as those in Fremont, Shanghai, and Berlin, are massive investments in EV production. For instance, the Tesla Gigafactory in Shanghai represents a \$2 billion investment, and the Gigafactory in Berlin is estimated at over \$5 billion (Reuters).

Technological Leadership: Tesla is a leader in EV technology, including its Autopilot and Full Self-Driving (FSD) capabilities, which are considered some of the most advanced in the industry. Tesla's proprietary battery technology and supercharging network offer a competitive edge that is difficult for new entrants to replicate.

Brand Recognition: As of 2024, Tesla commands approximately 17% of the global BEV market share.

Evaluation: The capital requirements, technological expertise, and brand loyalty make it exceedingly difficult for new entrants to successfully challenge Tesla. Therefore, the threat of new entrants remains low.

2. Bargaining Power of Suppliers: Moderate

Raw Materials: Tesla depends on a range of suppliers for materials such as lithium, cobalt, and nickel. Lithium alone has seen price increases due to higher demand for EV batteries, pushing up the cost of production (Statista).

Vertical Integration: Tesla's strategy of vertical integration—including in-house battery production at its Gigafactories—has reduced dependency on external suppliers. However, battery cell production still relies on partnerships with companies like Panasonic and CATL (Tesla's 2023 Annual Report).

Supplier Leverage: Despite Tesla's efforts to reduce supplier dependence, the increasing cost of essential materials such as lithium creates vulnerability. In 2024, lithium prices surged by over 200% over the past five years, which could impact Tesla's margins (Statista).

Evaluation: While Tesla's vertical integration gives it a degree of autonomy, it is still exposed to material shortages and cost fluctuations, especially with critical resources. This places the bargaining power of suppliers at a moderate level.

3. Bargaining Power of Buyers: Moderate

Competitors: Tesla faces increasing competition from established automakers like Volkswagen, Ford, and General Motors, which have ramped up their EV production. Additionally, new entrants like Rivian and Lucid Motors are offering competitive models.

Technological Differentiation: Tesla's Autopilot, Supercharger network, and vehicle software updates are key selling points that offer unique features that many competitors lack. This strengthens customer loyalty, reducing buyer bargaining power.

Price Sensitivity: Customers may be drawn to more affordable options from competitors like BYD and Ford's Mustang Mach-E, which offer comparable performance. Tesla's average selling price (ASP) remains above the industry average, which may limit price-sensitive consumers.

Evaluation: While Tesla has a loyal customer base and technological differentiation, alternatives in the EV market are growing rapidly. This means buyers have options, but Tesla's innovation reduces the extent of their bargaining power. As a result, buyer power remains moderate.

4. Threat of Substitute Products: Moderate

Hydrogen Fuel Cell Vehicles (FCVs): Companies like Toyota and Hyundai are investing heavily in hydrogen fuel cell vehicles. However, the infrastructure required for FCVs, such as fueling stations, remains less developed than Tesla's Supercharging network, posing a significant barrier for large-scale adoption (Statista).

Public Transport and Ride-sharing: Increasing interest in ride-sharing and autonomous public transportation solutions could reduce the demand for personal vehicles, including EVs. However, Tesla's long-term commitment to autonomous driving could offer an edge in this scenario (Tesla's Autonomy).

Energy Storage: Tesla's energy storage solutions (e.g., Powerwall, Megapack) provide a degree of diversification from traditional automotive substitutes. This further mitigates the threat of substitutes by offering a broader product portfolio (Tesla Annual Report 2023).

Evaluation: The threat of substitutes is moderate as alternatives such as hydrogen-powered vehicles and shared transportation models continue to grow. However, Tesla's diversified product range and strong technological edge in EVs and autonomous driving limit the overall risk.

5. Industry Rivalry: High

Automotive Rivals: Tesla competes with giants such as Volkswagen, General Motors, and Ford, who are increasingly moving toward EV production. BYD has also become a major competitor in the EV space, especially in China, Tesla's second-largest market.

Innovation Race: The pace of innovation in the EV market is rapid. Companies are focusing on battery efficiency, autonomous driving, and charging infrastructure, creating intense competition. Tesla, however, maintains an edge due to its early mover advantage and established Supercharging network.

Market Saturation: The EV market is expected to grow at a CAGR of 25-30% from 2024 to 2030 (Statista). However, as the market matures, rivalry will intensify, and Tesla's market share could be pressured by well-funded competitors.

Evaluation: Due to the increasing number of competitors and high levels of innovation, the intensity of rivalry in the EV market remains high. Tesla's technological lead and brand loyalty help mitigate this, but the competitive environment will continue to evolve.

Porter's Five Forces analysis shows that Tesla faces moderate to high challenges across several dimensions of its competitive environment. While the threat of new entrants remains low, and Tesla's technological advantages reduce buyer power and the threat of substitutes, it must navigate moderate supplier power and high industry rivalry. The expanding competition, particularly from traditional automakers and new entrants in the EV space, presents ongoing challenges that could affect Tesla's market position in the coming years.

Policy and Regulatory Impacts

EV Incentives and Emission Standards

U.S. Inflation Reduction Act (IRA): Tax Credits and EV Subsidies:

The Inflation Reduction Act (IRA) of 2022 restructured the \$7,500 federal tax credit, requiring North American vehicle assembly, stricter battery and mineral sourcing standards, and price/income caps. Tesla's North American Gigafactories ensure compliance, making the Model 3 and Model Y eligible for the full credit. State-level incentives, like California's Clean Vehicle Rebate Project and Zero Emission Vehicle (ZEV) mandate, further enhance Tesla's competitiveness and provide additional revenue streams through ZEV credit sales. Compared to competitors like Rivian and GM, Tesla's scale and localised supply chain give it a significant advantage under IRA policies.

EU Carbon Emission Policies and Renewable Energy Mandates:

In Europe, Tesla benefits from substantial EV subsidies, such as Germany's €4,500 and France's €5,000–€7,000 incentives, as well as Norway's VAT exemptions. These policies reduce ownership costs, boosting demand for Tesla's Model 3 and Model Y. Tesla's all-electric fleet meets the EU's strict CO₂ emissions target (95g CO₂/km), avoiding penalties that burden competitors like Volkswagen and Stellantis. Through the Emission Trading System (ETS), Tesla also generates revenue by selling surplus carbon credits to non-compliant automakers, strengthening its financial and operational position in Europe.

Chinese New Energy Vehicle (NEV) Quotas and Incentives:

China's NEV quotas and tax exemptions drive EV adoption, with Tesla's Shanghai Gigafactory offering critical advantages such as tariff avoidance and access to local subsidies. Tesla's local production enables competitive pricing against domestic leaders like BYD and NIO. While rivals benefit from government support, Tesla's global brand, high production scale, and compliance with NEV policies solidify its leadership in the Chinese EV market.

Trade and Tariff Dynamics

The U.S.–China trade relationship heavily influences Tesla's global operations, particularly in electric vehicles (EV) and critical raw materials like lithium, cobalt, and nickel. The U.S. trade deficit with China is substantial, with a growing focus on EV-related components. Recent tariffs imposed by the U.S. on Chinese EVs, batteries, and semiconductors, ranging from 25% to 100%, aim to protect domestic manufacturers like Tesla but increase production costs. For example, Tesla's Model 3 relies significantly on Chinese battery components, making tariffs a financial challenge. These tariffs also signal the U.S. strategy to reduce dependence on Chinese EV imports and prioritise domestic supply chains.

Exchange rates between USD, CNY, and EUR significantly affect Tesla. A strong dollar increases export costs from the U.S., while a weak yuan reduces manufacturing costs at Tesla's Chinese facilities. Similarly, fluctuating wages in high-tech manufacturing hubs, especially with increasing minimum wages in the U.S. and EU, add financial pressure. Furthermore, potential unionization in the U.S., driven by the United Auto Workers (UAW), poses risks to Tesla's labor model.

Tesla's global strategy must navigate the complexities of trade policies, fiscal measures, and labor dynamics. Balancing U.S., EU, and Chinese interests is crucial to maintaining its competitive edge in the rapidly evolving EV market.

Macroeconomic Factors:

Interest Rates and Tesla's Financing:

Interest rates are a critical determinant for capital-intensive companies like Tesla, which relies heavily on debt and equity financing to sustain growth and innovation. During the Trump administration, interest rates were relatively low, largely due to the Federal Reserve's accommodative monetary policy, which aimed to support economic growth following the Great Recession.

In the short term, these low interest rates provided Tesla with an opportunity to secure affordable financing for its ambitious expansion plans, such as the construction of Gigafactories and advancements in battery technology. This financial environment enabled Tesla to scale production capacity, which was essential for meeting the growing demand for electric vehicles.

However, in the long term, Tesla's reliance on borrowed capital exposed it to potential risks associated with future interest rate hikes. If rates were to increase significantly, Tesla could face higher debt-servicing costs, which would strain profitability. Moreover, higher interest rates could dampen consumer demand for electric vehicles by making auto loans more expensive, potentially slowing Tesla's revenue growth.

Central Bank Policy and Tesla's Market Valuation:

The Federal Reserve's monetary policy under Trump's tenure had profound implications for Tesla's valuation. By maintaining low rates and engaging in quantitative easing, the Fed stimulated liquidity in financial markets, leading to increased investor appetite for growth-oriented stocks like Tesla.

In the short term, Tesla benefited from a surge in speculative investment driven by abundant liquidity and the company's perceived potential to disrupt the automotive and energy sectors. This speculative enthusiasm was reflected in Tesla's soaring stock price, which reached unprecedented levels during the Trump era.

Over the long term, however, such market exuberance carries risks. If central bank policies tighten, reducing liquidity in the market, speculative investments could decline. Tesla's valuation, which many analysts argue is heavily based on future growth expectations, could face downward pressure. A shift in investor sentiment could result in increased volatility and potentially harm the company's ability to raise capital through equity markets.

DCF	
Ticker	TSLA
Date	24/12/2024
EDV	24/12/2024
Assumptions	
WACC	
TGR	2.5%
Historical	
Revenue	
% growth	15.2%
EBIT	26%
% of sales	71%
Taxes	5.1%
Tax rate	17%
Capital Flow Items	
D&A	2.5%
% of sales	6%
CapEx	3.5%
% of sales	10%
Change in NWC (Non-working Capital)	-0.5%
% of sales	1.0%
% of change in sales	0.5%
DCF	
Revenue	24,578
% growth	20%
Conservative Case	53,823
Base Case	81,462
Optimistic Case	96,771
% of sales	73%
Conservative Case	113,220
Base Case	132,473
Optimistic Case	158,567
Taxes	110
Tax rate	(17%)
Sensitivities	
D&A	2,352
% of sales	5%
CapEx	6,482
% of sales	10%
Change in NWC	-0.5%
% of sales	1.0%
Diluted Shares	3,000
Implied Price per Share	173,579

Figure 14. DCF report for TSLA

Trump Administration Policies and Tesla:

The Trump administration's policies had mixed effects on Tesla. On one hand, Trump's tax reforms, including corporate tax cuts, provided a short-term boost to Tesla's profitability. Additionally, the administration's deregulation efforts reduced some operational burdens, though many of these measures were more beneficial to traditional automakers than to Tesla.

On the other hand, Trump's withdrawal from the Paris Agreement and promotion of fossil fuel industries posed challenges for Tesla's long-term vision of a sustainable energy future. The administration's lack of support for renewable energy initiatives contrasted sharply with Tesla's mission, potentially hindering broader adoption of EVs in the United States.

In the short term, Tesla managed to navigate these challenges by focusing on international markets and leveraging consumer interest in sustainable products. Over the long term, however, the absence of robust governmental support for clean energy during the Trump years may have slowed the pace of EV infrastructure development in the U.S., impacting Tesla's domestic growth potential.

Financial Valuation: DCF Analysis

Revenue Projections

This report presents a discounted cash flow (DCF) analysis for Tesla (TSLA) as of December 24, 2024 (Fig 14), based on a set of key assumptions regarding the company's financial performance and market conditions. The DCF model is employed to estimate Tesla's intrinsic value, taking into account its projected cash flows, cost of capital, and future growth prospects.

The analysis is based on two primary assumptions: a Weighted Average Cost of Capital (WACC) and a Terminal Growth Rate (TGR). The WACC is used as the discount rate to calculate the present value

WACC	
Market Cap	1,319,000,000
% of Equity	100.00%
Cost of Equity	15.13%
Risk Free Rate	4.62%
Beta	2.3
Market Risk Premium	4.57%
Debt	2,468
% of Debt	0.00%
Cost of Debt	2.97%
Tax Rate	7.00%
Total	1,319,002,468

WACC

Figure 15. WACC report for TSLA

of future cash flows, considering both the cost of equity and debt for the company. A WAAC of 15.1% reflects a relatively high risk profile for Tesla, consistent with its status as a growth company in a volatile industry. The Terminal Growth Rate represents the expected long-term growth rate for Tesla's free cash flows beyond the forecast period (2033E onwards) and significantly influences the terminal value calculation. TGR has been set at 2.5%, aligning with long-term economic growth expectations and providing a conservative basis for estimating Tesla's value in perpetuity.

Cash Flow Projections

Cash flow projections are driven by key factors such as depreciation and amortisation (D&A), capital expenditures (CapEx), and changes in net working capital (NWC). D&A is forecasted to remain at approximately 6% of revenue, consistent with Tesla's historical patterns, while CapEx is assumed to stabilise at 9% of revenue. These levels reflect Tesla's continued investment in production capacity and technological innovation. Improvements in working capital management, evidenced by negative NWC values, further support Tesla's ability to generate free cash flow over time.

Unlevered free cash flow (FCF) is forecasted to grow from \$7,213M in 2024 to \$27,337M in 2033. The present value of these cash flows is significantly impacted by the high WACC, emphasising the sensitivity of Tesla's valuation to its risk profile. The terminal value, calculated using the 2.5% terminal growth rate, contributes \$221,859M to the valuation, discounted to \$192,703M. This highlights the long-term growth potential embedded in Tesla's business model, though it underscores the sensitivity of the valuation to terminal growth and discount rate assumptions.

The analysis yields an enterprise value of \$276,179M. After adjusting for cash and debt, Tesla's equity value is estimated at \$286,407M. With 1,650M diluted shares outstanding, the implied price per share is calculated at \$173.58. This valuation is broadly consistent with Tesla's current trading range, suggesting that the market has already priced in much of the company's growth potential and associated risks.

The results of this DCF analysis highlight both the opportunities and challenges facing Tesla. The company's ability to sustain

strong revenue growth and operational efficiency will be critical to achieving the projected valuation. However, the high WACC reflects the market's perception of risk, driven by Tesla's exposure to competitive pressures, macroeconomic uncertainties, and potential disruptions in supply chains.

Key Risks and Mitigation Strategies

Geopolitical tensions and supply chain constraints pose significant challenges to Tesla's operations. U.S.–China relations, marked by tariffs and restrictions on key technologies, threaten Tesla's dependence on its Shanghai Gigafactory and Chinese suppliers. Similarly, the EU's push for local EV production, under initiatives like the **Fit for 55** package, could pressure Tesla to further expand its European operations. Meanwhile, critical mineral policies in the U.S. and EU focus on reducing reliance on Chinese suppliers by incentivising domestic mining and processing of key materials, such as lithium and nickel. Tesla's partnerships, like the one with Piedmont Lithium, align with these goals, ensuring compliance with government sourcing requirements and mitigating supply chain risks.

Tesla also benefits from onshoring initiatives, such as the Biden Administration's funding for domestic EV battery plants, which provide tax breaks and incentives to bolster U.S. manufacturing. These efforts strengthen Tesla's North American supply chain while global sanctions on cobalt suppliers in regions like the Democratic Republic of Congo remain a concern for battery production. To address these risks, Tesla is exploring alternative sources and diversification strategies, aligning with long-term sustainability and localisation goals that reduce dependence on China and promote resilience across its operations.

Contributions

References

- [1] California Air Resources Board (CARB). *Zero Emission Vehicle (ZEV) Program*. 2023. URL: <https://ww2.arb.ca.gov/>.
- [2] International Energy Agency (IEA). *Global EV Outlook 2023*. 2023. URL: <https://www.iea.org/reports/global-ev-outlook-2023>.
- [3] Internal Revenue Service (IRS). *Inflation Reduction Act of 2022: Clean Vehicle Credits*. 2023. URL: <https://www.irs.gov/clean-vehicle-tax-credits>.
- [4] National Highway Traffic Safety Administration (NHTSA). *Corporate Average Fuel Economy (CAFE) Standards*. 2023. URL: <https://www.nhtsa.gov/laws-regulations/cafe-standards>.
- [5] National Renewable Energy Laboratory (NREL). *The National Electric Vehicle Infrastructure (NEVI) Formula Program*. 2023. URL: <https://www.energy.gov/nevi>.
- [6] U.S. Trade Representative (USTR). *2023 Report on China's Trade Policies*. 2023. URL: <https://ustr.gov/>.
- [7] World Economic Forum (WEF). *The Global Battery Alliance: Securing a Sustainable Future for EVs*. 2023. URL: <https://www.weforum.org/global-battery-alliance>.
- [8] United Nations Framework Convention on Climate Change (UNFCCC). *The Paris Agreement: Status of Implementation*. 2023. URL: <https://unfccc.int/paris-agreement>.
- [9] European Commission. *Fit for 55: Delivering the EU's 2030 Climate Target*. 2023. URL: <https://ec.europa.eu/climate-policies/fit-for-55>.
- [10] J. Durbin and S. J. Koopman. "Time Series Analysis by State Space Methods". In: *Oxford Statistical Science Series* (2001).
- [11] U.S. Department of Energy (DOE). *Critical Minerals and Rare Earth Elements Supply Chain Report*. 2023. URL: <https://www.energy.gov/critical-minerals>.
- [12] Paul Glasserman. *Monte Carlo Methods in Financial Engineering*. Applications of Mathematics 53. New York: Springer, 2004.
- [13] John C. Hull and Alan White. "The Pricing of Options on Assets with Stochastic Volatilities". In: *The Journal of Finance* 42 (2 1987), pp. 281–300.
- [14] Business Insider. *Tesla's Biggest Growth Business in Q3: Energy Storage*. Oct. 2024. URL: <https://www.businessinsider.com/teslas-biggest-growth-business-q3-energy-storage-batteries-2024-10>.
- [15] Dan Irvine. *Electric Vehicle Sector Faces Market Headwinds Amid Surge in Adoption*. Feb. 2024. URL: <https://www.forbes.com/sites/danirvine/2024/02/18/electric-vehicle-sector-faces-market-headwinds-amid-surge-in-adoption/>.
- [16] Reuters. "Tesla's Gigafactory Shanghai". In: (2024).
- [17] Statista. *Tesla Global Market Share*. URL: <https://www.statista.com/chart/27733/battery-electric-vehicles-manufacturers/>.
- [18] Tesla Inc. *Analysis*. Finbox. URL: <https://finbox.com/NASDAQGS:TSLA>.
- [19] Tesla Inc. *Analytical Insights*. Infront Analytics. URL: <https://www.infrontanalytics.com>.
- [20] Tesla Inc. *Financial Charts*. FinanceCharts. URL: <https://www.financecharts.com>.
- [21] Tesla Inc. *Financials*. MacroTrends. URL: <https://www.macrotrends.net/stocks/charts/TSLA/tesla/revenue>.
- [22] Tesla Inc. *Fundamental Analysis*. GuruFocus. URL: <https://www.gurufocus.com/stock/TSLA/summary>.
- [23] Tesla Inc. *Performance Metrics*. YCharts. URL: <https://ycharts.com/companies/TSLA>.
- [24] Tesla Inc. *Stock Analysis*. Stock Analysis. URL: <https://www.stockanalysis.com/stocks/tsla/>.
- [25] Tesla's Official Financial Reports. Tesla, Inc. Available online: <https://www.tesla.com/impact>. 2023. (Visited on 12/16/2023).
- [26] Tesla's 2023 Annual Report. Tesla, Inc. URL: <https://www.tesla.com/annualreport>.
- [27] Greg Welch and Gary Bishop. *An Introduction to the Kalman Filter*. Available online at https://www.cs.unc.edu/~welch/media/pdf/kalman_intro.pdf. University of North Carolina at Chapel Hill, 2001.