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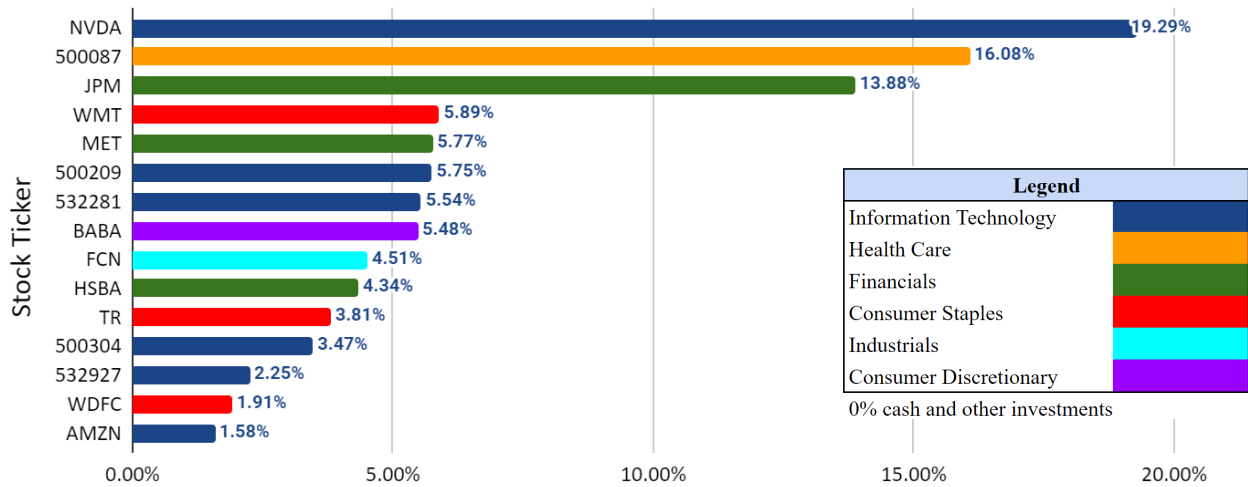
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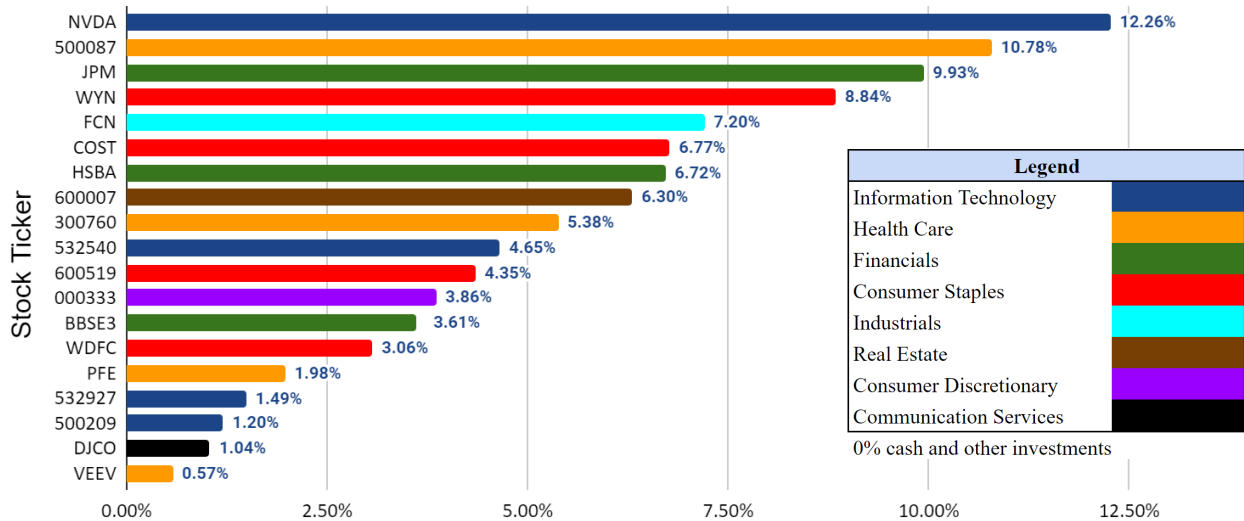
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WinS Portfolio

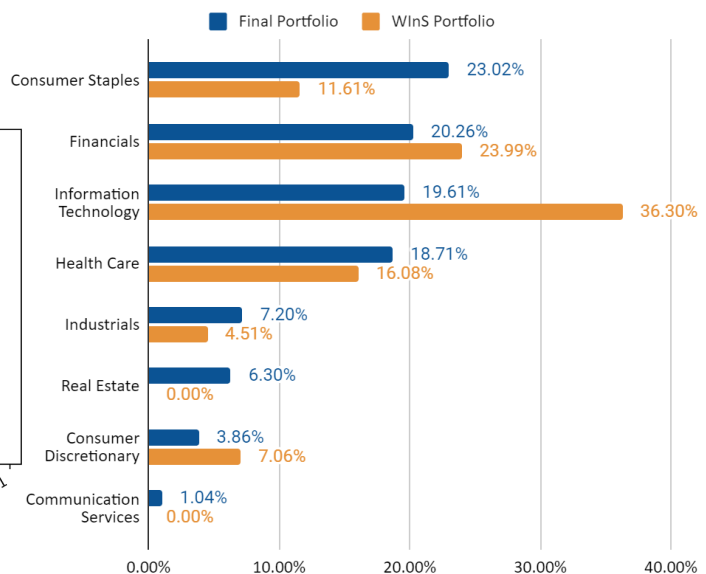


Final Recommended Portfolio

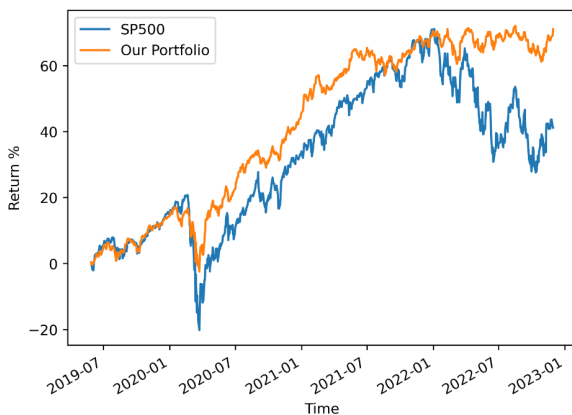


Allocation (in %)

Sector Allocations



Our Portfolio VS S&P500



Summary

Investment Strategy: Our strategy dynamically adjusts return and risk targets to align with Peter's goals. Our Four Factor Filter (F^4) model selects environmentally friendly and financially secure companies with either high upside potential or strong hedging qualities. We utilize our proprietary AI-powered return estimator, *Turing*, alongside the Black-Litterman model to optimize Peter's portfolio, maximizing risk-adjusted returns and minimizing downside deviation. Moreover, our LightGBM risk management model provides stop-loss signals to insulate our portfolio against sudden crashes.

Uniqueness: Firstly, *Turing* uses Deep Learning models to translate implied upsides from traditional valuation techniques and statistical trends into contextualized return figures, enhancing the versatility of fundamental analysis in varying market conditions. Secondly, our F^4 model synthesizes financial scores, performance metrics, ESG outlooks and valuations to efficiently screen for ideal stocks. Thirdly, we formulated a mathematical equation which dynamically adapts to both our client (financial goals, donation decisions etc.) and realized returns for accurate portfolio optimization.

Advisor Reflection: Throughout this competition, the team worked very hard to learn about different economic and financial concepts in order to create a comprehensive strategy for the client. They were able to do independent research and come up with many interesting ideas together. Despite only having 4 members, each person went out of his way to contribute to the project, and were able to go beyond what was taught in class to incorporate many advanced concepts. They also managed their time well by delegating work and setting deadlines. As an economics teacher, this competition has also provided me with new insights into how we can incentivise students to engage in learning outside of the curriculum.

1. NVDA: *“A market leader in the semiconductor industry, with AAA ESG score in the 95th percentile. It has high growth potential whilst diversifying its revenue sources to modern sectors. DCF and Comps valuations give 29.4% potential upside, and it is 19.3% of our portfolio. ”*

Initially, each member was responsible for analyzing separate factors (ESG, financial security, valuation etc.) before ranking companies using separate metrics. However, we realized that this asynchronous method fails to consider stocks holistically. This led to the formulation of our F⁴ model, synthesizing our research and improving team coordination to facilitate systematic stock selection. This note of Nvidia best encapsulates the wide range of factors F⁴ evaluates.

2. JPM: *“JPM is the largest IB in the US, and steadily performs throughout various macroeconomic conditions, providing a suitable hedge to our portfolio. We expect it to have higher return-to-risk ratio than competitors, and it takes up 13.9% of our portfolio.”*

This reflects our evolving investment thesis given new expectations of prolonged high interest rates, viewing financial firms (especially JPM) as stocks with strong medium-term returns and hedging qualities instead of stable, low returns. This led us to develop *Turing*, leveraging on modern technology to account for changing macroeconomic conditions when forecasting returns.

3. AMZN (Sell): *“Portfolio adjustment”*

Though not as detailed as other notes, this reflects the application of our LightGBM risk management model. After opening our position in AMZN, the stock fell by 20%. Our model analyzed various technical indicators and stock options data (open interest, put/call ratio, volume etc.), forecasting with high confidence that AMZN will underperform the market in the short-to-medium term. This triggered a manual re-evaluation of AMZN, drawing attention to its worsened fundamental outlook (after Q3 earnings). Thus, we trimmed our position according to our re-optimized portfolio weights. Following our sell order, AMZN fell by an additional 6%.

Client Analysis: Given Peter’s aims to 1) establish a **self-sustaining fund in 5 years** and 2) a **yoga/wellness center within 15 years**, his required portfolio returns (r) follow the formula:

$$20000 \prod_{i=1}^{14} (1 + r_i) + 80000 \prod_{i=6}^{14} (1 + r_i) - \sum_{i=6}^{14} p_i \left[\prod_{j=i}^{14} (1 + r_j) \right] \geq C + B + p_{15}$$

Where r_i = return in the i th year, p_i = prize money awarded in the p th year,
 C = Inflation-adjusted cost of starting the yoga center in year 15, B = buffer capital

Type	Cost	Assumptions/Timeframe
Rental	Min: \$20/sqft, \$20000~30000 yearly Base: \$35/sqft, \$35000~52500 yearly Max: \$60 sqft, \$60000~90000 yearly	1. 1000-1500 sqft (20-30 pax) 2. Initial Cost = Deposit = ½ yearly rent + Advance payment = 3-month rent 3. Required by 14Y7M 4. Monthly rental payment from 15Y4M
Construction & Refurbishment	Min: \$10000 Base: \$15000 Max: \$20000	1. Required by 14Y7M to start construction 2. Recurring costs not considered
Equipment, Materials & Advertising	Min: \$6000 Base: \$8000 Max: \$10000	1. Required by 14Y12M 2. Recurring costs not considered
Labour (1 instructor and 2 admin)	Min: \$8300 Base: \$11250 Max: \$14200	1. Yoga instructor pay range: \$40000-\$70000/yr; Administrators: \$30000-\$50000/yr 3. Monthly payment from 15Y
Total cash required by 15Y	Min: \$59200~64200 Base: \$85500~94250 Max: \$116800~131800	1. 4x monthly recurring costs' worth of capital required from start to breakeven 2. Tax and certification costs omitted

We assume that the remaining \$80,000 is available for investment after 5 years as an unrealistically high CAGR (21.0%) is required to fulfill his goals otherwise. In the base case, $C = 153900 \sim 169650$ (adjusted for 4% annual inflation), $B = 50000$, and $p_i = 7500$. Assuming constant returns, $r \geq 13.2\%$ CAGR. As p_i varies, ~75% of base case

scenarios require $\leq 14\%$ CAGR. Given Peter’s eco-conscious character (especially concerns regarding plastic waste), our portfolio will only incorporate ESG-positive or ESG-neutral stocks.

Risk Profile: Peter (Forbes 30 under 30 social entrepreneur¹ & member of the Unreasonable Group²) embraces disruptive entrepreneurship, displaying above average risk tolerance (RT). Yet, linguistic analyses of Peter’s past statements show preferences for “tried-and-tested methodologies”/“learning from successful models”.³ Moreover, his focus on “Impact Alpha”, seeking to “maximize impact [...] precisely” reveals a prudent investment philosophy.⁴ These factors, alongside his youth (25), suggest that Peter currently has a moderate RT. Eventually,

¹ Watson R. W. “From Economic Empowerment To Waste Management, These 30 Under 30 Social Entrepreneurs Are Making An Impact In Asia”

² Unreasonable Group. “Peter Hjemdahl”

³ The Wharton School. “6 Lessons Learned From a Wharton Undergrad’s Social Entrepreneurial Journey”

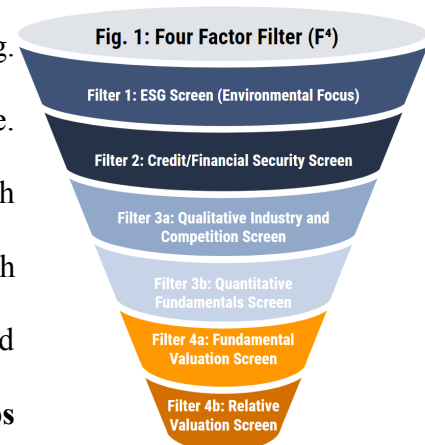
⁴ Hjemdahl P. W. “How to Pick Impact Causes Effectively - Learnings From CBS’ ‘The Activist’ Fiasco”

given potentially greater responsibilities (i.e. starting a family), his RT will decrease. Such risk will be measured in terms of **downside deviation below 8.45% CAGR**, the level needed to achieve his desired minimum return of \$10,000 after the first 5 years (when fund is launched).

Investment Thesis: Current macroeconomic headwinds create opportunities for entering undervalued, technologically innovative companies with long-term growth potential.⁵ Financial firms also stand to gain from increased interest rates in the coming years.⁶ Meanwhile, defensive, low-beta industries (consumer staples, healthcare, etc.) offer stability during volatile periods.⁷

Investment Strategy: We synthesize 4 score-based filters (Fig. 1) to select 50 stocks which best fit our client’s financial profile.

Filter 1 eliminates companies with poor ESG, aligning with Peter’s environmentalism. *Filter 2* eliminates companies with high bankruptcy risk, applying **Altman’s Z-score**⁸ and comparing 10 different **liquidity, coverage, and leverage ratios**



against similar companies from the given list, removing those below the 30th percentile in more than 3 ratios. *Filter 3a* assigns **Q-scores** (range of 0-1) to companies based on *qualitative* analysis of their competitor landscapes, reflecting their relative performance to industry averages. *Filter 3b* uses Piotroski’s **F-score**⁹ (normalized to 0-1) to *quantitatively* screen companies’ fundamental outlook. We select 100 highest T-scoring companies, where **T-score** = $\frac{1}{2} \times \text{Q-score} + \frac{1}{2} \times \text{F-score}$. *Filter 4a* uses semi-automated discounted cash flow (DCF) models with in-built **3-scenario** analysis (base, best and conservative cases) where fundamental

⁵ Tandberg-Johansen A. & Kise E. H. “Outlook: Technology Stocks Will Outperform the Overall Market in the Long Term”

⁶ Davis Funds. “Why Financial Stocks May Represent the Most Attractive Opportunity in Today’s Market”

⁷ Fidelity Viewpoints. “Stocks that offer shelter in a storm”

⁸ Altman E. I. “Predicting Financial Distress Of Companies: Revisiting The Z-Score And Zeta[®] models”

⁹ Piotroski J. D. “Value Investing: The Use of Historical Financial Statement Information to Separate Winners from Losers”

assumptions (i.e. revenue growth, EBIT margins, CapEx, WACC etc.) are manually adjusted to value companies. We employ perpetuity growth, P/E and EV/EBITDA exit multiple models to obtain a comprehensive range of terminal values, where the final DCF value = average of all cases and models. *Filter 4b* uses automated comparable companies analysis (Comps), curating a suitable peer group of companies and calculating their mean, median, minimum and maximum multiples (P/E, EV/Revenue, EV/EBITDA). We then apply these 3 multiples to value each company, where Comps value = average of all 3 valuations obtained. 50 highest V-scoring stocks, where **V-score** = (DCF value + Comps value)/(2*Market Capitalization), are selected.

To determine allocations, we employ **Post-Modern Portfolio Theory**¹⁰ (PMPT), optimizing portfolio weights based on each stock's expected return, variance, and covariance with other stocks. To account for Peter's evolving return targets and risk profile, we limit **SLPM**¹¹ (deviation below Peter's desired minimum of 8.45% CAGR) to 9.97% (\approx S&P500's 10-year SLPM) and maximize return in the first 5 years, adhering to his moderate RT. Subsequently, we minimize SLPM based on r (by formula), accounting for his declining RT. Moreover, our proprietary expected return model, *Turing*, utilizes **deep neural networks** with 4 input indicators to forecast annual return: DCF upside, Comps upside, Exponentially Weighted Moving Average (EWMA) and CBOE Volatility Index (VIX). DCF and Comps constitute traditional valuation techniques; EWMA (decay = 0.01) captures statistical trends; VIX reflects market conditions and potential shifts in investor sentiment. Given our hypothesis that returns are approximated by a unique combination of these 4 variables, we train our models on each stock to identify complex relationships and determine said combination using historical data (10 years). *Turing* is highly adaptive as companies are valued differently in different market conditions. For

¹⁰ Sortino F. and Satchell S. "Managing downside risk in financial markets: Theory, practice and implementation"

¹¹ Second Lower Partial Moment or Semivariance measures variance of asset returns that fall below a certain minimum acceptable level of return. See Wojt A. "Portfolio Selection and Lower Partial Moments"

instance, while valuations directly impact stock price, its rate of reversion to fair value may increase amidst market volatility. *Turing* pinpoints this rate for each stock in different market conditions, translating long-term value-driven projections into annual return estimates. We also incorporate the **Black-Litterman model**,¹² with positive relative view vectors for the technology, financials, consumer staples and healthcare sectors, cohering with our investment thesis. To manage risk, we use AutoEncoders¹³ to generate embeddings for each stock using its derivatives data and alpha indicators fed into LightGBM for classification. This forecasts potential downturns, providing quantitative stop-loss signals to minimize losses while triggering manual re-valuation when necessary.

Portfolio Overview: Our portfolio consists of 19 stocks from 8 sectors. Its backtested CAGR of 14.1% exceeds required return of 13.2% (0.9% margin of safety), achieving Peter's goals while adhering to his moderate RT (9.97% SLPM and maximum drawdown of 19.5% $\approx \frac{1}{2}$ of S&P500's). Using PMPT, each allocation plays a unique role. Financial stocks (JPM, HSBA) benefited by rising interest rates boast high medium-term returns while high-tech growth stocks (NVDA, 300760) boast high long-term returns. Meanwhile, consumer staples (WYN, COST, 600519) and healthcare (500087, PFE, VEEV) stocks with low SLPM and low covariance serve as hedges to potential fluctuations of aforementioned high-return stocks, minimizing overall portfolio risk. Moreover, our largest sector allocation, consumer staples, serves as a hedge against inflationary pressures. Additionally, our portfolio consists of ESG-positive stocks like NVDA and COST (using plastic bags made from recycled ocean plastic¹⁴), aligning with Peter's environmental consciousness and advocacy against plastic usage. To illustrate our overall strategy, we analyze our two largest holdings: Nvidia (NVDA) and Cipla (500087).

¹² Black F. & Litterman R. "Asset Allocation Combining Investor Views with Market Equilibrium"

¹³ Hinton G. E. & Salakhutdinov R. R. "Reducing the Dimensionality of Data with Neural Networks"

¹⁴ Packaging Gateway. "KeepCool and Costco launch 100% ocean plastic reusable bags"

Nvidia: With an MSCI ESG score of AAA (95th percentile),¹⁵ constant development of energy-efficient GPUs, use of non-plastic packaging, and high recycling rate of 93%,¹⁶ Nvidia strongly aligns with our client's environmental interests, passing *Filter 1*. Nvidia boasts a high Z-score (low likelihood of bankruptcy) and passes all 10 of *Filter 2's* ratios with exceptionally

Fig. 2: Credit/Financial Security Screen (NVIDIA)			
Initial Primary Credit Screen: Altman Z-Score = 7.51 (>1.1)			
Secondary Credit Screen (10/10 Passed)		Calculated Ratio	Percentile
Liquidity Ratios	Quick Ratio	6.05	37.3
	Cash Ratio	0.459	36.7
	Operating Cash Flow Ratio	2.10	91.8
Coverage Ratios	Interest Coverage Ratio	48.1	41.2
	Debt Service Coverage Ratio	42.5	43.4
	Asset Coverage Ratio	2.90	46.5
	Cash Coverage Ratio	48.1	53.2
Leverage Ratios	Total Debt to Equity Ratio	0.587	67.3
	Total Debt to Total Assets Ratio	0.264	69.4
	Total Debt to EBITDA Ratio	1.03	55.1

Fig. 4: NVIDIA Revenue Scenario Analysis

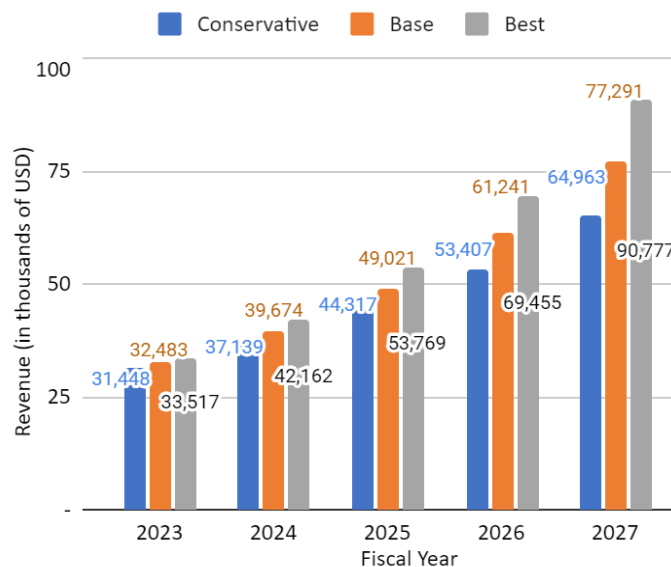
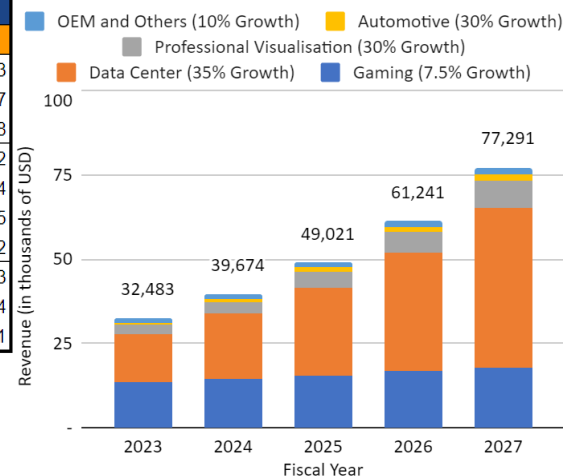


Fig. 3: NVIDIA Projected Revenue (Base Case)



opportunities (Fig. 3): Data Center revenue will rise with growing digitisation and reliance on Big Data, especially in developing economies,¹⁸ Professional Visualization solutions (Omniverse, AI infrastructure etc.) boast up to 45% CAGR in the next 7 years,¹⁹ and Automotive-related

high operating cash flow ratio (Fig. 2). Its sustained investment into advanced technologies (Tensor Core, Transformer Engine etc.) competitors like Intel and AMD lack solidifies its economic moat in the semiconductor industry.¹⁷ Its diverse revenue sources hold significant growth

¹⁵ MSCI. "ESG Ratings & Climate Search Tool: Nvidia Corporation"

¹⁶ Nvidia Corporation. "2022 Corporate Responsibility Report"

¹⁷ Hughes J. "Nvidia Competitors Analysis : How Do They Compete Globally?"

¹⁸ Wadhvani P. & Gankar S. "Data Center Services Market Growth, Statistics: Global Report 2027"

¹⁹ Chauhan H. "Where Will Nvidia Be in 5 Years?"

revenue will surge with the accelerated transition to electric vehicles, giving it a final Q-score of 0.9. Additionally, Nvidia achieves an F-score of 5 out of 9, demonstrating strong fundamentals. Overall, Nvidia's T-score is 0.728, placing it within the top 100 stocks (passing *Filters 3a* and *3b*). In *Filter 4a*, we forecast Nvidia's revenue streams (Fig. 3 and 4), each with suitable ranges of growth rates, obtaining a final DCF value of \$244.89 (45.1% upside). In *Filter 4b*, our Comps (Fig. 5) indicate that while Nvidia's 2022 multiples are relatively high, 2023 multiples (primarily EV/EBITDA and P/E) are lower than industry averages, boosting its relative valuation.

Fig. 5: Trading Multiples for NVIDIA's Peer Group

Ticker	EV / Revenue		EV / EBITDA		P / E	
	22	23	22	23	22	23
NVDA	15.7x	6.5x	37.2x	15.4x	42.6x	17.6x
AMD	7.3x	4.8x	28.9x	29.1x	38.2x	35.2x
ASML	13.0x	9.0x	36.9x	25.6x	41.4x	35.6x
AVGO	8.1x	6.3x	14.2x	11.1x	34.1x	40.0x
INTC	2.0x	5.0x	5.0x	12.8x	6.1x	14.1x
NXPI	4.7x	4.1x	12.6x	10.8x	23.7x	31.6x
Mean	8.5x	5.9x	22.4x	17.5x	31.0x	29.0x
Median	7.7x	5.6x	21.5x	14.1x	36.2x	33.4x

As shown in Fig. 6, the final average value of \$204.43 (21.1% upside)

earns Nvidia a V-score of 1.21 (5th highest V-scoring stock), passing *Filter 4*. By training *Turing* on Nvidia's 10Y data, we observe that DCF, Comps, and EWMA predicted upsides are positively related to its annual returns while VIX is inversely related (Fig. 7). Utilizing aforementioned DCF and

Comps valuation upsides alongside current EWMA and VIX data, after recent downturns, *Turing* predicts a 19.6% annual return for Nvidia, highest amongst all 50 stocks passing our F⁴.

Fig. 6: Valuation Summary Chart - Equity Value per Share (\$)

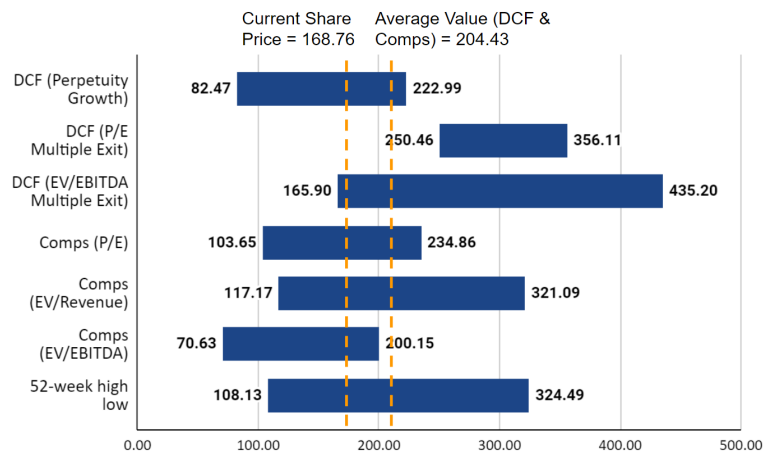
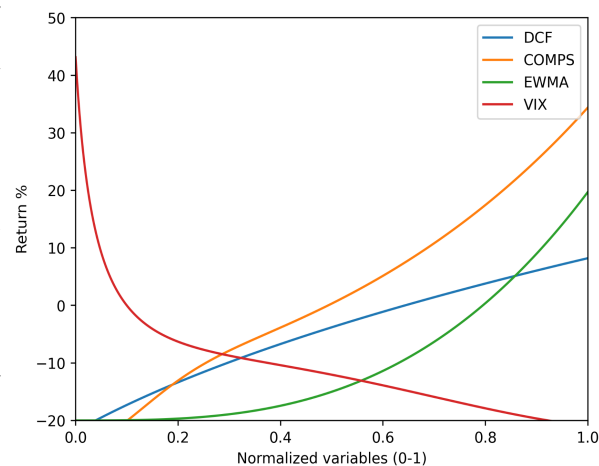


Fig. 7: Relationship between each variable and annual return (Turing)



Cipla: As part of the Dow Jones Sustainability Emerging Market Index,²⁰ Cipla's devotion to carbon neutrality (pioneering investment in a 30 MW solar project in Maharashtra²¹) and zero waste (repurposing 100% of post-consumer plastic waste²²) is undeniable, passing *Filter 1*. Cipla passes *Filter 2* with a high Z-score (7.96) and >30 percentile for all 10 liquidity, coverage and leverage ratios. Given the prominence of respiratory symptoms among majority of patients in 2022²³ and increasing burdens of chronic respiratory disease (3rd most deadly in India),²⁴ Cipla can leverage its competitive advantage as one of the largest developers and providers of respiratory-related treatments, specializing in affordable medication.^{21,25} Its recent acquisition of a 21.8% stake in GoAptiv (offering a unique “phygital” model providing quality access to rural India) further cements its advantage over rivals like Sun Pharmaceuticals,^{26,27} earning a Q-score of 0.8. With an F-score of 5, Cipla's T-score is 0.678 (within top 100 stocks), passing *Filter 3*.

Given substantial growth opportunities in India, Emerging Markets (28.8% 5Y CAGR) and Africa,²⁸ we forecast Cipla's revenue (with scenario analysis similar to Nvidia) in *Filter 4a*. Accounting for a 2.18% country risk premium,²⁹ Cipla's final DCF value is ₹1539.02 (39.1% upside). In *Filter 4b*, both Cipla's 2022 and 2023 trading multiples are below industry averages, boosting its relative valuation with a final Comps value of ₹1217.05 (10.0% upside). Its final average valuation is ₹1378.03 (24.6% upside), as shown in Fig. 8, translating to a V-score of 1.25 (3rd highest-scoring stock). While Cipla's V-score is slightly higher than Nvidia's

²⁰ Cipla Limited. “Annual Report 2021-22”

²¹ The Economic Times. “Cipla adds capacity of captive renewable energy power plant in Maharashtra, Karnataka”

²² Cipla Limited. “Cipla ranked as one of the most sustainable healthcare companies in the Dow Jones Sustainability Emerging Markets Index”

²³ Sharma B. B. et al. “Proportionate clinical burden of respiratory diseases in Indian outdoor services and its relationship with seasonal transitions and risk factors: The results of Sword survey”

²⁴ PayBima. “Top 10 Most Dangerous and Deadliest Diseases in India, 2022 – Their Signs, Causes and Preventions”

²⁵ Finshots. “An overview of Cipla and the Pharma Industry”

²⁶ Mittal S. “How Cipla is creating a strategic approach for automation and digitization”

²⁷ GoAptiv. “Home”

²⁸ Agarwal A., Dreszer J. & Mina J. “What's next for pharma in emerging markets?”

²⁹ Damodaran A. “Country Default Spreads and Risk Premiums”

Fig. 8: Valuation Summary Chart - Equity Value per Share (₹)

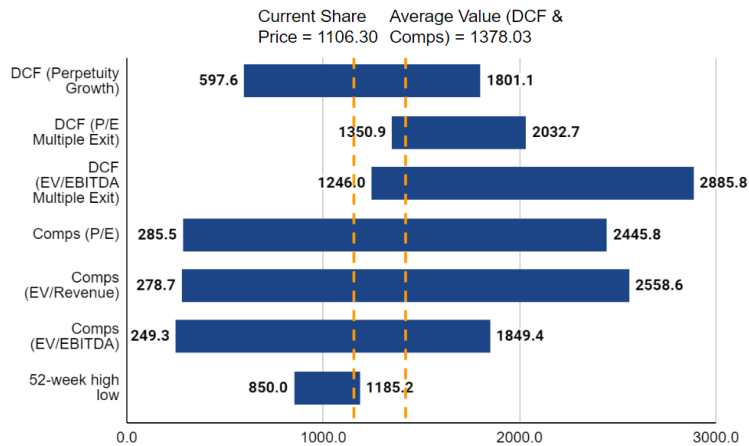
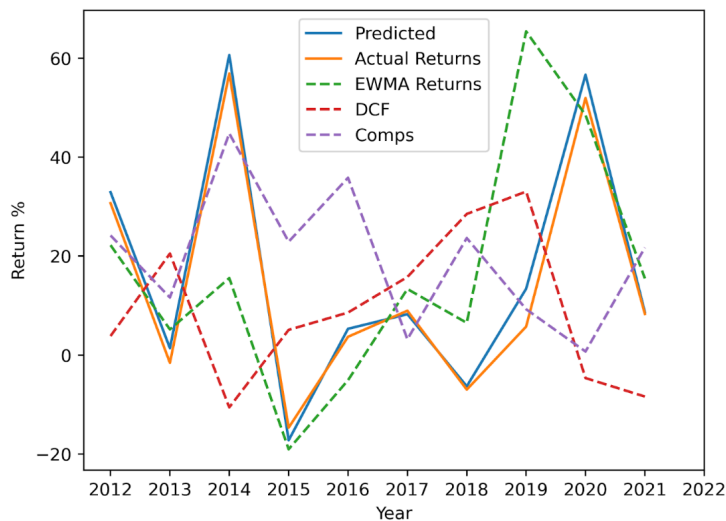


Fig. 9: Implied Upsides (DCF, Comps and EWMA) VS Actual Returns



(1.25>1.21), *Turing* demonstrates that Cipla's rate of reversion to fair value is lower than Nvidia. In fact, after training *Turing* on Cipla's 10Y financial data to determine the precise relationship between key variables which best approximates actual returns (blue line in Fig. 9), its predicted annual return is 12.1% (lower than Nvidia's 19.6%). However, given its relatively high expected returns as a low beta stock with low covariance with growth stocks (like Nvidia) in our portfolio, Cipla is our second largest allocation.

Conclusion: To assess Peter's financial goals, we have modeled the various expenses required to set-up a Yoga Center, with detailed scenario breakdowns. We then developed a dynamic mathematical formula calculating his required returns: if our portfolio initially outperforms return targets, future return targets can be lowered, achieving Peter's goal while eliminating unnecessary risks. We have pinpointed Peter's risk profile and environmental concerns, ensuring that our portfolio closely aligns with his investment ideology. Ultimately, our strategy's unique fusion of traditional valuation methodologies (DCF & Comps) and modern technological tools (Deep Learning algorithms) to achieve Peter's goals ensures that WGAM can win him over.