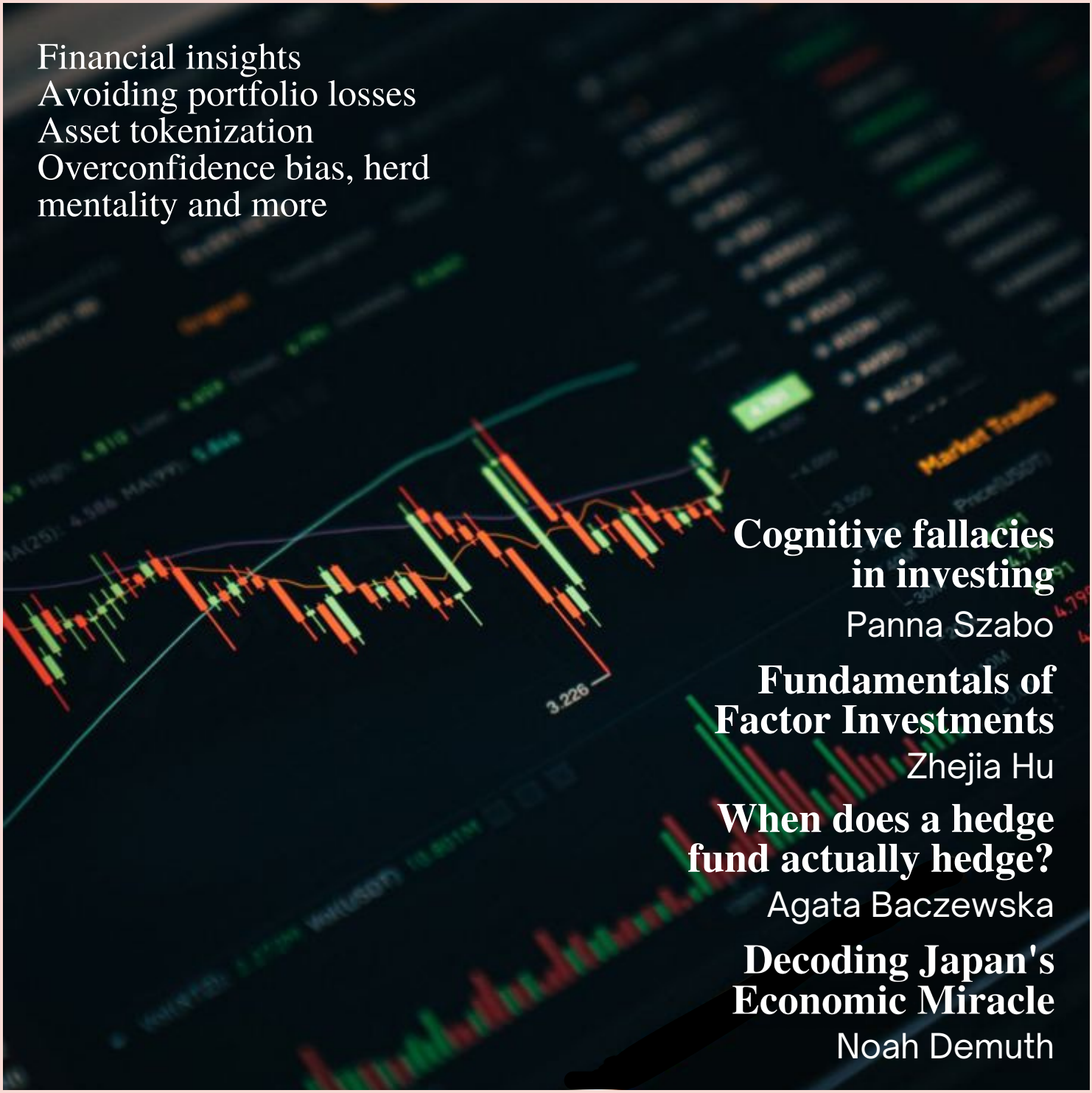
EDITORIAL COMMITTEE APRIL 2024

B&R Beurs

SPRING MAGAZINE 2024



INVEST. CONNECT. EXCEED.

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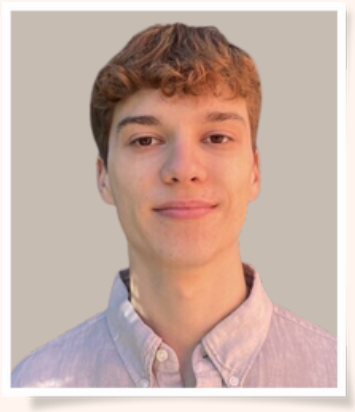

NOAH DEMUTH

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EDITOR'S LETTER

To exude a spring mood, the first issue of the B&R Beurs Magazine 2024 designated subjects with great care for readers' fresh financial aspirations and was designed to ensure discernment in their execution. The following articles maintain the theoretical standard accompanied by up-to-date discussions on risk management, behavioural finance, and economic matters. The clarification of coefficients or ratios was supported by a mathematical review in both the opening and the ending articles.

I would like to thank Sude Bozcal for her involvement in the preparation of this issue.

Cheers,

MAGAZINE EDITOR

WHEN DOES A HEDGE FUND ACTUALLY HEDGE?

Agata Baczewska

Hedge funds present diverse risk and return combinations owing to substantial stakes, utilisation of leverage and managers refraining from divulging portfolio losses; executing a thorough benchmark derives thus from such understanding of the metrics behind them. Each assesses a distinct facet of investment's nature, eventually delineating the potential return-to-risk ratio. As this is not only in the greatest interest of investors, but it characterises the main objective of their role, it is necessary to recognise the results of adeptly-arranged hedge funds.

Alpha and Beta

In the same way as with any other investment method, the slightest fluctuation around the safety of returns - preferably higher than mere inflation coverage - can be assured through an analysis of historical performance, responsiveness to market conditions, liquidity, volatility, risk tolerance, and diversification. However, at the outset, a preliminary assessment is imperative to ascertain the essence of an investment - what returns might it yield?

It is alpha that evaluates the extent to which an investment's actual return surpasses its expected return considering its risk. It quantifies the degree of outperformance against a benchmark, such as the S&P 500, presented as a percentage (Team, 2023). Calculated by subtracting the benchmark return from an asset's return, a positive alpha implies outperformance, whereas a negative alpha indicates underperformance. Alpha gauges past behaviour and requires a long-term measurement for accuracy, making it not necessarily reliable for predicting future investment outcomes.

$$Alpha\ \alpha\ =\ R_i - R_f + \beta(R_m - R_f)$$

Where:
Ri - the realised return of the portfolio;
Rm - the return on the market portfolio;
Rf - the risk-free rate of return for the time period;

Furthermore, beta compares assets' volatility to the returns of a market index (Kenton, 2022). The coefficient can be described as the percentage change in assets' stock return given a 1% change in the return of the market portfolio.

$$Beta\ \beta\ =\ \frac{Covariance(R_e,\ R_m)}{Variance(R_m)}$$

Where:
Re - the return on an individual stock;
Rm - the return on the market portfolio;
Covariance - how changes in a stock's returns are related to changes in the market's returns;
Variance - how far the market's data points spread out from their average value.

Given that alpha may be accused of potential manipulation by leveraging the fund return, an alternative metric is the Treynor Ratio, denoting reward-to-volatility ratio, which considers the excess return of the fund relative to its beta coefficient (Atilgan, Bali & Demirtas, 2013).

$$Treynor\ ratio\ =\ \frac{R_i - R_f}{\beta_i}$$

While the Treynor Ratio prominently features beta as a measure of systematic risk, it's essential to recognise that beta encapsulates only a portion of the risk spectrum. Systematic risk, as measured by beta, reflects the sensitivity of a portfolio's returns to broader market movements. However, it does not account for other nuanced sources of risk inherent in complex investment strategies, such as tail risks, liquidity risks, or factors specific to certain hedge fund strategies.

Consequently, while a high alpha remains a desirable goal for hedge funds, the quest for high beta is cautioned against if the aim is a genuine hedge. Moreover, the dynamics of hedge fund leverage adjustments are motivated by the risk-return trade-off, where increased leverage enhances expected returns but concurrently amplifies volatility and credit risk. This balance is particularly significant as providers of credit facilities impose limits on leverage to mitigate the potential risks associated with market volatility, credit default, and other constraints (Getmansky, Lo & Makarov, 2003). A strategic approach, such as a Long/Short Equity strategy with dynamic leverage management, can align with these considerations, seeking high alpha while navigating risks beyond systematic factors alone.

The Sharpe Ratio, the Sortino Ratio, the Rachev ratio

The Sharpe Ratio outlines a balance between risk and reward. It quantifies the excess return generated by an investment or portfolio in relation to its volatility, with volatility serving as a proxy for risk. For hedge funds, the Sharpe Ratio provides a quantitative lens through which investors can scrutinise the efficiency of returns relative to the inherent risk assumed.

$$Sharpe\ Ratio\ = \frac{R_p - R_f}{\sigma_p}$$

Where:
Rp - the return of the portfolio;
Rf - the risk-free rate;
ϛp - standard deviation of the portfolio's excess return. Complementing the Sharpe ratio, the Sortino ratio brings forth a more refined perspective by concentrating on downside risk. This ratio selectively incorporates the volatility associated with negative returns. The Sortino approach aligns with the exigencies of certain hedge fund strategies, particularly those where safeguarding against downside risk is of paramount concern.

In such scenarios, the Sortino Ratio emerges as a discerning metric, offering insight into how effectively a hedge fund navigates adverse market conditions. The calculation parallels that of the Sharpe ratio except the denominator, where downside portfolio volatility is employed - the higher the Sortino ratio, the better the risk-adjusted performance. (Measuring Hedge Fund Returns | Preqin, n.d.).

$$Sortino\ Ratio = \frac{R_p - R_f}{\sigma_d}$$

Where:
ςp - standard deviation of the downside.

Both a Sharpe ratio and a Sortino ratio exceeding 1, and particularly one maximising the magnitude above 1, is generally deemed superior. More precisely: [1-2) is considered as acceptable, [2,3) as good, while [3+) as excellent. To diversify the scope of research on the reward-to-risk ratio, hedge funds employing Global Macro or Long/Short Equity strategies also utilise the so-called Rachev ratio.
It is expressed as the ratio of ETR (Expected Tail Return) to ETL (Expected Tail Loss).

$$RR(r_p) = \frac{\nu(r_p - r_b)}{\varrho(r_p - r_b)}$$

Where:
rp -rb - the active portfolio return;
ν(rp) - denotes the return of the benchmark portfolio;
ρ(rp) - calculates the risk of rp.
The highest RR ratio, the best performance (Stoyanov, Rachev & Fabozzi, 2008).

Drawdown

The calculation of the maximum drawdown is the percentage difference between the highest and lowest values of a hedge fund index during the last 36 months. The methodology ensures that the maximum drawdown statistics are comparable across indices. The smaller the drawdown, the safer the fund (Hedge Funds: Drawdown, n.d.). Event-driven hedge funds focus on profiting from corporate events such as mergers, acquisitions, and restructurings. Drawdown analysis can be relevant in assessing how these funds handle unexpected developments in deal outcomes or market reactions to specific events (Kenton, 2022).

$$MaxDD = \frac{L - P}{P} \cdot 100\%$$

Where:
L - lowest value of portfolio;
P - peak value of portfolio.

Conclusion

Hedge funds must employ various methods to safeguard their assets; for this purpose, they require diverse measures, most of which are widely recognised and utilised in other investment practices. Yet, it is important to remember what they take as the subject, and what results are those that ensure consistent income.

COGNITIVE FALLACIES IN INVESTING

Panna Szabo

All investors and traders want to make well-informed, rational decisions. However, in dealing with the uncertainty and complexity of the modern financial markets, individual decisions are often impacted by emotions or heuristics. While these generalizations can minimize the mental workload, leading to faster decision-making, they can be misleading, causing biased thinking. Indeed, research has found that most mistakes inventors make are behavioral in nature. These cognitive fallacies not only impact their portfolio negatively, but they also have a profound effect on the financial markets, leading to higher volatility and generating bubbles in the stock market. Therefore, being aware of these mental biases is essential to making rational choices concerning our finances. In this article, I will show some of the most common cognitive fallacies that investors often experience during their process of research and decision-making.

Overconfidence bias

Despite being one of the best-known, this cognitive fallacy persists as the most common mistake in general decision-making. It is a natural human tendency to believe to be better than others, smarter, kinder, more intelligent, or better at investing. For investors, this irrational belief in their superiority can often motivate them to take greater risks, neglect fundamentals, and construct under-diversified portfolios, which will lead to lower returns or even unexpected losses. In addition to diminished profits, overconfidence bias also contributes to increased market volatility and mispriced stocks. Economically speaking, the overconfident behavior of investors and traders leads to a loss of market efficiency.

The best way to avoid or curb overconfidence bias is to educate yourself frequently from diverse sources and keep track of your past investment decisions. You can learn a lot about yourself as an investor when you reevaluate your financial history and recognize your mistakes, good decisions, and the role of luck.

Anchoring bias

Similar to confirmation bias, anchoring bias is also a cognitive method of self-perseverance. It describes the inflexibility to change our beliefs which have been previously 'anchored' to a statistically random information or value. In investing, common anchors are based on the historical performance of a stock such as returns in the previous year or purchase price. Rationally, it is easy to realize that the exact price that had been paid when acquiring a piece of equity is not an indicator of future performance, however, anchoring bias can cause investors to hold stocks longer than it would be logical to due to their irrational inner beliefs that the purchase price reflects the fair value. Anchoring is often paired with another common heuristic called adjusting, which describes the cognitive shortcut that happens when an individual learns a new piece of information that contradicts the 'anchored' beliefs. In this case, rather than reevaluating the situation, people tend to adjust their beliefs slightly from the anchor, which is arguably still better than adhering to the anchor, however, the new valuation might still be far from the truth.

Confirmation bias

Confirmation bias is the tendency to completely ignore or give little credit to information that contradicts our existing beliefs. It usually occurs in one or more of these three steps: biased search, biased interpretation, and biased recollection of memories. In the era of automatized search engines, avoiding this bias requires a fair amount of work, however, it is crucial in order to make rational decisions about our portfolio. To illustrate this concept, let's consider the upcoming elections in the US. As both parties have different economic goals in mind, the results of the elections have major implications for American equities. Reading our favorite newspaper and scrolling through social media might easily convince us that our preferred party is going to win, forcing us into making biased decisions about our investments.

Recency bias

As investors, finding the balance between valuation based on historical data and current trends is never an easy task. Research shows that humans often demonstrate a tendency to attribute more weight to recent information at the expense of long-term observation.

Recency bias can cause investors to make irrational decisions such as buying into overhyped stocks or holding them even after their value has significantly decreased. Economic cycles consisting of booms and recessions are natural - therefore our long-term investment portfolio should not be overly affected by decisions made based on the temporary fluctuations around the long-run trend.

Framing effect

The framing effect describes the phenomenon that investors' behavior can be influenced by presenting the same information differently. Consider an example: would you rather invest in a stock that has an 80% chance of generating returns or a stock that has a 20 % chance of incurring losses? Mathematically, they are the two sides of the same coin, however, due to the wording, the second choice seems less desirable. This framing effect is rooted in another cognitive distortion called loss aversion, which describes the tendency to feel a stronger emotional impact from a loss compared to an equivalent gain.

Herd mentality

Beginner or unconfident investors often fall prey to the 'herding instinct', which makes them inclined to follow the decisions of their peers instead of basing their decisions on fundamental analysis and risk-reward tradeoff evaluation. This is often based on their unconscious fear of being left behind and their beliefs that others have more information or a better view of the financial system, which allows them to make superior choices.

Evaluating the effect of herding behavior in the stock market is tricky; while it often leads to overhyped stocks, no law says stock prices and fair valuation should eventually converge. If investors keep buying, the prices will keep rising until the perception of the company remains unchanged, creating an asset bubble. Problems arise, however, when in light of negative news, investors start selling in panic leading to a possible market crash.

Successful investing requires a lot of skills such as financial literacy, analytic mindset, and risk management. This list can be adjusted with the ability to recognize the strengths and weaknesses of our own cognitive abilities, as these biases can have a significant impact on the performance of our portfolio. While being aware of these heuristic imperfections does not guarantee that we will not fall prey to them in the future, it is still our best resource in avoiding such fallacies and mitigating their effects.

Noah Demuth

DECODING JAPAN'S ECONOMIC MIRACLE

The Japan economic miracle is a phase of strong economic growth in Japan, beginning after the Second World War and continuing until the end of the Cold War. During this period, Japan quickly established itself as the second strongest economy in the world (1968-2010) with a strong electronics, shipbuilding and steel industry.
The highlight of this period was undoubtedly 1989, when the Japanese owned 13 of the 20 most valuable companies in the world and accounted for 40% of global capitalization, briefly overtaking the USA.

The Japanese economic miracle was followed by an asset price bubble that build up during the 1980s. During this period, real estate and stock market prices were heavily overpriced and in 1990 the price bubble burst as a response to the change in monetary policy of the Bank of Japan. This caused the Japanese economy to stagnate and the Nikkei 225 Index fell -38.72% in a year (Ushinawareta Nijūnen, Lost Decades).

Historical Background

After the atomic bombs in Nagasaki and Hiroshima, Japan surrendered shortly afterwards. From 1945 to 1952, the American occupation began. The Americans reformed the country economically and politically with General MacArthur and his team helping to shape the new Japanese constitution. As a result, the Americans were regarded as Japan's greatest supporters and contributed to Japan's rapid economic rise.

Business Conditions

After the Americans occupied Japan, they dismantled the Zaibatsus. Zaibatsus were corrupt and powerful family businesses that dominated the Japanese industry.
Later on they were replaced with the Keiretsu system, which was the first step towards economic growth. The introduction of the Keiretsu enabled Japan to undercut its rival international competitors. Keiretsu refers to the grouping of Japanese companies from different sectors including manufacturers, suppliers,

distributors, and financiers. Keiretsu allows companies to be legally independent but economically interdependent. This makes it possible to enter the market with joint resources to reduce cost, get more efficient and get better finance possibilities. The aim of the Japanese companies was to achieve efficient and future-oriented market share gains.

Export-oriented Strategy

The Ministry of International Trade and Industry (MITI) had a great influence on Japanese industry and thus on Japan's exports. MITI placed great emphasis and financial support on private businesses that had the potential to become major markets in the future, such as the steel industry and electronics. Furthermore, MITI's goal was to strengthen the domestic economy by reducing import competition to protect Japanese companies and facilitating the licensing of foreign technology to promote innovation. This enabled Japan to quickly establish companies such as Toyota and Sony in the global market, leading to Japan's trade surplus.

Politics

Politics played a major role in creating economically friendly social harmony and stability.

The Yoshida Doctrine from 1951, drawn up by Japan's Prime Minister Shigeru Yoshida, placed a strong emphasis on economic reconstruction and technological progress. With this doctrine, the intention was to reduce military spending to a minimum while relying on the security alliance with the USA. This harmonizes with Article 9 of the Constitution, which came into force in 1947 and is often referred to as the no war clause.

The Income Doubling Plan, drawn up by Prime Minister Ikeda in 1960, set out to double the Japanese economy

by 1970 and ensure a high standard of living for its citizens. The main objectives of the plan were to promote welfare, foreign trade and domestic investment.

Human Capital Development and Innovation

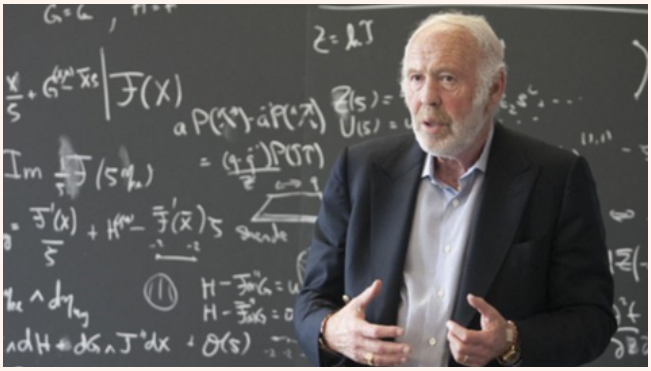
Japan greatly expanded local education at the beginning of the economic miracle. Furthermore, great attention was paid to the development of scientists and managers in order to sustainably promote the targeted industries. In addition, Japanese companies (known as Kaisha) relied on the ever-increasing development of human capital to remain competitive and prepare for changes in the global market. Last but not least, Japanese workers have a very strong loyalty to their companies and are committed to lifelong work (Shūsin Koyō).

Japan placed great emphasis on R&D to produce goods of high quality in more efficient ways and thus remain competitive in the world market. As a result of the Japanese's high level of education, they were able to apply the technologies from other countries, improve them and make them more efficient.

FACTOR INVESTMENT 1
FUNDAMENTALS OF FACTORS

Zhejia Hu

Review of CAPM Theory and Introduction to Arbitrage Pricing Theory



In the Portfolio Management academy, the Capital Asset Pricing Model (CAPM) is initially presented as an inherent outcome of portfolio diversification. Imagine a scenario where a market portfolio exists, characterised by a mean-variance frontier payoff. In such a case, the expected return of any asset in the market can be formulated as the sum of the risk-free return and the product of the asset's beta and the market portfolio's excess return over the risk-free return. In specific, given a set of assets, the weights assigned to each asset in a portfolio can be varied to form a subset of the mean-variance plane. This subset represents the universe of all possible portfolios. Among these, the portfolio that boasts the maximum Sharpe ratio is deemed optimal. Market participants should ideally strive to possess this portfolio, as it offers the most desirable risk-reward trade-off. With the market portfolio, a method emerges for comparing the expected return of an individual asset with the expected return of the market portfolio. This comparison is facilitated by the beta of the asset, which is defined as the ratio between the excess expected return of the asset and the excess expected return of the market portfolio. Conversely, the CAPM formula offers a method to predict an asset's expected return based on its historical returns. Initially, we estimate the asset's beta by performing a regression analysis, using the asset's historical returns as the dependent variable and the market's historical returns as the independent variable. This estimated beta is then incorporated into the CAPM formula to derive the asset's expected return. The CAPM can be conceptualised as a linear model with a single parameter: the excess expected return of the market portfolio over the risk-free rate. The underpinnings of the model are deeply rooted in asset

pricing theory, providing a theoretical framework for understanding the dynamics of financial markets and the valuation of assets.

The validity of the CAPM as a forecaster of an asset's expected return in real-world conditions, mathematically under real world measure $\mathbb{P}$ can be succinctly demonstrated as follows. Following *Fundamental Theorem of Asset Pricing*, the price of the asset at time t: P_t should be $\mathbb{E}^{\mathbb{P}}\left[\sum_{u=t+1}^{T} \frac{\pi_u}{\pi_t} D_u \,\middle|\, \mathcal{F}_t\right]$ where random variable D_u represents the potential cash flow generated at time u. $\mathcal{F}_t$ is a set containing all the market information we have at time t and stochastic process $\{\pi_t\}$ is called *state-price density* and the financial interpretation of the ratio $\frac{\pi_u}{\pi_t}$ is the ratio of conditional probabilities between risk neutral measure and real world measure times the accumulated discounted rate, a typical operator that performs two operations: mapping the probability distribution of real world measure $\mathbb{P}$ to risk neutral measure $\mathbb{Q}$ and discounted the value from future time u back to current time t. The Discounted-Cash-Flow (DCF) method, which is commonly used for equity valuation, can be derived from the fundamental asset pricing equation. The random variable R_{t+1} that donates return of the asset at time $t+1$ is $\frac{P_{t+1} + D_{t+1}}{P_t}$, according to the *Arbitrage-Free Model*, it must hold that the discounted return of any asset must be a martingale under risk neutral measure $\mathbb{Q}$ ($\mathbb{E}^{\mathbb{Q}}[R_{t+1}] \equiv R^{\mathrm{f}}$), which could be expressed, under the real world measure $\mathbb{P}$, as $\mathbb{E}^{\mathbb{P}}\left[\frac{\pi_{t+1}}{\pi_t} R_{t+1} \,\middle|\, \mathcal{F}_t\right] \equiv 1$. Because the risk free return, donated as R^{f}, could also be seen as the return of an asset that has zero-variance return, the risk free asset in reality, the conclusion could be drawn that $\mathbb{E}^{\mathbb{P}}\left[\frac{\pi_{t+1}}{\pi_t} R^{\mathrm{f}} \,\middle|\, \mathcal{F}_t\right] \equiv 1$. This could provide us the condition expectation of random variable $\frac{\pi_{t+1}}{\pi_t}$: $\mathbb{E}^{\mathbb{P}}\left[\frac{\pi_{t+1}}{\pi_t} \,\middle|\, \mathcal{F}_t\right] = \frac{1}{R^{\mathrm{f}}}$. This could brings us the equation of evaluating the risk premium of an asset over risk free asset

$$\mathbb{E}^{\mathbb{P}}[R_{t+1}] - R^{\mathrm{f}} = -R^{\mathrm{f}} \operatorname{Cov}\left(R_{t+1}, \frac{\pi_{t+1}}{\pi_t} \,\middle|\, \mathcal{F}_t\right)$$

. The relationship between SPD and CAPM is based on the premise that we could define $\frac{\pi_{t+1}}{\pi_t}$ as a linear function

of market return R^{M}_{t+1}, which brings us the familiar CAPM equation $\mathbb{E}^{\mathbb{P}}[R_{t+1} - R^{\mathrm{f}} \mid \mathcal{F}_t] = \mathbb{E}^{\mathbb{P}}[R^{\mathrm{M}}_{t+1} - R^{\mathrm{f}} \mid \mathcal{F}_t] \frac{\mathrm{Cov}(R_{t+1},\, R^{\mathrm{M}}_{t+1} \mid \mathcal{F}_t)}{\mathrm{Var}(R^{\mathrm{M}}_{t+1} \mid \mathcal{F}_t)}$. The underlying principle of this premise is that the transformation of the probability measure, which essentially redistributes the likelihood of different states of the world, is solely encapsulated by the market return.

Nevertheless, certain critiques directed towards the CAPM theory pertain to its testability. Roll's Critique posits that the CAPM remains untestable due to the unobservable nature of the true market portfolio's composition. Specifically, an overarching question persists regarding the precise definition of a market portfolio. In practice, observable constraints on asset trading, such as short-sale restrictions, and currency complications in international asset trading, further obfuscate this definition. This prompts the exploration of an alternative that endeavours to address these aforementioned issues: *Arbitrage Pricing Theory*. Prior to delving into Arbitrage Pricing Theory, it is essential to first introduce *factor models of asset returns*, which states the return of an asset i is influenced by K systemic (non-diversifiable) factors $\{f_k\}_{k=1}^{K}$, in addition to an idiosyncratic factor $u^{(i)}$ which is uncorrelated among all assets and hence diversifiable:

$$R^{(i)} = \mathbb{E}[R^{(i)}] + \sum_{k=1}^{K} b_k^{(i)} f_k + u^{(i)},$$

where $b_k^{(i)}$ are the loading of asset i to factor f_k. It should be noted that both $\{f_k\}_{k=1}^{K}$ and $u^{(i)}$ have zero expectations: $\mathbb{E}[f_k] \equiv 0$ and $\mathbb{E}[u^{(i)}] \equiv 0$. Furthermore, for two different assets i and j, there are zero correlation between random variables $u^{(i)}$ and $u^{(j)}$: $\mathrm{Corr}(u^{(i)}, u^{(j)}) \equiv 0$, which posits the characteristic that a well-diversified portfolio is exposed solely to factor risks. When integrating these risk factors into reality, a pivotal question to address is how exposure to a specific factor could influence the return of an asset. If feasible, we could manage how our portfolio or asset is exposed to a particular factor. To tackle this question, a *factor portfolio* P_k is created, which has a unitary risk of factor k and the loading of that portfolio to factor k is 1: $b_k^{(P_k)} = 1$. To construct such portfolio, assume the world has M assets, the target portfolio has a weight vector $\mathbf{w}$ and a matrix $\{B_{ik}\}_{i=1,k=1}^{M,K}$ structs the loadings of asset m to factor k. A portfolio needs to be created with only one unit loading towards a single-exposed factor k,

equivalent to having a loading factor $\mathbf{b}^{(P_k)} := \{\mathbb{I}_{i=k}\}_{i=1}^{K}$, therefore, the weight vector of target portfolio $\mathbf{w}^{(P_k)}$ must satisfy the equation $B\,\mathbf{w}^{(P_k)} = \mathbf{b}^{(P_k)}$. If there exists a matrix B' such that $B'\,B = \mathrm{I}$, the target weight vector could be derived $\mathbf{w}^{(P_k)} = B'\,\mathbf{b}^{(P_k)}$ and the factor portfolio could be constructed from these assets based on $w\,\mathbf{w}^{(P_k)}$ where the value w makes the sum of the allocation of each asset to one. The expected return of this portfolio $\mathbb{E}\left[R^{(P_k)}\right]$ over the risk free return R^{f} is defined as the premium of factor k. Based on this definition, the Arbitrage Pricing Theory states that the expected return of an asset depends only on its factor exposure:

$$\mathbb{E}[P] = R^{\mathrm{f}} + \sum_{k=1}^{K} b_k^{(P)} \left(\mathbb{E}\left[R^{(P_k)}\right] - R^{\mathrm{f}}\right)$$

There are two fundamental insights to be gleaned from the aforementioned formula:

1. A portfolio with no exposure to any factor risk must offer risk free return.
2. If there is one factor and the premium of the factor is equal to the market premium, CAPM is reduced to APT.

Factors Investment

In this section, we shall delve deeper into the aforementioned factors, including the specific types of information pertaining to a particular company or its operating environment that could be construed as a factor. The objective is to extract pertinent information and formulate reasonable predictions regarding the company's excess return.

Factor Type

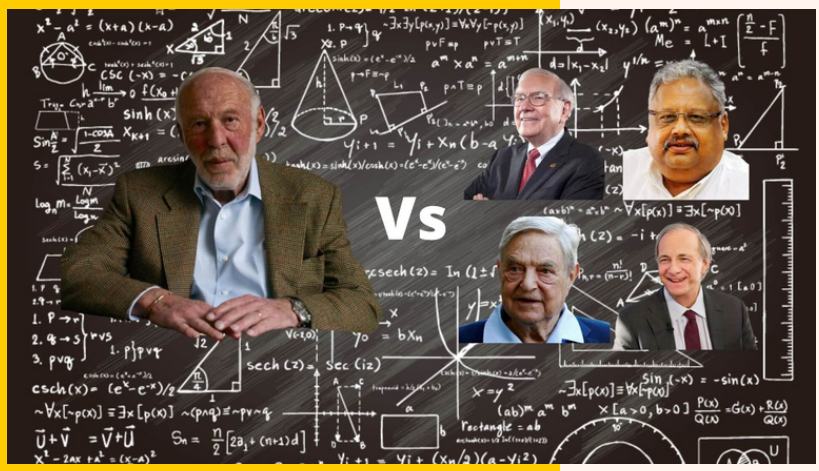
Two principal categories of factors warrant consideration: macroeconomic factors and fundamental factors. It is evident that these factor types are distinct, and consequently, the approach to handling factors from these two categories should differ correspondingly.

Macroeconomic Factors Models use the realised values of macroeconomic variables. In the paper (Chen et al., 1986), the factors used are *monthly growth of industrial production*, *change in expected inflation*, *unexpected inflation*, *difference in portfolio return between junk bonds and long-term government bonds*, *difference between treasury-bill rate and long-term government bonds* and the return of an asset is linear combination of these macroeconomic variables and an

asset-specific constant term. In this model, for each asset, a constant term and its exposures towards each of the above mentioned macroeconomic variables are estimated based on the historical return of an asset by using time series regression. This model satisfies the Generalised Gauss-Markov assumptions, indicating the fact that the estimate of constant term and exposures are Best Linear Unbiased Estimates and Maximum Likelihood Estimation if the error term follows a Gaussian distribution.

Fundamental Factors Models determine the common factors variables using fundamental and asset-specific attributes such as sector/industry membership, firm size (market capitalisation), dividend yield, style, and so on. It must be emphasised that the estimation process for models based on fundamental factors is separate from that of models based on macroeconomic factors. All companies operate within the same macroeconomic environment, hence, the realised value of macroeconomic variables can be applied as the feature value across all companies. However, each company possesses unique fundamental data, which may differ significantly from other companies. Therefore, for a specific feature such as the PE ratio, a method is required to determine the actual feature value corresponding to the fundamental information, based on all representative companies. In specific, in the macroeconomic factors model, it is not necessary to estimate the feature value, while estimating the feature value is necessary in the fundamental factors model. One method to estimate the feature value is *Fama-French Approach*. To evaluate the feature value of factor k at time t: f_{kt}, all considered assets are sorted based on the factor and splitted into 5 equally-weighted quintile portfolios. Then, a hedged portfolio is created by having a long position in the quintile portfolio with best performance in the current factor and having a short position in the quintile portfolio with worst performance in the current factor. We define the feature value of the current factor as the return of the hedged portfolio. Finally, time-series regression is applied to estimate the factor loadings for individual assets. In real practice, fundamental factors model has attracted attention from investors and are further classified into 10 subcategories following (Zhou & Gu, 2022): profitability, growth, operating efficiency, surplus capacity, leverage safety, company management,

valuation, analysts, shareholders, scale, and compound. Each subcategory reflects one aspect on the fundamentals, for instance, profitability factors describe the profitability of the business for a company and example factors are **EPS**, the ratio between net income and shareholders' equities, and leverage safety factors describe the financial safety of the company given its liability and operation situation and example factors are **CCR**, the ratio between operating cash flow and current liabilities. It is imperative to acknowledge that for fundamental factors, some of them are already employed when we conduct financial analysis on the company and these financial ratios can be directly selected as factors when constructing a multi-factor model, such as the earnings per share factor. There are other factors, which have implicit financial interpretation, are powerful at predicting asset returns, such as operating acceleration factor OP_{SD}, the increase in operating income. Furthermore, in practice, different factors may exhibit different efficiency under different conditions. The Accrual Profit Ratio APR_{TTM} factor of surplus capacity subcategory, the ratio between profits, performs well in the overall market and the CSI 500 index , but shows relatively weaker performance in the Shanghai and Shenzhen 300 index, indicating its effectiveness is weaker in large-cap stocks.



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