

Principles of Factor Investing

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Agenda for Today

Today you will learn the basics of:

- What do people refer to when they talk about investment factors
- Why you should invest in ETF's
- How to assess the performance of your investment portfolio

Large ongoing debate on many issues I will touch on today

Focus on key lessons the majority of finance academics would (probably) agree

First Things First - I

A little about myself:

- Assistant Professor of Finance at the University of Maryland
- PhD in Economics with focus on Finance, Machine Learning and Financial Econometrics from the University of California, San Diego

Multiple areas of research:

- Evaluate what factors explain the performance of mutual and pension fund managers
- Exploring the factors underlying commodity markets
- Option pricing research extending Black-Scholes formula to more realistic cases
- Predicting stock market returns using machine learning algorithms
- Studying the performance of individual investors and understanding the effectiveness of robo-advising on investment decisions

First Things First - II

My strengths:

- Handling Large Datasets
- Econometric Modeling
- Implementing investment strategies

Less knowledgeable about:

- Tax considerations
- Execution of investment strategies on brokerage platforms
- Individual stock, mutual funds, or ETF picks

The importance of Diversification

- Before we talk about factors, we have to talk about diversification
- I have worked with numerous companies understanding the behavior of individual investors
- Under-diversification is a universal trait of individual investors
- Under-diversified portfolios result in high risk and low returns

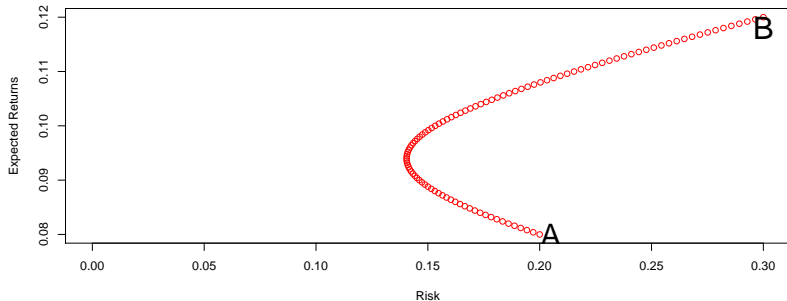
Intuition Behind Diversification - I

	A	B
Expected Returns	8%	12%
Volatility	20%	30%

Correlation = -0.3

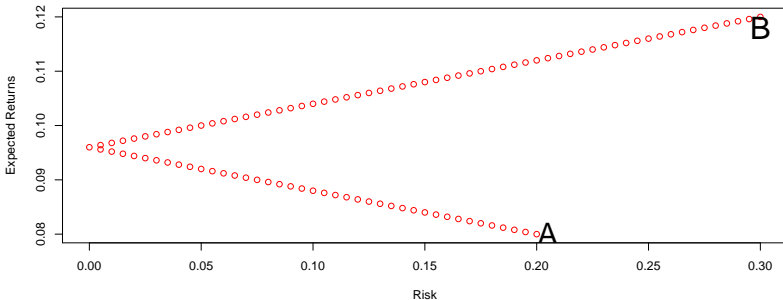
What happens when we construct a portfolio using the two assets?

Expected returns and risk vary with the weight on each asset!



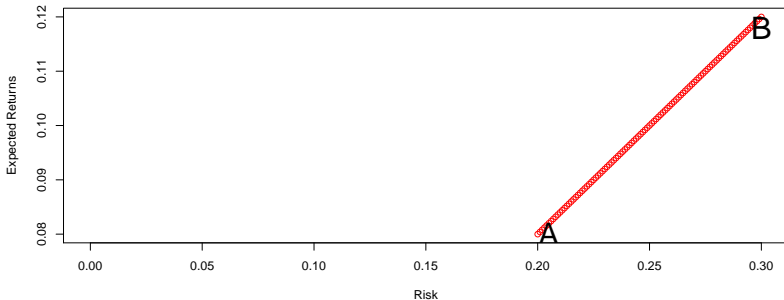
Intuition Behind Diversification - II

Correlation = -1



Intuition Behind Diversification - III

Correlation=1



Gains from Diversification

Elton and Gruber (1977)

Number of Stocks in Portfolio	Average St.Dev. of Annual Portfolio Returns	Ratio of Portfolio St.Dev. to St.Dev. of a Single Stock
1	49.24%	1.00
2	37.36%	0.76
4	29.69%	0.60
6	26.64%	0.54
8	24.98%	0.51
10	23.93%	0.49
20	21.68%	0.44
30	20.87%	0.42
40	20.46%	0.42
50	20.20%	0.41
400	19.29%	0.39
500	19.27%	0.39
1,000	19.21%	0.39

Always be DIVERSIFIED!

Factors and Investing over the Life Cycle - I

The investments you choose should be related to your labor income

If your income is closely related to the stock market, it behaves like a **stock** (if you work in finance, for example)

→ **you should invest less in equities**

If your income is largely unrelated to the stock market, it behaves like a **bond** (if you are a bankruptcy attorney or a debt collector)

→ **you should invest more in equities**

Standard Advice from Financial Advisors: Lower the allocation to equities as you age

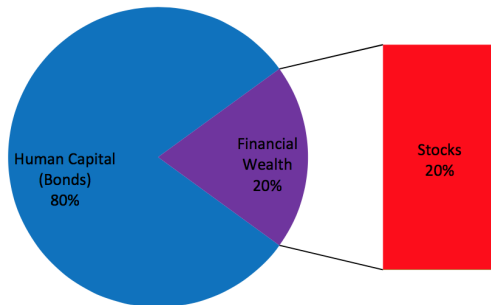
$$\text{Percentage of Wealth in Equities} = 100 - \text{Age}$$

The advice is not completely correct . . .

Factors and Investing over the Life Cycle - II

Suppose a person targets 20% risky assets over her whole life

Young Person: Bond-Like Human Capital

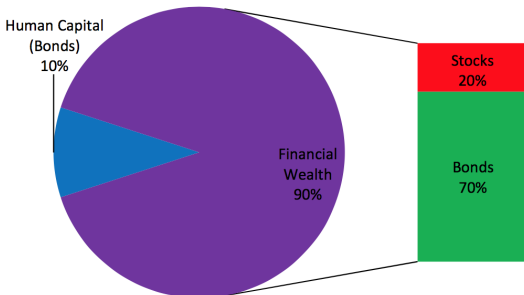


(Source: Asset Management by Andrew Ang)

Factors and Investing over the Life Cycle - III

Suppose a person targets 20% risky assets over her whole life

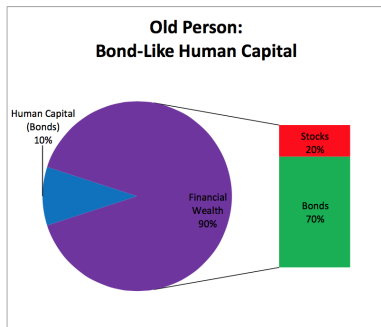
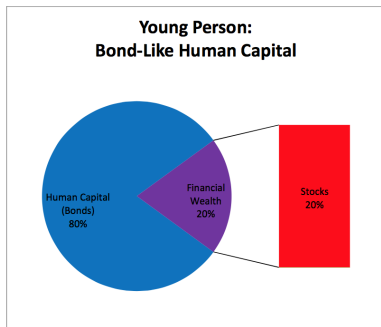
Old Person: Bond-Like Human Capital



(Source: Asset Management by Andrew Ang)

Factors and Investing over the Life Cycle - IV

With bond-like human capital, you hold **fewer** risky assets as you age

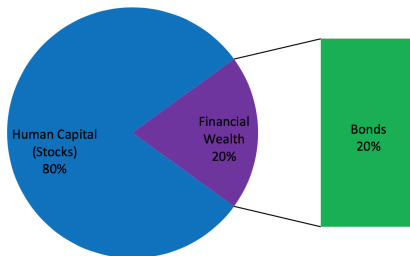


(Source: Asset Management by Andrew Ang)

Factors and Investing over the Life Cycle - V

Suppose a person targets 80% risky assets over her whole life

Young Person: Stock-Like Human Capital

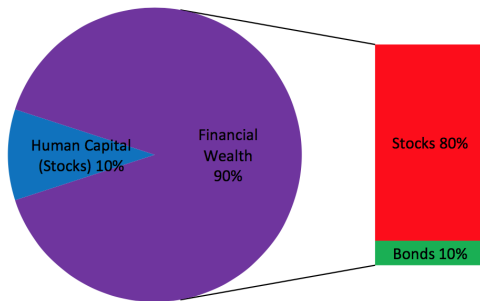


(Source: Asset Management by Andrew Ang)

Factors and Investing over the Life Cycle - VI

Suppose a person targets 80% risky assets over her whole life

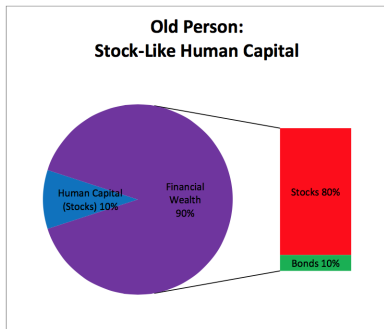
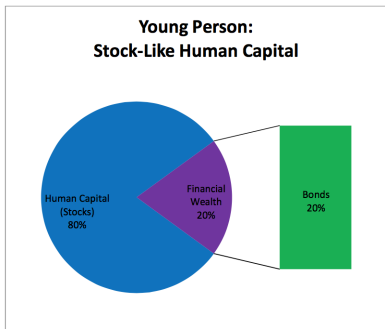
Old Person: Stock-Like Human Capital



(Source: Asset Management by Andrew Ang)

Factors and Investing over the Life Cycle - VII

With stock-like human capital, you hold **more** risky assets as you age



(Source: Asset Management by Andrew Ang)

What do People Actually Do?

- A large fraction of households do not hold any equity (non-participation)
- Older working households hold higher fractions of equity than younger working households (household equity shares increase with age)
- Even at retirement the fraction of equity held is very high
- Rich households hold more equity than poor households

Definition of Investment Factors

Factors are investment styles that deliver high returns over the long run

Factors can be **static** or **dynamic**

Examples of static factors:

- Equities
- Bonds

Static factors are obtained by simply buying assets (long-only positions)

Examples of dynamic factors:

- Value-growth investing
- Momentum investing
- Long-short volatility investing

Dynamic factors are long-short positions where you adjust constantly portfolio weights

Definition of Investment Factors - I

Historically, stock market delivered a 6% return in excess of the risk-free rate per year

In addition: the academic literature has uncovered that certain types of stocks outperform other types of stocks

For example:

- Value stocks outperform growth stocks
- Small capitalization stocks outperform large capitalization stocks
- Past winners outperform past losers
- Illiquid stocks outperform liquid stocks

→ We can create strategies to capture additional returns. **HOW?**

Definition of Investment Factors - II

Buy the stocks that perform well and “short” the stocks that perform poorly:

- Value-Growth Factor = Value stocks minus growth stocks
- Size Factor = Small stocks minus large stocks
- Momentum Factor = Winning stocks minus losing stocks
- Illiquidity Factor = Illiquid securities minus liquid securities

Definition of Investment Factors - III

Basic idea of how to construct a factor

Value-Growth factor as an example

- Take all the stocks in the market, usually people focus on the ones listed in the NYSE, NASDAQ (Approximately 6,000)
- Divide them into 2 groups on the basis of their Book value over Market value
- Buy half of the stocks and short half of the stocks
- Factors are *market neutral* if the long and short legs are equal in size
→ If a factor is market-neutral, it generally does not move with the market

Impossible to do for an individual investor!

Even large asset managers cannot short that many stocks

→ generally use smart strategies to short only some of the stocks and not all

Definition of Investment Factors - IV

As always, the devil is in the details!

Many variants are possible:

1. The definition of market and book value is important
2. You can construct 10 (or 100!) groups instead of 2
3. Because shorting is very expensive, usually the “short” leg simply has a low (and positive) or zero weight in the portfolio
4. Asset managers use more sophisticated techniques to isolate one factor from another

Example: if all the stocks that have a high book-to-market ratio are also small in capitalization, a portfolio would be exposed to two factors at the same time.

How Many Factors Are There?

The Capital Asset Pricing Model (CAPM):

1. Predicts there should be only one factor
2. Stocks with high “beta” should have higher returns than the ones with low “beta”
3. The CAPM fails dramatically in empirical tests

The Arbitrage Pricing Theory of Steve Ross:

1. Shows that theoretically there could be very many factors
2. The finance world is split on how many there are
3. Academics have found more than 300 factors
4. Many of these factors are the results of data-snooping

**Academics constantly trying to isolate new factors ...
...and test whether the ones discovered are really there**

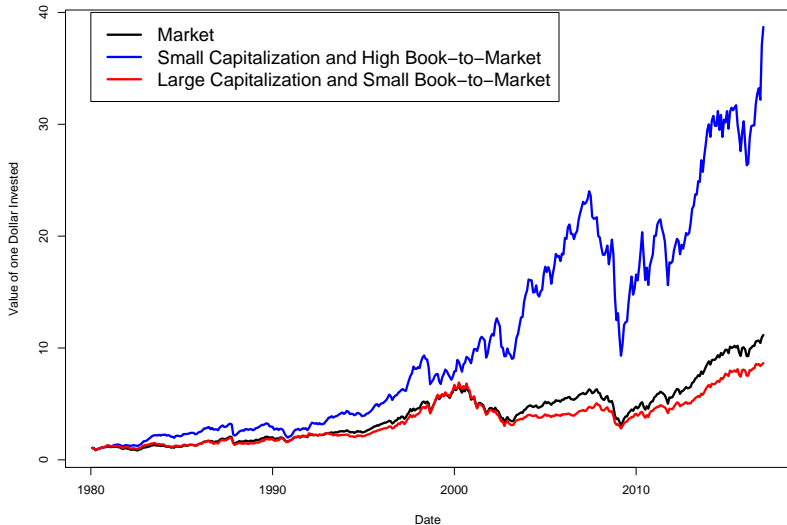
How Many Factors Are There?

Many academics would agree that some of the major factors are:

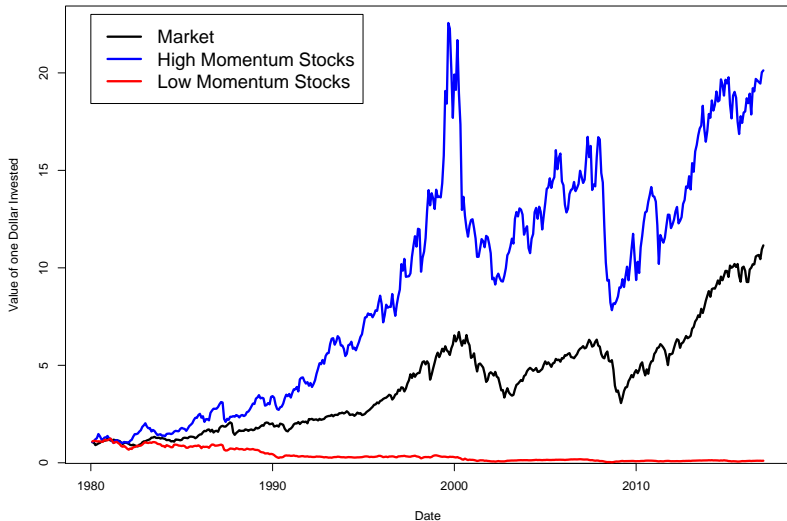
- Value-Growth Factor = Value stocks minus growth stocks
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- Illiquidity Factor = Illiquid securities minus liquid securities

The “Size” factor does not seem to be in the data anymore

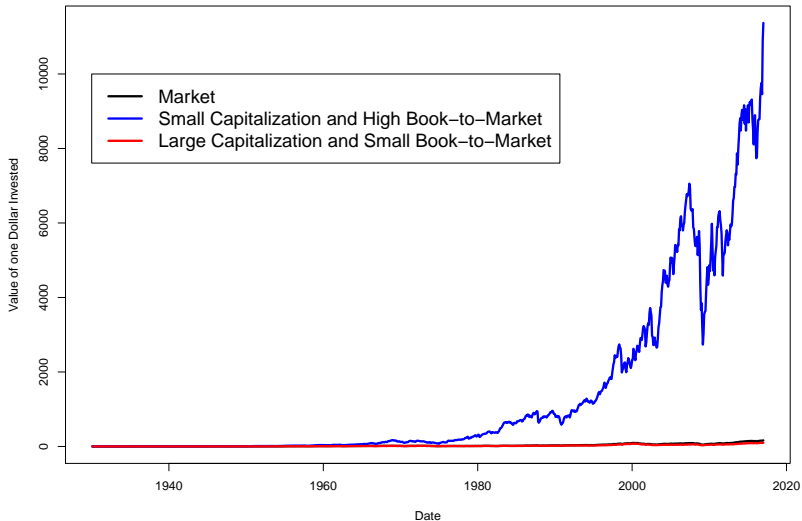
Some sense of the Magnitudes



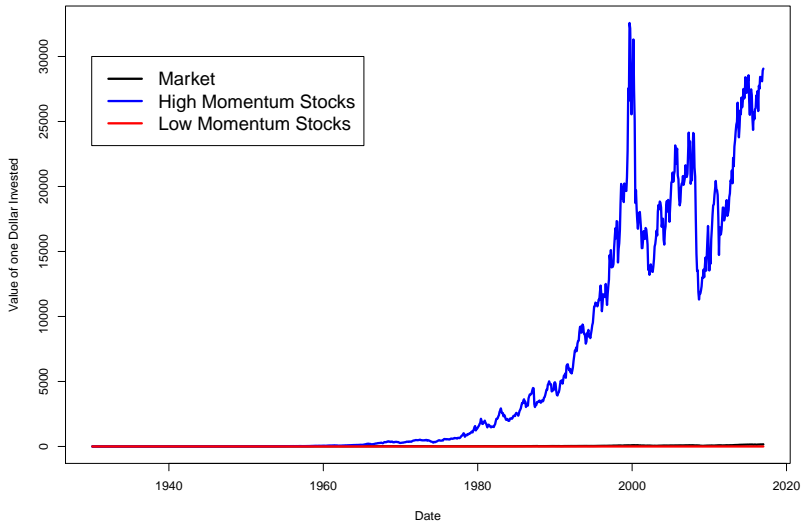
Some sense of the Magnitudes



Some sense of the Magnitudes



Some sense of the Magnitudes



Why are Factor Returns so High?

Factors are also called risk-factors because they are risky!

→ **They suffer big losses in periods of crisis**

Look at the returns of Momentum in 2001 and 2007-2008

The declines compared to the market portfolio are much more pronounced

Academics study whether the premia are compensation for risk or not

- If YES, they are called **risk-factors**
- If NO, they are called **anomalies**

Who Decides What Strategies Are Factors?

Broadly speaking, well accepted factors have the following characteristics:

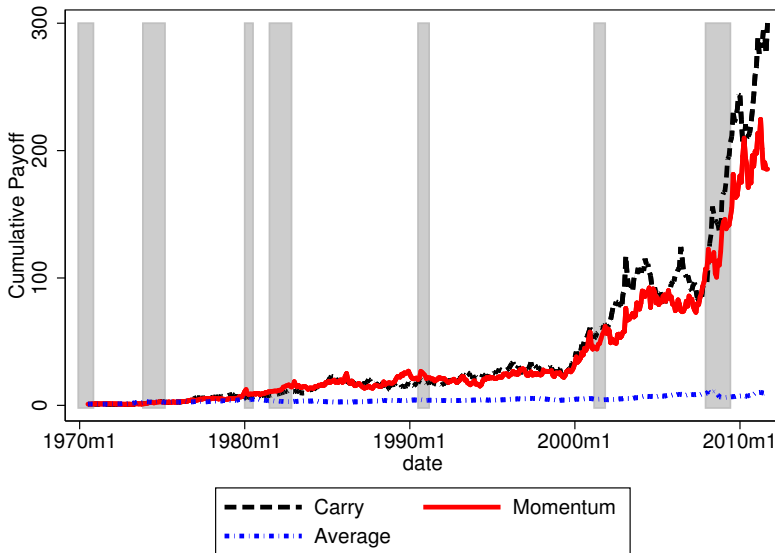
- They are justified by academic research
- They exhibit a premium that is expected to persist in the future
- Return history for bad times should be available
- They should be easy to implement with liquid instruments

If you interview 10 factor investors, you will obtain 10 different (but similar) answers

Are factors specific to equities? No, they are ubiquitous across asset classes

For example: I have a paper showing that carry and momentum are the most prominent factors in commodities (see next page)

Carry and Momentum in Commodities



Are Factors a New Thing?

NO!

Think of the value-factor. Value investing has been around since Graham and Dodd and has Warren Buffett as its biggest proponent

People have proposed rational and behavioral theories to explain its performance

Explanations of the Value Factor - I

Rational Explanations:

- Changing betas: value firm betas increase during risky times
- Value firms are risky because during bad times
 - They are burdened with more unproductive capital
 - They want to cut back on capital, face higher adjustment costs
 - Growth firms can better deal with a downturn by deferring investment

Explanations of the Value Factor - II

Behavioral Explanation:

- Most behavioral explanations of value center around over-reaction/ over-extrapolation
 - Investors over-extrapolate past growth rates into the future
 - Growth firms have had high past growth rates. Prices of these firms are bid up too high reflecting excessive optimism
 - When growth does not materialize, prices fall so returns are low relative to value firms
 - Naïve investors over-extrapolate and prices reflect the over-reaction. Contrarian (value) investors outperform by taking the opposite side

Explanations of the Momentum Factor are Mainly Behavioral

Explanations range from *under-reaction* to *over-reaction*

Main idea: investors do not incorporate in a timely fashion the stocks' news

Intuition: Suppose a piece of good news is revealed today:

- If investors incorporate information efficiently, price would go
 - from \$5 to \$10 the same day
- If investors incorporate information slowly, prices would go
 - from \$5 to \$6 on the first day
 - from \$6 to \$8 on the second day
 - from \$8 to \$10 on the third day

→ The second mechanism can generate momentum

How do Factor Investors Think? - I

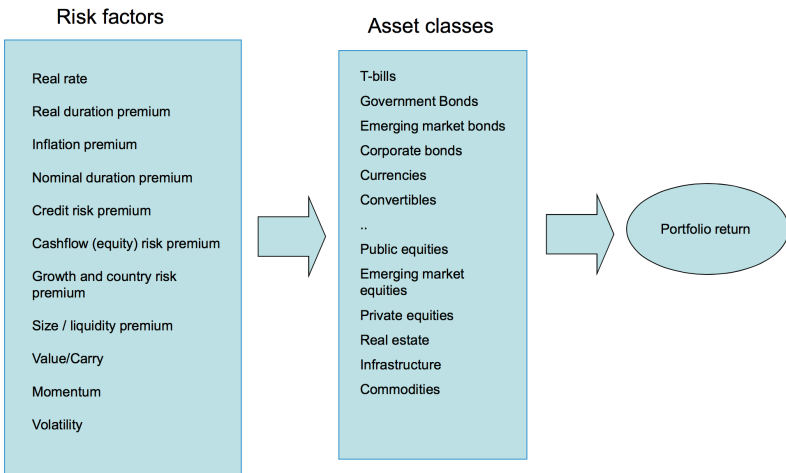
- They don't think in terms of stocks...
- ...or in terms of asset classes...
- ... they think of portfolio allocation in terms of exposure to factors
- Exposure to a given factor can be obtained using different asset classes
- Once you know what factor you are exposed to, you know how your portfolio performs in different economic environments

How do Factor Investors Think? - II

Each factor can proxy for a different source of risk. In general, we look at:

- Recessions
- Periods of low GDP growth
- Periods of low consumption
- Periods of high inflation
- Periods of high stock market volatility (when the VIX is high)
- Productivity shocks
- Demographic risks
- Political risks

How do Factor Investors Think? - III



(Source: Asset Management by Andrew Ang)

Are Factors for you?

The Market Portfolio (the S&P 500) is held by the **AVERAGE** investor

If you **ARE** the average investor, you should hold the Market Portfolio

If you suffer **LESS** in recessions or have longer horizon than the **AVERAGE** investor:

- TILT your portfolio towards these factors
- You will get better returns on average, but you will suffer more in recessions (intuitively it is like selling an insurance policy)

If you suffer **MORE** in recessions or have shorter horizon than the **AVERAGE** investor:

- TILT your portfolio away from these factors
- You will get worse returns on average, but you will suffer less in recessions (intuitively it is like buying an insurance policy)

How to Obtain Factors' Exposure

Easiest way is to purchase Indexed Mutual Funds or ETFs

ETFs have several advantages:

- They are very liquid
- They are more tax-efficient than mutual funds
(you pay taxes if mutual fund managers sell stocks because of redemptions)
- They are more transparent
(holdings are published on a daily basis)
- Can be shorted

Big Players: BlackRock, StateStreet and Vanguard.

Investment Recipe

- Look at the various factors known to outperform (Size, Value, Momentum, Illiquidity)
- Decide which ones you want to be exposed to
- Buy an ETF with an exposure to that factor (Google the name, try to pick ETFs with a large trading volume)
- Be careful about leveraged ETFs

Leveraged ETFs

Leveraged ETFs are “reset” daily, so the return of a leveraged ETF over a certain window is not equal to the return of the underlying index leveraged

Example: Invest \$100 in an index and in a “3 x Leveraged ETF of the index”

	Index Return	Index Investment	Leveraged ETF Investment
Day 1	10%	$\$100 \times (1 + 0.1) = \110	$\$100 \times (1 + 0.1 \times 3) = \130
Day 2	-10%	$\$110 \times (1 - 0.1) = \99	$\$130 \times (1 - 0.1 \times 3) = \91
Overall Return	-1%	$(\$99 - \$100)/\$100 = -1\%$	$(\$91 - \$100)/\$100 = -9\%$

You would expect the return to be -3% on the leveraged ETF but it is not.

Performance Evaluation

The return on your portfolio by itself is not very informative

Sometimes the market goes up and sometimes it goes down

Compare every period the returns on your investment portfolio to some benchmark

- **Easiest approach:** Simply subtract the benchmark return from the average return
- **More involved:** include the volatility in the computation (Information Ratio & Sharpe Ratio)

Choosing the Benchmark is Key

Benchmarks should be:

- Well-Defined
- Tradeable
- Replicable
- Adjusted for Risk

The “SPY” – the ETF that tracks the S&P 500 - checks all the boxes

Basic Approach

Use the returns on the on the S&P 500 (or the Russell 1000) and run a regression:

- of the excess returns on the portfolio
- on the excess returns on the S&P 500

More formally:

$$R_t^p - RF_t = \alpha + \beta (R_t^{BMK} - RF_t) + \epsilon_t$$

The α measures the outperformance of your portfolio compared to the benchmark

- if $\alpha > 0$, you are beating the market
- if $\alpha < 0$, you are losing against the market

The β measures the risk of your portfolio compared to the benchmark

- if $\beta > 1$, your portfolio is riskier than the market
- if $\beta < 1$, your portfolio is safer than the market

Use 10 years of monthly data for reasonably accurate results

More Advanced Approach

Add the Small-Minus-Big Factor, the Value Factor and the Momentum Factor

More formally:

$$R_t^D - RF_t = \alpha + \beta_1 (R_t^{BMK} - RF_t) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \epsilon_t$$

- The α has the same interpretation as on the previous slide
- Each β measures how much your portfolio moves with each benchmark

Use 10 years of monthly data for reasonably accurate results