Empirical Asset Pricing:
Nobel Prizes in Financial Economics

Jiangyuan LI
SHUFE SOF

2024

Brief introduction of the class

- Class name: Asset Pricing.

- Is this a class to teach you how to make money?

- No.

- Could you make money without a good understanding of the knowledge in the class?

- Maybe yes (unfortunately).

- Could you make money based on the knowledge in the class?

- Yes.

Why is it the case?

- Financial market, if not the most complicated, should be one of the most complicated systems in human society.

- Even a 51-hours course would only present two or three sketches of the whole picture.

- One should accumulate thousands of hours of studies to become a qualified professional investor, and tens of thousands of hours to become a successful one.

- Picture from *Paul Goldsmith-Pinkham*

How to draw an owl

1.

2.

1. Draw some circles   2. Draw the rest of the fucking owl

Your own passion

- Data, plots, statistics and those fancy words from the finance world may sound exciting to someone. However, it could be boring to someone else.

- I took the Investment 101 class at the age of around 20-21 years old in SHUFE. Like most of the students after NCEE (Gao Kao). I have no idea what to do, what excites me, or what could make me feel meaningful. The class does be like an eye-opener for me.

- I have never expected that most of my career path after graduation and in a foreseeable future would be relevant to "Investment 101".

- I have undergraduate classmates who are with a financial background but have made great achievements as cuisine bloggers, professional models, screenwriters and snowboard players. You are still at the age to explore the possibility of your life, of course, becoming a financial professional is one of the excellent possibilities.

Your own passion

- Please use the information in the class to decide if you would like to become a financial professional. I do hope the class would be beneficial to you not only in the perspective of knowledge but also in your career path.

- It would be very pathetic that after 10 years of graduation, one still doesn't know what you can do (lower bar), or luckily enough, what you feel passionate (upper bar).

- If you just feel excited about the fancy office building, events and lifestyle, don't be shame about it. Be honest to yourself.

- If you do feel something passionate, be brave to take the leap of faith. However, please do respect the rules.

- It's just a 16-week class, you are free to go anywhere after 16 weeks.

Finance as a subject

- I will deliver the course from the perspective of a finance professor instead of a financial professional. The reason is that I am not a financial professional.

- Finance as a subject is relatively young. Some of the big names you will hear in the class are still alive or just passed away several years ago.

- Now you are going to hear some of the names, and their contribution to the knowledge of human beings.

Markowitz (1952): Mean-variance investor

- Modern finance as a scientific subject should be dated from Markowitz (1952).

- The milestone achievement of mean-variance optimal investor is nowadays a common sense concept for most of us.

- The achievement was made by a 25-year-old PhD student Markowitz's (1952) PhD, which has been awarded by Nobel Prize for the "pioneering work in the theory of financial economics".

- We will cover the details of MV investor's detail in the next class.

- Pitcure from *Nobelprize.org*

(1927.08.24-pressent)

Markowitz (1952)

- "The motivation behind my dissertation was to apply mathematics to the stock market." - Harry Markowitz

- "This is not a dissertation in economics, we can not give you a PhD in economics for this." - Milton Friedman

Photo credit: Courtesy of Baruch College, the City University of New York.

Markowitz (1952)

- Markowitz presents us with an elegant world. In this world, an optimal investor only cares about two key features of an investment.

- Return and Risk (both in expected sense, because they are random variables in nature).

- When one rational investor would like to achieve a high expected return, it is inevitable to increase her expected risk at the same time (this is not accurate, but safe for now.)

- Here comes the trade-off (aha trade-off again). The optimal investor needs to decide how much risk she would like to take.

- Sometimes one unit of marginal risk can not deliver her a desirable amount of return (concavity).

Analytical level: 3 step methods

- Conceptual level: A rational investor needs to decide the optimal risk level to keep a balance of the risk-return trade-off.

- Applicable level:
    - measurement of return: $r_{t+1} = \frac{P_{t+1} + D_{t+1}}{P_t} - 1$.

    - measurement of risk: $Var(r_t)$.

    - Trade-off: $\max_{w_t} \mathbb{E}(r_{t+1}) - \frac{1}{2}\gamma\, Var(r_{t+1})$, where γ is the risk-averse coefficient, w_t is the weight in risky asset and r_t is the portfolio return that is dependent on w_t.

- Statistical level:
    - $\hat{r}_{t+1} = \bar{r}_t = \frac{1}{T}\sum_{t=1}^{T} r_t$.

    - $\widehat{Var}(r_{t+1}) = \frac{1}{T-1}\sum_{t=1}^{T}(r_t - \bar{r}_t)^2$

Tobin (1958): two funds separation

- Right after the publication of Markowitz (1952) in the Journal of Finance, there were only a few citations in the literature. Tobin (1958) was the one who cited.

- Tobin's luckier than Markowitz because he got the Nobel Prize in 1981.

- In Tobin's work, he gives us an elegant result, which nowadays we name as two-fund separation

- A mean-variance investor in Markowitz (1952) should only hold two funds, one risky and one risk-free.

(1918.03.05 - 2002.03.11)

Tobin (1958)

- Instead of using different combinations of risky assets, MV investors should hold the same risky portfolio.

- If they have different risk attitudes represented by different γ, they should only adjust the weight between risk-free assets and risky assets.

- The result is not regulated by force. It is because, if an investor deviates from the rule, she would be worse off.

- Of course, in reality, we do hold different risky assets instead of the same one, but the reality does not jeopardize Tobin's contribution. Tobin (1958) illuminates what features in reality cause us to choose different risky assets.

- Nowadays, the prediction of Tobin (1958) becomes increasingly true, after the introduction of ETFs by John McQuown in Wells Fargo.

Sharpe (1964): CAPM

- If there is a superpower that only allows one theory exists in financial economics, it would be CAPM.

- In Markowitz, the optimal MV investor calculates the return and risk to achieve a partial equilibrium.

- Sharpe (1964) argues, that given all of the investors behave according to Markowitz (1958), what will happen in the whole economy?

- It will end up with a general equilibrium, where some investor borrows, some others lend, and the net amount of total borrowings and lendings cancel out.
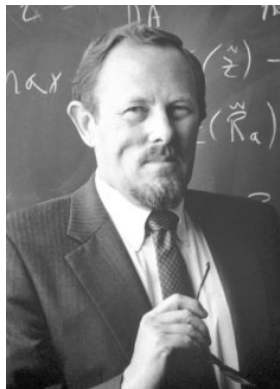
(1934.06.16 - Present)

Sharpe (1964)

- How much an investor holds a market portfolio is dependent on his risk attitude. Collectively, All investors hold all the assets.

- Here, we could conclude one major function of financial market: risk allocation.

- In the equilibrium, the risky asset in Tobin (1958) becomes the the Market Portfolio.

- In Markowitz (1952), the weight of a stock in a portfolio should be decided by the correlation between all other existing stocks.

- In Sharpe (1964), all the existing stocks boil down to a single most important factor, market portfolio. One doesn't need to keep track of the correlations with all existing stocks, the only thing matters is $\beta_i = cov(R_i, R_m) / var(R_m)$.

Sharpe (1964)

- CAPM delivers a further understanding of financial risk. The risk in an individual stock is not defined by its variance.
  (Do you still keep the accuracy statement in mind in the previous several slides?)

- Imagine two stocks have the same variance. One commoves with the market portfolio greatly, the other slightly, which one is riskier?

- The first one.

- The reason is that one can diversify the risk uncorrelated with the market portfolio, but can not diversify the risk associated with the market portfolio.

Sharpe (1964)

- Here comes the important concept that we name the risk in the market portfolio: systematic risk.

- Under the equilibrium analysis, we could highlight the systematic risk in a beautiful manner:

$$E(R_i) - r_f = \beta_i(E(R_m) - r_f).$$

- You hold the stock to get paid only for the systematic risk you are bearing. If a stock only contains idiosyncratic risk, the expected return should be r_f.

- A rational investor would diversify this stock's risk right away.

Ross (1976): Arbitrage Pricing Theory

- Stephen Ross was born as a Boston boy who felt eager to sunshine and beach in California. He did follow his heart to choose his starting point from CalTech like our friend Sheldon Cooper.


(1944.02.03 - 2017.03.03)

Ross (1976)

- Ross comes up with a brilliant idea to achieve the result of CAPM without using the assumption of CAPM.

- The contribution relieves the application of factor modelling with any numbers.

- Fama French 3 factor.
  Charhart momentum factor.
  Hou Xue and Zhang Investment Factor.
  Stambaugh and Yuan Mispricing Factor.
  Fama French 5 Factor.
  Fama French 6 Factor.
  … and… 400 plus anomalies you name it.

- Unfortunately, Ross didn't get a Nobel Prize before he left.

- Let's leave the details of the APT model in the following class.

Fama (1970): Efficient Market Hypothesis

- Eugene Fama was born in Boston (again) and received his MBA and PhD degree from Chicago University.

- After graduation, he spends his entire professional career in Chicago from a junior professor to a God of Finance Academia. He is still active in research work right now.
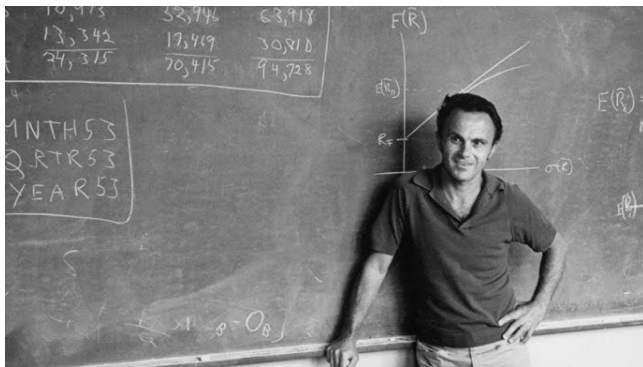
Fama (1970)

- In one of his milestone research works, Efficient Capital Markets: A Review of Theory (1970), he summarizes the previous financial economics research and concludes the research work on a systematic level.

- Nowadays, the industry and academy both agree the work is the major starting point of modern financial economics research and name it Efficient Market Hypothesis.

- It is just one of his research contributions among Fama-French 3, 5, 6 factors, Fama-MacBeth regression, Fama-Bliss test, Fama-French fund manager test, you name it.

- Fama shares the Nobel Prize in 2013 with Robert Shiller (Behavior Finance) and Peter Hansen (GMM).

(1939.02.14 - Present)

Fama (1970)

- Given this is a hypothesis, it could be valid or not. However, the value of EMH is not from whether it is valid or not.

- Three forms of EMH:
    - Weak form: Past information. You can't predict the market by the candle chart.

    - Semi-strong: Public information and weak form. You can't predict the market by the GDP growth rate and unemployment rate.

    - Strong: Privation information and semi-strong form. You can't predict the market even if you are the son of Jack MA.

- We will carefully discuss three different forms of EMH in the later class.

- The analysis of EMH reveals one of the major functions of the financial market - information intermediation.

Black and Scholes (1973): Option pricing

(Fischer Black, 1938.01.11 - 1995.08.30)

- Black and Scholes started their landmark work of option pricing in the 1970s at MIT.

- After several successful academic achievements, Black also started his practice at Goldman Sachs in the 1980s.

- As the Black-Litterman model for asset allocation and Black–Derman–Toy interest rate derivatives model. Both models have been published afterwards but created as an application in-house for Goldman Sachs.

- Black passed away in 1995 due to his terrible throat cancer.

Black, Scholes (1973)

- Myron Scholes has a very successful academic career, but a terrible industry record.

- His partnership in Long-Term Capital Management ends up with a liquidation.

- We have to admit that the LTCM failed in a very successful way.

- In current business education, the case of LTCM becomes a must-learn case of tail risk for every batch of future professionals.

- If you want to learn every detail, the book Why genius fail? (a much more interesting book than your Qidian).

(1941.07.01 - Present)

Black, Scholes and Merton (1976)

- Robert C. Merton is the one who was born with a sliver spoon.

- His father Robert K. Merton is the father of modern sociology and criminology.

- Scholes and Merton are lucky enough to get the Nobel Prize in 1997 when Black passed away after around two years.

- The Nobel Prize committee doesn't have the tradition to award posthumously. However, in the statement of 1997, they give Black full credit for his contribution to modern financial economics.

(1944.07.31 - Present)

Black, Scholes and Merton (1976)

- Markowitz (1952) illuminates us that there is a risk-return trade-off.

- Sharpe (1964) shows that not all the risks matter, just the systematic risk should be compensated.

- BSM gives us a method to only get a part of the distribution of an asset.

- We will show how sensitive the option and other derivatives could be to tail risks in the latter class.

Shiller (Behavioral Finance) and Hansen (GMM)

(1946.03.29 - Present)

(1952.10.26 - Present)

Shiller (Behavioral Finance)

- Shiller was born in Detroit, Michigan and earned his PhD degree at MIT under the supervision of Modigliani. The PhD thesis was titled "Rational expectations and the structure of interest rates".

- Shiller published his landmark work in 1981 and challenged the dominant view of EMH at that time.

- He argued if we assume the present value of the equity is the discounted future cash flow, no matter how to calculate the present value of the dividend, the volatility of the dividend can't justify the volatility of stock return.

- The additional volatility could only come from one source animal spirits.

Hansen (GMM)

- Las Peter Hansen is more of a statistician than an economist.

- He put forward an estimation method to ask how much the equity premium should be.

- Now we name the method as GMM.

- It's very hard to explain by intuition, but let me try.

Shiller (Behavioral Finance) and Hansen (GMM)

- Let's just stop here for now. I wouldn't like to overwhelm any one of you.

- I know stories, gossips and jokes are much more interesting than data, plots, and models for most of the students.

- However, as a serious financial economic class, you can't just get full of those.

- That's how life works, there are some parts easy and interesting, some parts hard and never interesting.

- However, there also exist some parts with enough training and hard work that you will feel interested and achievement.

Conclusion

- Let's conclude here.

- Take a break and hold on. We are going to the training part.