

Japanese Stock Market Indices

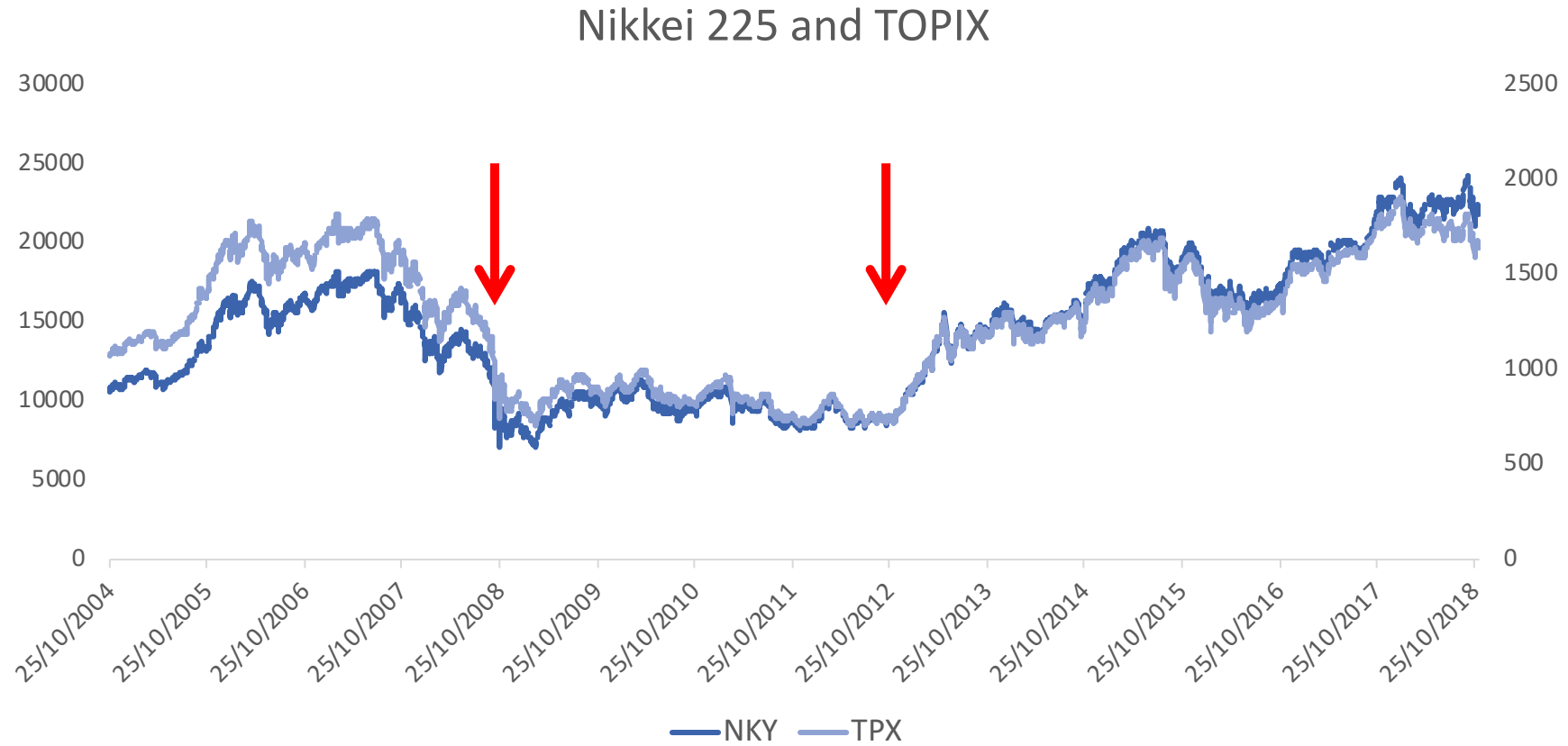
Nikkei 225, TOPIX, and Financial Fragility

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Introduction



Strictly for educational purposes. Do not use to make investment decisions.

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Introduction

- Part I: Review
- Part II: Nikkei 225
- Part III: Tokyo Stock Price Index (TOPIX)
- Part IV: Nick Leeson and Barings Bank (January 1995)
- Part V: Index Volatility Trading and Correlation Trading
- Part VI: BOJ

Part I: Review (Open-End Funds and Closed-End Funds)

- Open-end funds: a type of mutual fund
- Can issue and redeem shares at any time
- No shares limit
- Not traded on open market
- Funds reprice based on the number of shares bought and sold
- Price based on NAV

Part I: Review (Open-End Funds and Closed-End Funds)

- Closed-End Funds \approx ETFs
- Launched through IPO
- Limited shares
- Trade on open market
- Price affected by supply and demand, allowing to trade at prices below or above its real value

Part I: Review (Exchange-Traded Fund)

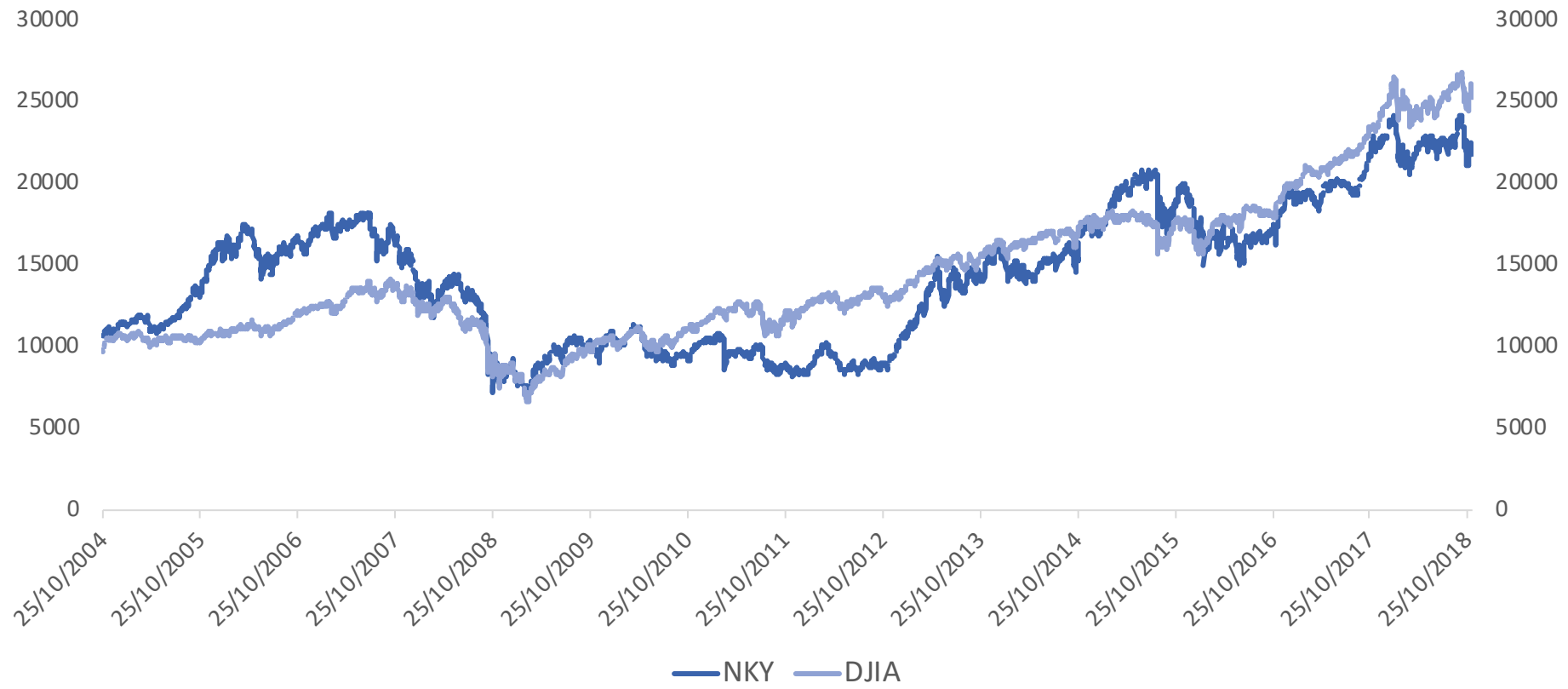
- Combination of open-end funds and closed-end funds
- Mutual fund can be traded on an exchange (like a stock)
- Oldest and largest ETF – SPDR S&P 500
- Owns underlying asset and divides ownership of assets into shares
- Based off index that tracks stocks, commodities, bonds, or a basket of assets
- Subject to Investment Company Act of 1940

Part I: Review

- The Japanese economy today
 - Third largest in the world by nominal GDP
 - -0.1% short term interest rate and 0% 10-years Japanese government bond
- Tokyo Stock Exchange (TSE) is the 4th largest stock exchange globally
 - First Section
 - Second Section
 - Mothers = Market of the High-Growth and Emerging Stocks

Part II: Nikkei 225

Price-Weighted Indices



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Part II: Nikkei 225 – Introduction

- Price-weighted index (similar to Dow Jones Industrial Average)
- Yen-denominated
- 225 stocks listed on the Tokyo Stock Exchange First Section
- 6 Sectors: Technology, Financials, Consumer Goods, Materials, Capital Goods/Others, and Transportation and Utilities

Part II: Nikkei 225 – Change in Constituents

- Add or delete by “liquidity in the market” and “sector balance”
- Liquidity: “trading value” and “magnitude of price fluctuation by volume” = $(High\ price/Low\ price) / Volume$
- Top 450 stocks in terms of the liquidity are selected to form the “high liquidity group”
- Non-constituent stocks which are in the top 75 of the high liquidity group are added
- Among the 450 stocks, half number of those that belong to a sector is designated as the “Appropriate number of stocks” for such a sector

Part II: Nikkei 225 – Calculation

- Calculated every 15 seconds during the Tokyo Stock Exchange's trading hours

- $$\text{Adjusted Stock Price} = \frac{\text{Stock Price} \times \text{¥}50}{\text{Presumed Par Value (¥)}}$$

- $$\text{Nikkei Stock Average} = \sum \frac{\text{Adjusted Stock Price}}{\text{Divisor}}$$

Part II: Nikkei 225 – Example

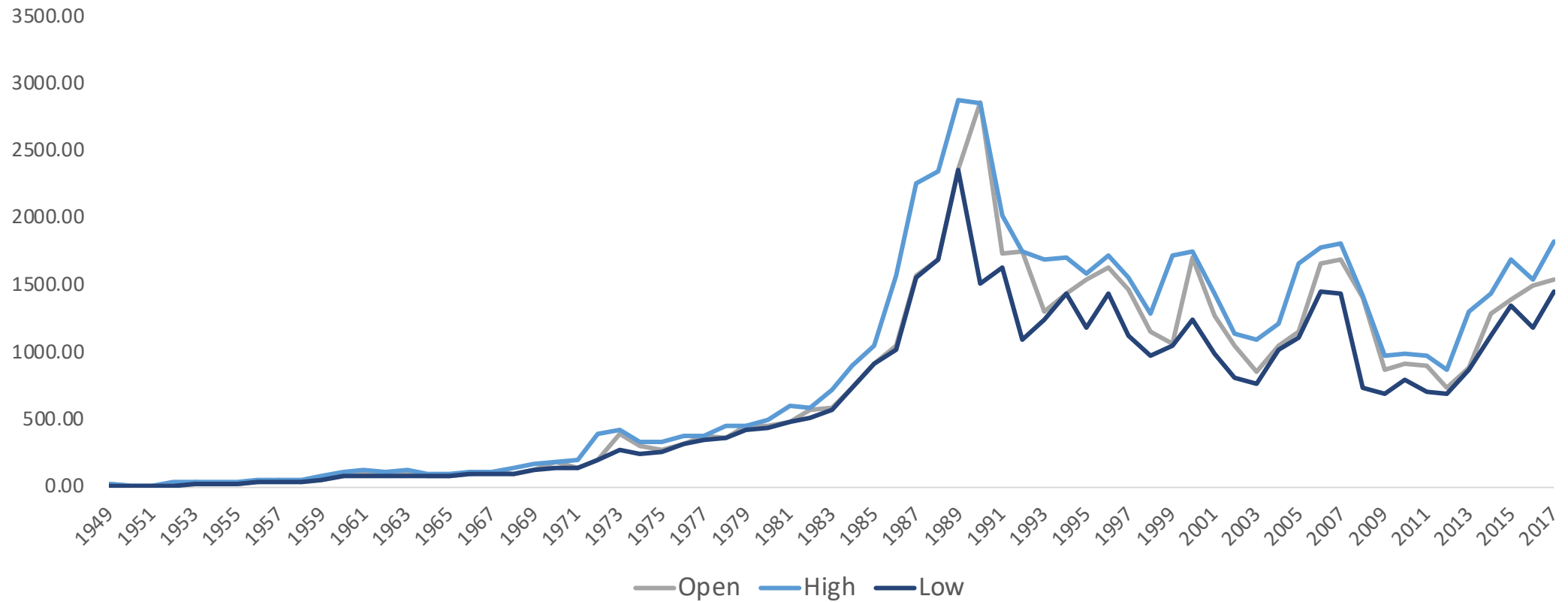
- Three stocks, A, B, and C, the presumed par value of them are ¥50
- Prices are A= ¥400, B= ¥500, and C= ¥900, divisor is 3
- Index = $(400+500+900)*50/50/3 = 600$
- If A is deleted and D (stock price ¥1000, presumed par value ¥50) is added
- $Adjusted\ Stock\ Price = \frac{Stock\ Price \times ¥50}{Presumed\ Par\ Value\ (¥)}$
- $Nikkei\ Stock\ Average = \sum \frac{Adjusted\ Stock\ Price}{Divisor}$
- New aggregate price of B, C, and D is $500 + 900 + 1000 = ¥ 2400$
- New divisor = $2400/600 = 4$

Part III: TOPIX

- Free-float adjusted market capitalization weighted index
- All 2113 listed companies from the TSE 1st Section
- Top 10: Toyota, MUFG, SoftBank, Nippon Telegraph and Telephone Corporation, SONY, Sumimoto Mitsui, Honda, Keyence, Nintendo, Mizuho
- Assumes market capitalization on the base date (4 January 1968) is 100 points

Part III: TOPIX

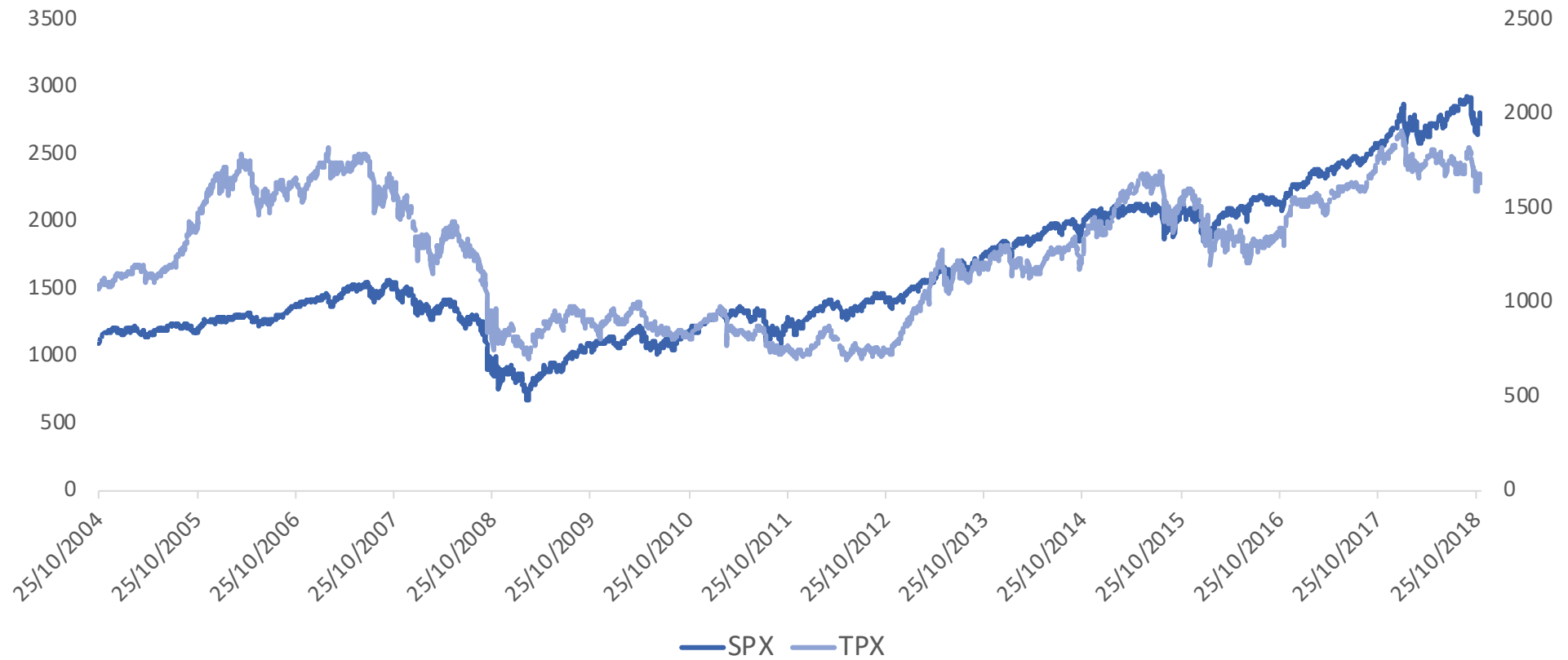
TOPIX (annual data from TSE)



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Part III: TOPIX

Free-Float Adjusted Market Cap Indices



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Part III: TOPIX

- Calculated to the nearest hundredth
- $$\text{Index} = \frac{\text{Current Market Value}}{\text{Base Market Value}} \times \text{Base Point}$$
- $$\text{Current Market Value} = \sum_{\text{Companies}} \text{Shares} \times \text{Price}$$
- $$\text{Shares} = \text{Total Number of Listed Shares} \times \text{FFW Ratio}$$
- If a newly listed company's market cap exceeds 1% of total adjusted market value of TOPIX, company is included in the index in phases

Part III: TOPIX

- Example of an adjustment

1. Old base market value is ¥20trn and previous day's market value is ¥400trn, TOPIX is 2,000.00
2. Stock A listed shares increase by 100m. If previous day close was at ¥2,000, the adjustment amount is 100m shares x ¥2,000 = ¥200bn.
3. Base mkt val is $¥20\text{trn} \times (\text{¥}400\text{trn} + \text{¥}200\text{bn}) / \text{¥}400\text{trn} = \text{¥}20.01\text{trn}$
4. $(\text{¥}400\text{trn} + \text{¥}200\text{bn}) / \text{¥}20.01\text{trn} = 2,000.00$ (same as before)

Part IV: Nick Leeson and Barings Bank

- British derivatives trader in the Singapore branch of Barings Bank (oldest merchant bank in England, founded in 1762)
- Success in speculative trading
- Used secret trading account 88888
- Strategies:
 - Arbitrage baskets of stocks in the Japanese cash market against Nikkei futures
 - Arbitrage contracts on Nikkei futures between OSE and SIMEX
- Led directly to the collapse of Barings Bank, \$1.4 billion losses

Part V: Index Volatility and Correlation

- As mentioned in David's presentation, people trade options to bet on volatility
 - If you think real < implied, bet premium on option is expensive and short gamma, long theta; long otherwise
- We can be more specific using a BSM framework

Part V: Index Volatility and Correlation

- Suppose we can continuously delta-hedge

- Static portfolio at t is $C - \Delta S_t$

- $(C(S_{t+1}) - \Delta S_{t+1}) - (C(S_t) - \Delta S_t) + r(C - \Delta S_t)$
 $= C(S_{t+1}) - C(S_t) - \Delta(S_{t+1} - S_t) + r(C - \Delta S_t)$

- Use a Taylor expansion for the difference $C(S_{t+1}) - C(S_t)$:

$$C(S_{t+1}) - C(S_t) = \Delta(S_{t+1} - S_t) + \frac{\Gamma}{2}(S_{t+1} - S_t)^2$$

- So the change is then $\frac{\Gamma}{2}(S_{t+1} - S_t)^2 + r(C - \Delta S_t) + \theta$

Part V: Index Volatility and Correlation

- Given $\frac{\Gamma}{2} (S_{t+1} - S_t)^2 + r(C - \Delta S_t) + \theta$, express in terms of vol
 - Use identity $(S_{t+1} - S_t)^2 \cong \sigma^2 S_t^2$
- PnL is $\frac{1}{2} \sigma^2 S_t^2 \Gamma + r(C - \Delta S_t) + \theta = 0$ (no arb)
- So PnL is proportional to $\frac{1}{2} S_t^2 \Gamma (\sigma_{real}^2 - \sigma_{implied}^2)$

Part V: Index Volatility and Correlation

- Volatility of an index tends to trade richer than its constituents' vol due to supply/demand
- But due to correlation, index vol realizes lower
- Dispersion trading: going short index implied vol and long single stock implied vol
- Compare with index arbitrage – here we are using options

Part V: Index Volatility and Correlation

- [Show derivation of dispersion trading formulae on board]

Part V: Index Volatility and Correlation

- [Show PCA model]

Part VI: BOJ

- The Bank of Japan's monetary policy includes more familiar things such as YCC but also *asset purchases*
- Top 10 shareholder in nearly 40% of listed companies, including 4% of first section
- Annually purchases ¥6trn of ETFs and ¥90bn of J-REITs
- In July, the BOJ announced that on 6 Aug 2018 they would change the amount of each ETF to be purchased
 - TOPIX purchases to increase annually from ¥2.7trn to ¥4.2trn
 - Nikkei 225 purchases to decrease from ¥3trn to less than ¥1.5trn

Part VI: BOJ

- Process
 1. BOJ places order for an ETF
 2. ETF share is freshly created by an asset manager using a basket
- Consequences
 - Inflated equity prices
 - ETFs can be held indefinitely on the bank's balance sheet
 - BOJ's assets exceed GDP
 - Picking winners and losers?

Sources

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Nikkei 225:

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TOPIX:

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- JPM European Equity Derivatives Strategy. *Correlation Vehicles*. London, 2004.

All other data for graphs and models obtained from Bloomberg Terminal, located on-campus in the Statler Nestle Library