Understanding Exchange Traded Funds

Radha Krishna

October 8, 2023

Capitalization Weighted Indices

- Popular Indices that are cap-weighted :
  - SENSEX, NIFTY, S&P 500, NASDAQ-100, FTSE-100, Hang Seng Index
- Components are weighted according to the total market value of their outstanding shares.

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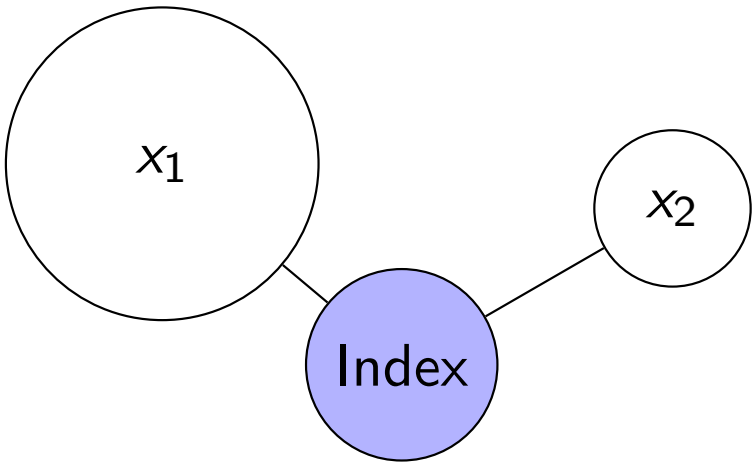
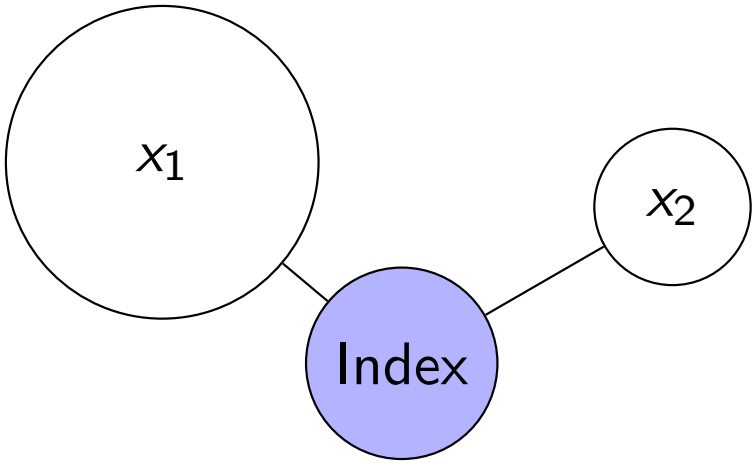


Stock	Price	Shares	Value
x_1	\$100	50,000	\$5M
x_2	\$25	100,000	\$2.5M

- Total Market Value = \$7.5M
- *Divisor* = 7500
- Index @ start = 1000

Corporate Action: Stock Split

2-for-1 split for $x_1 \Rightarrow$ for every 1 share of x_1 , there are 2 shares of x_1



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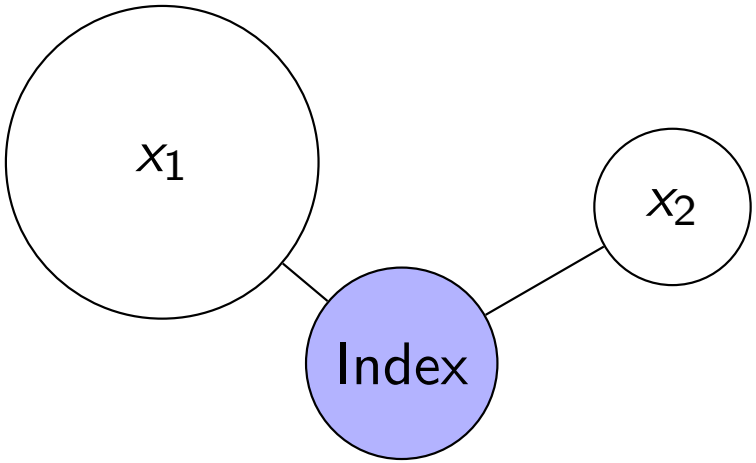

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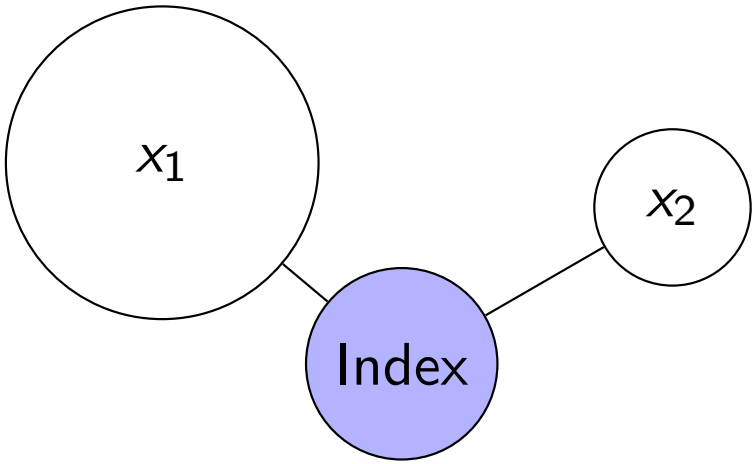
$2 per 1 share of x_1



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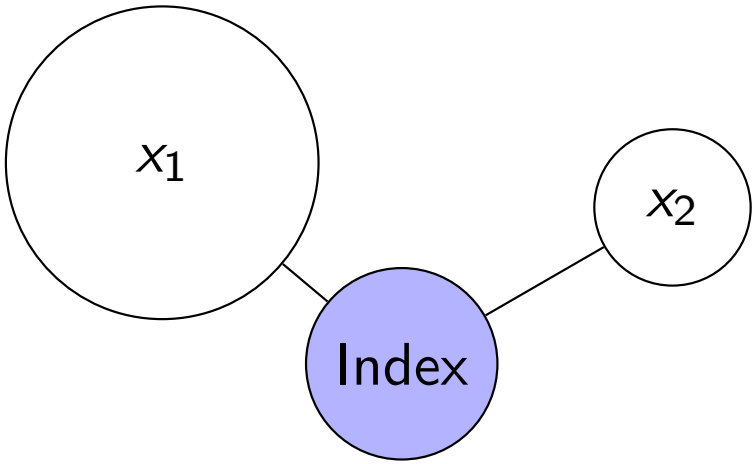

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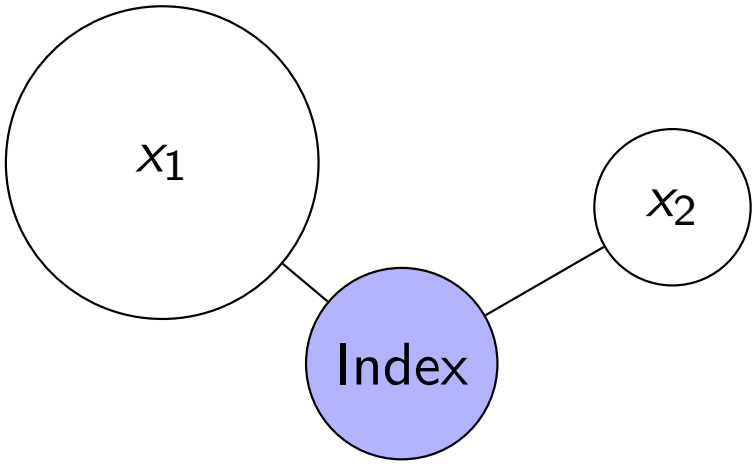
Stock	Price	Shares	Value
x_1	$98	50,000	$4.9M
x_2	$25	100,000	$2.5M

- Total Market Value = $7.4M
- Index = 1000
- *Divisor* = 7400

Index change

x_2 goes out of the index and x_3 enters the index. The new entrant x_3 has share price \$50 and $200,000$ outstanding shares .



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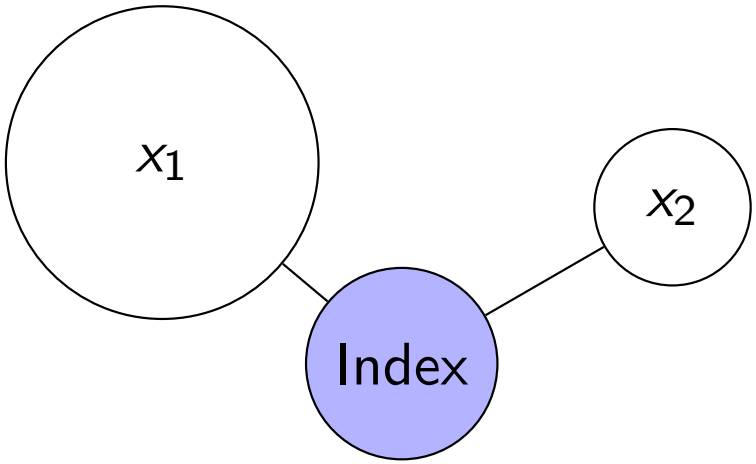

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Stock	Price	Shares	Value
x_1	\$100	50,000	\$5M
x_3	\$50	$200,000$	\$10M

- Total Market Value = \$15M
- Index = 1000
- *New Divisor* = 15000

- Laundry list of Corporate Actions
  - Merger / Demerger/ Amalgamation
  - Change in shares outstanding
  - Stock split
  - Spin-off
  - Change in IWF
  - Ordinary Dividends, Special Dividends
  - Bonus
  - Rights
- There is a demand for someone doing this "behind-the-scenes" work for various indices.
- Index Service & Maintenance provider - IISL (NSE subsidiary set up in 1998).
  - List of corporate actions and their ex-dates, record-dates
  - Index change date
  - Data files reflecting the current and new composition of the index

Collective Investment Vehicles

- *Open-end funds / Mutual funds*
  - Perpetual IPO - Issue and redeem ownership shares through out the life of the fund
  - The *number* of units outstanding is *open-ended*
  - No secondary market trading
  - Assets grow or reduce based on subscriptions and redemptions
  - Assets are valued once a day, at closing prices and NAV is determined
  - "Story factor" is strong

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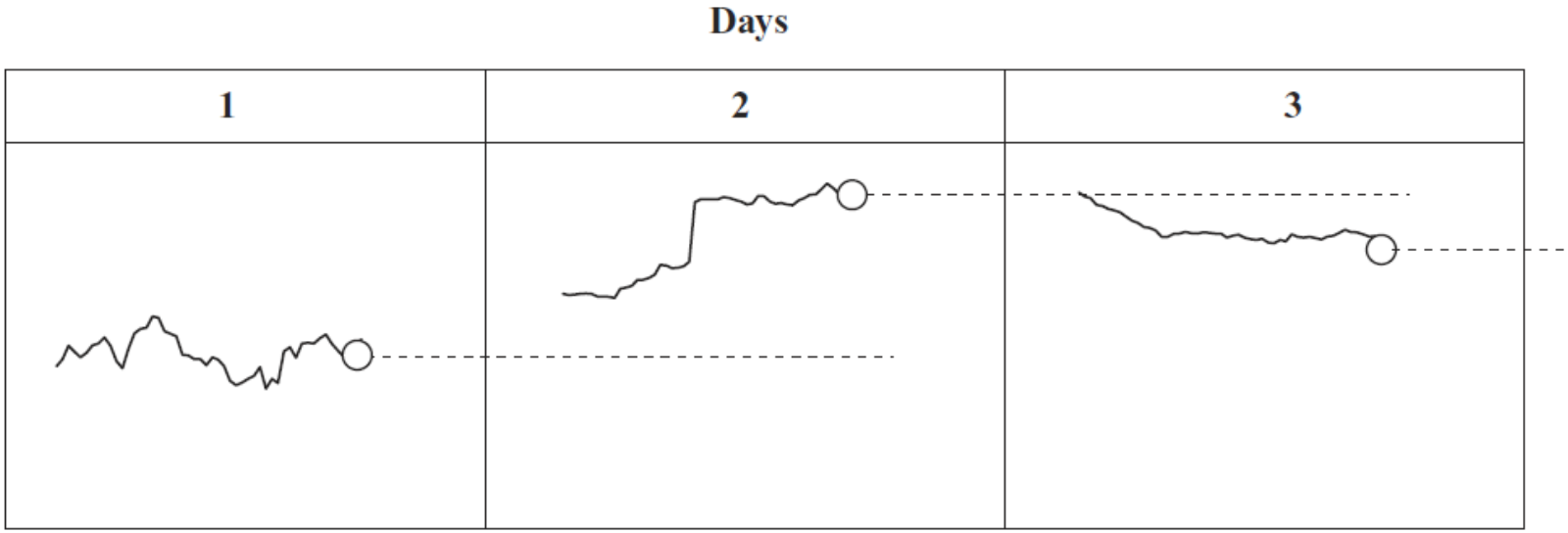
- *Unit Investment Trusts*
- *Exchange-Traded funds*
- *Hedge funds*

Collective Investment Vehicles

What's wrong with the Mutual Fund Structure ?

Mutual Funds - 1.0



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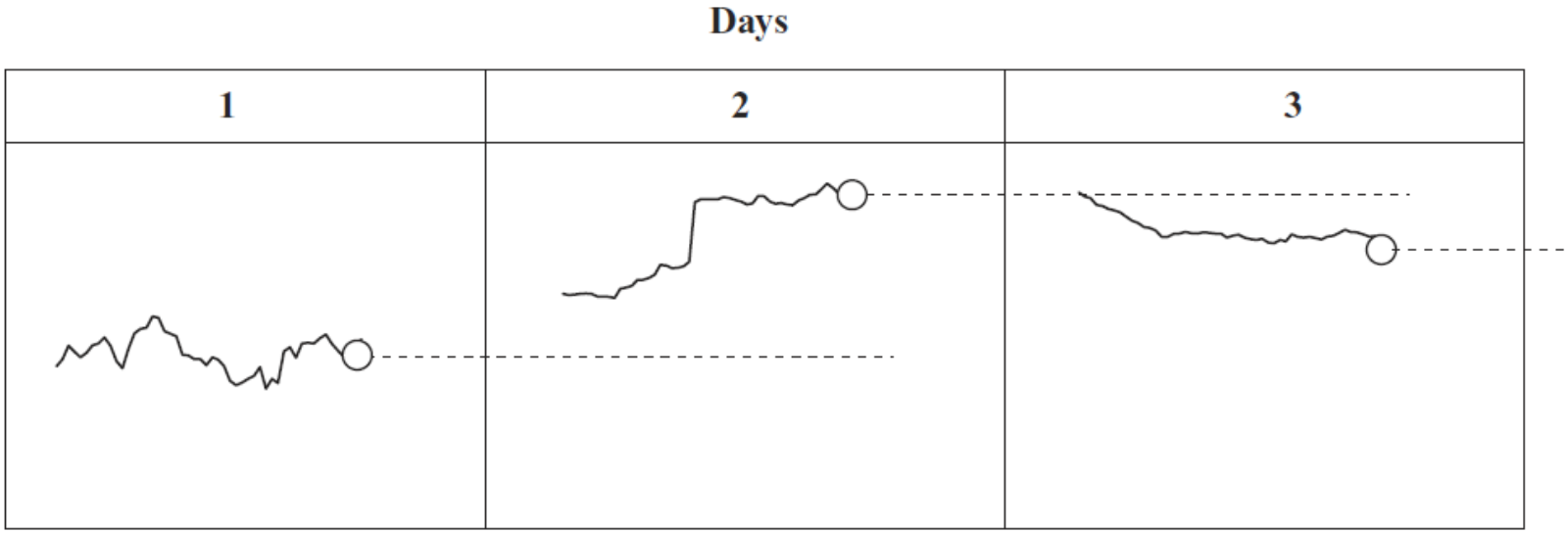

What's the problem here ?

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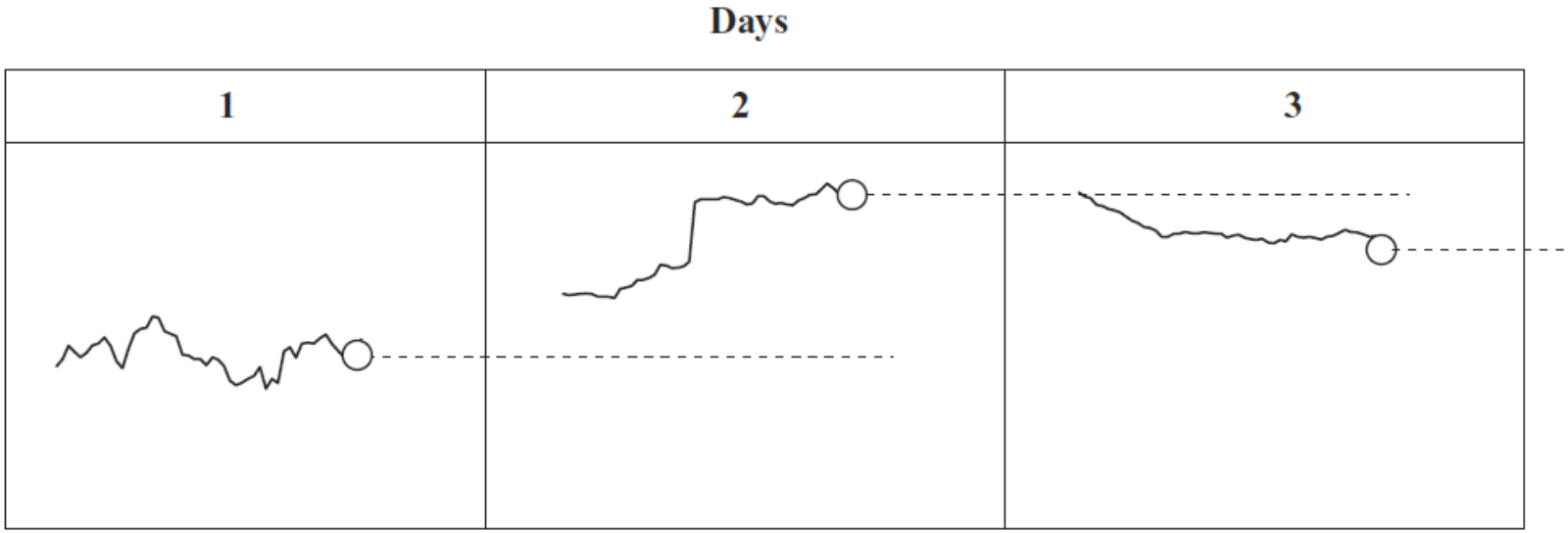
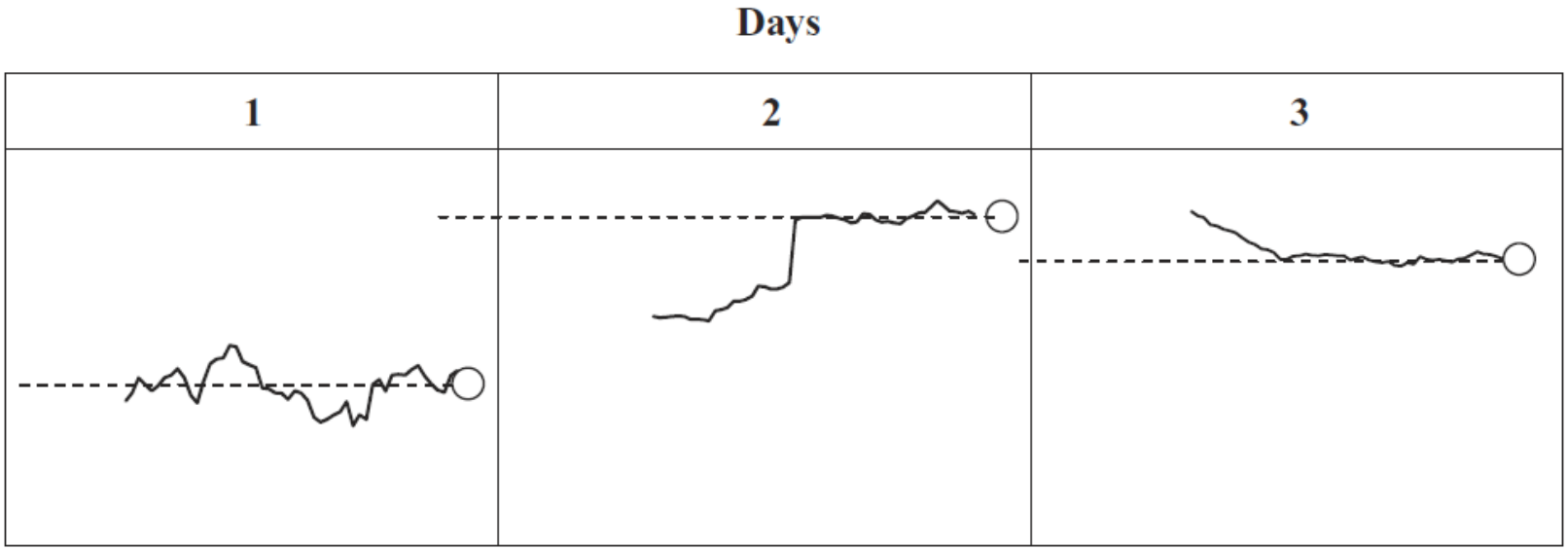


What's the problem here ?

- Buying units at Day 1's NAV on Day 2 as market rose.
- Sell units at Day 2's NAV on Day 3 as market fell.
- Traders loved it. Investors hated it.
- Backward pricing led to abuses by dealers and by traders.

Mutual Funds - 2.0

Fund share transactions priced at the NAV *next determined* by the fund after the order was received.



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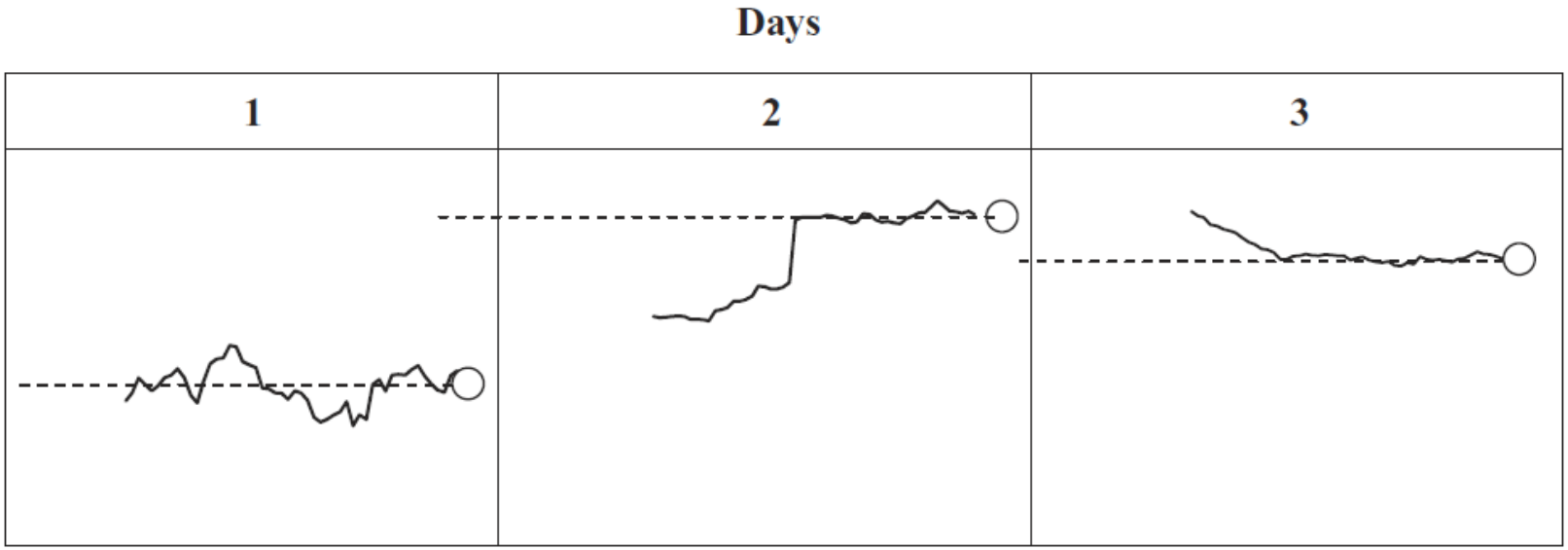

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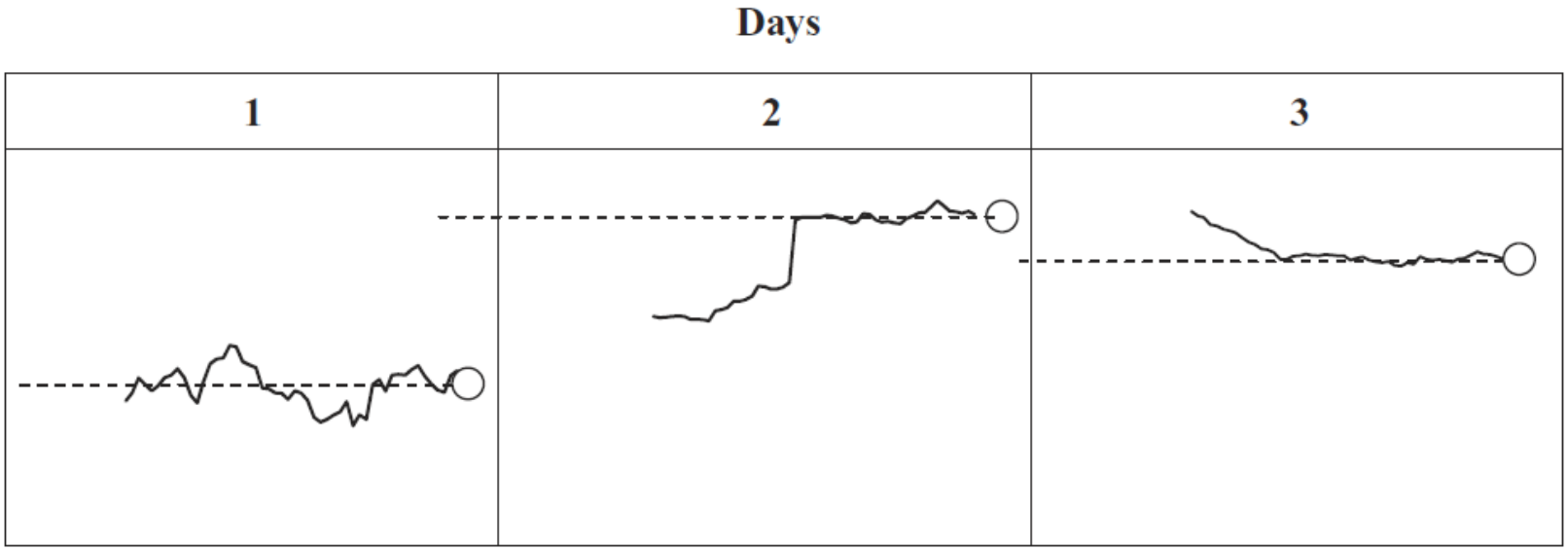

Is it a fair system ?

- *Late trading scandal* : traders are allowed to purchase fund shares after 4:00 p.m. at that day's closing price.
- *Market timing scandals* : Funds alerted "special" customers of large trades.

Mutual Funds - 2.0 : Free Liquidity problem

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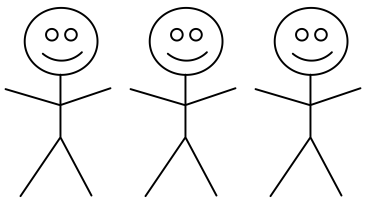
Day 1 : Three investors invest a Million INR each, in a Mutual Fund.



Mutual Fund

Total Assets = 3Million INR

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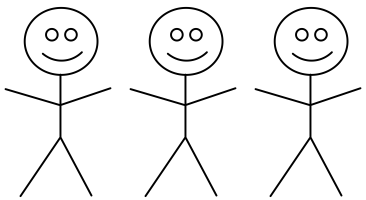

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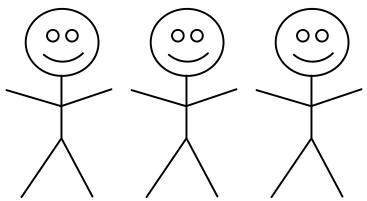

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In an ideal scenario :

- If we assume transaction charges as 20 bps, TC = 1M × 0.2% = 2000
- Redeemed investor should get back 1M - 2000

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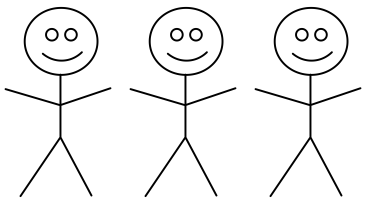

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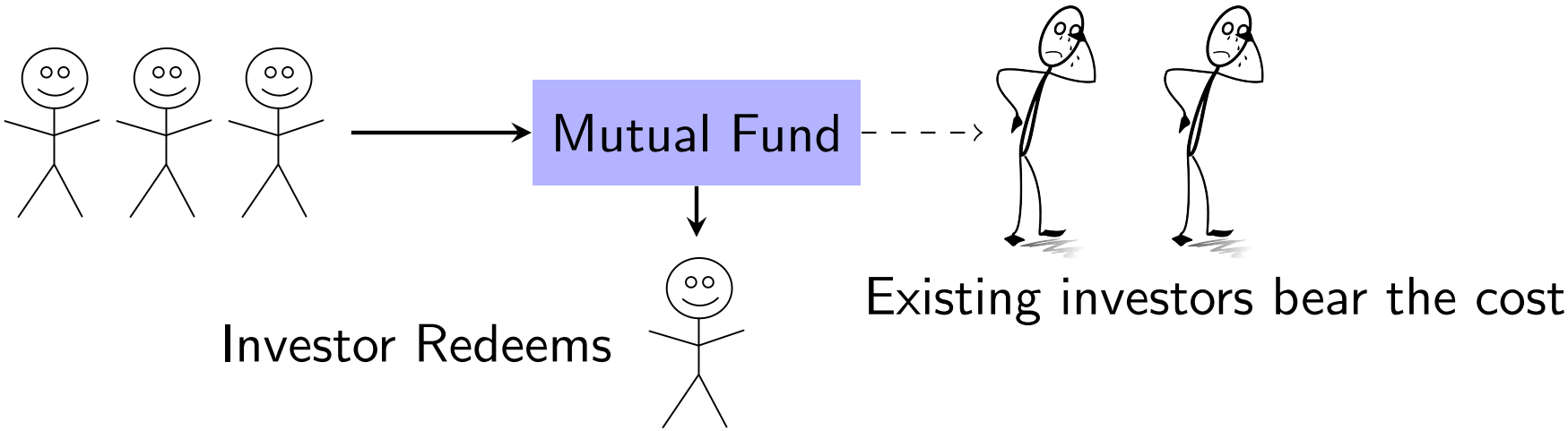
In reality, what is the amount that the investor gets back?

Mutual Funds - 2.0 : Free Liquidity problem



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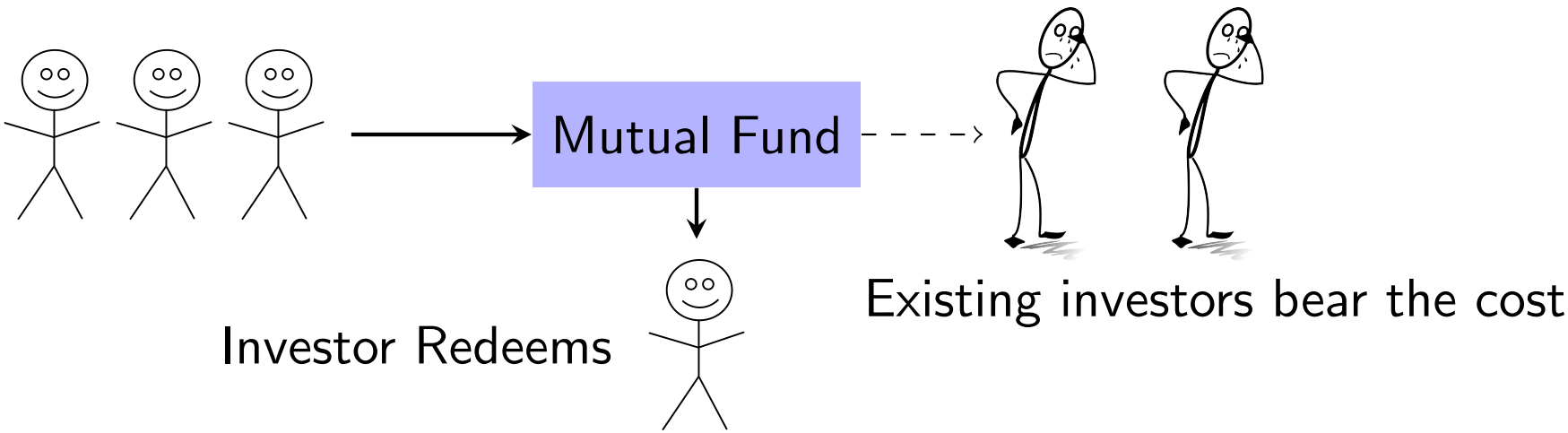


- Redeemed investor gets the units based on end of day NAV
- Fund manager needs to generate money by selling shares. Transaction costs are shared by everyone.
- If we assume transaction charges as 20 bps, TC $= 1M \times 0.2\% = 2000$
- Redeemed investor gets back $\sim$ 1M - (2000/3)
- Over time, these costs create a massive drag on returns

Mutual Funds - 2.0 : Tax efficiency issue

Portfolio run up

Fund manager

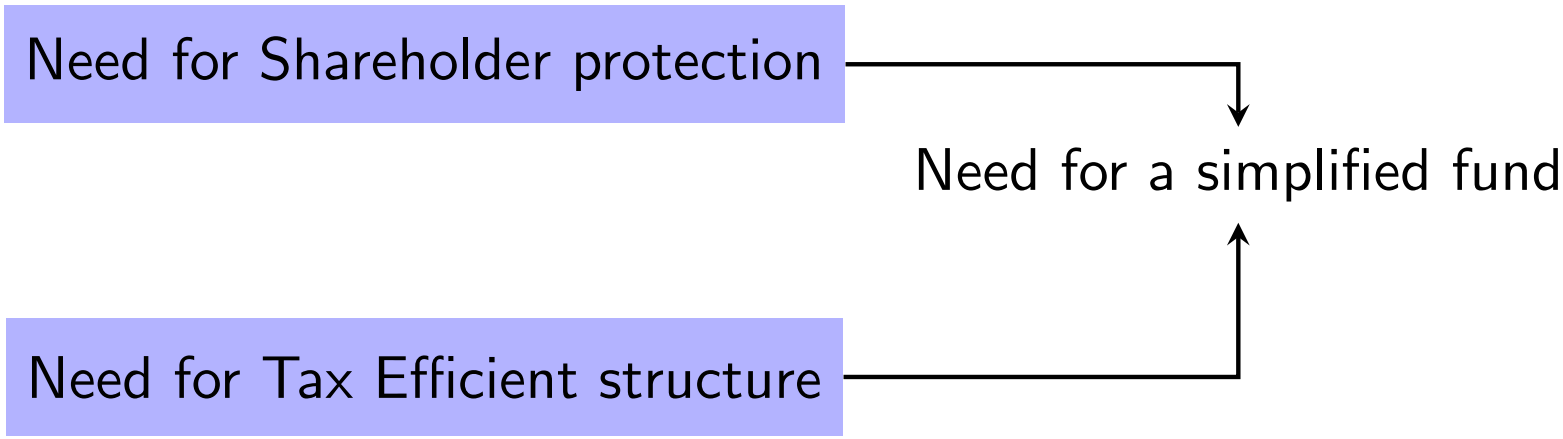
realize gains, distribute taxable gains

hold overvalued securities, avoid realizing capital gains

When the portfolio value goes up, a mutual manager is forced to think about :

- Mix of taxable and tax-exempt shareholders in the fund
- Long term investors who will be forced to pay for tax on capital gains

Why is there a need for a different fund structure ?



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Need for Shareholder protection

Need for Tax Efficient structure

Need for a simplified fund

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Launch of Spiders, 1993

Primary Market - ETFs

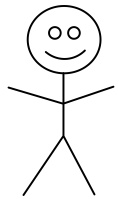
{ Transaction are *in-kind* }

Warehouse of stocks

creation basket

one creation unit

(10,000 ETF shares)



Authorized Participant

creation basket

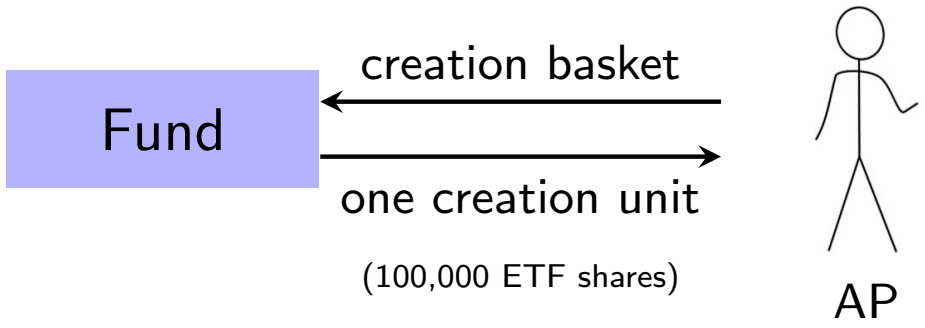
Stock 1 = q_1 shares
Stock 2 = q_2 shares
⋮
Stock 50 = q_{50} shares
Cash component

- *Creation of units* : AP delivers the creation basket and receives the creation unit
- *Redemption of units* : AP gives the creation unit and receives the creation basket

Primary Market - ETFs

- *Authorized Participants* : Large financial institutions and Market makers
- Spiders has about 30 AP's.
- By design, retail investors are out of the primary market.
- ETF values its funds on a real time basis and provides the indicative NAV (*iNAV*) to all its investors.
- What do AP's do with the ETF shares ?
  - Hold ETF shares
  - Sell ETF shares to their client
  - Sell ETF shares to other investors on an exchange
  - AP's typically act as market makers and supply liquidity in the *secondary market* where ETF shares are traded

CREATION



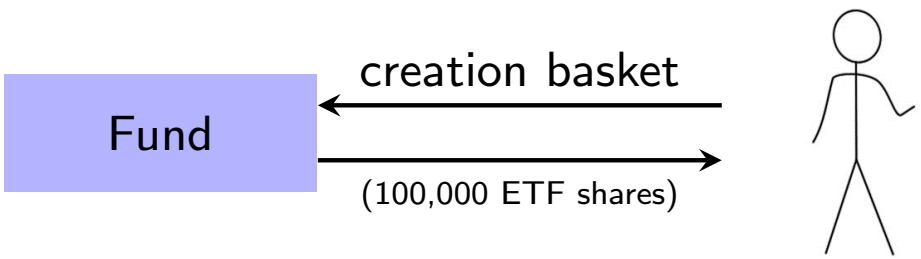
- Imagine you are an AP and you want to buy ETF shares
- Let 1 creation unit = 100000 ETF shares
- Let the transaction cost be 20 bps.

What will be your total cost of buying 1 creation unit ?

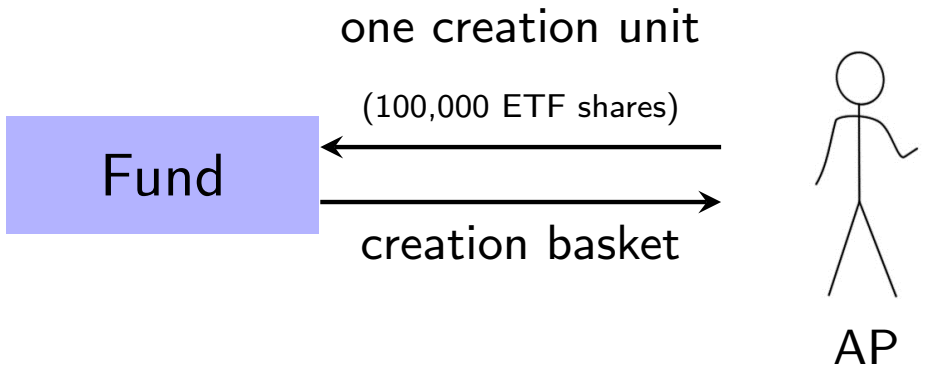
Stock	Quantity
BEL	33
COALINDIA	1686
CONCOR	123
ENGINERSIN	170
GAIL	767
IOC	411
OIL	232
ONGC	1706
PFC	593
RECLTD	560
Cash component	45,325

Stock	Quantity	Price	Value
BEL	33	3582.4	118,219
COALINDIA	1686	364.0	613,704
CONCOR	123	1482.2	182,310
ENGINERSIN	170	213.0	36,210
GAIL	767	402.9	309,024
IOC	411	348.7	143,315
OIL	232	492.7	114,306
ONGC	1706	320.0	545,920
PFC	593	294.9	174,875
RECLTD	560	350.8	196,448
Purchase value			2,434,333
Transaction Cost(+)			4,868
Net Buy value of shares			2,439,202
Cash component			45,325
Total cost			2,484,527

Buy value of 1 ETF share = 24.8452757



REDEMPTION



- Imagine you are an AP and you want to sell ETF shares to the fund
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- Let the transaction cost be 20 bps.

What will be your total cost of selling 1 creation unit ?

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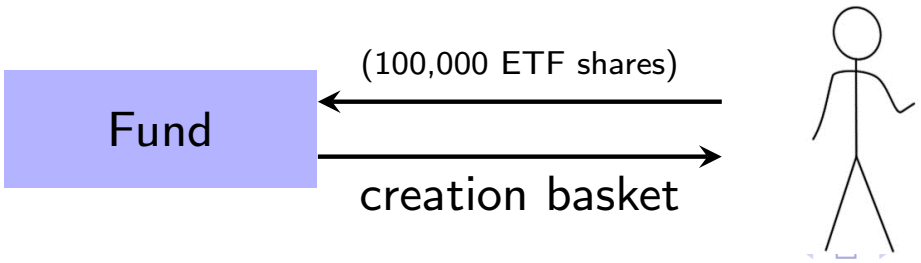
RECLTD	560	350.8	196,448
Sell value			2,434,333
Transaction Cost			-4,868
Net Sell value of shares			2,429,465
Cash component			45,325
Total Value			2,474,790

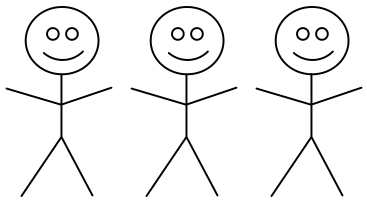
Sell value of 1 ETF share = 24.7479023

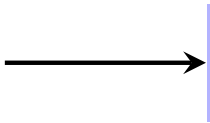


Does Free Liquidity problem exist in ETF ?

What is the problem with Mutual Funds ?

Day 1 : Three investors invest a Million INR each, in a Mutual Fund.





Mutual Fund

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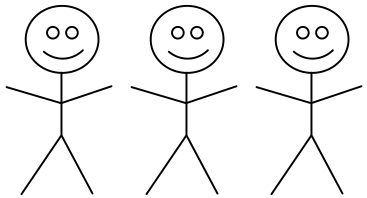
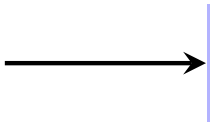
Day 2 : Redemption request for Million INR from an investor





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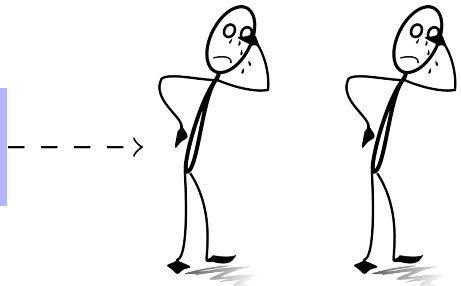
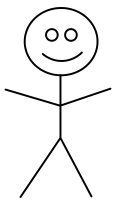


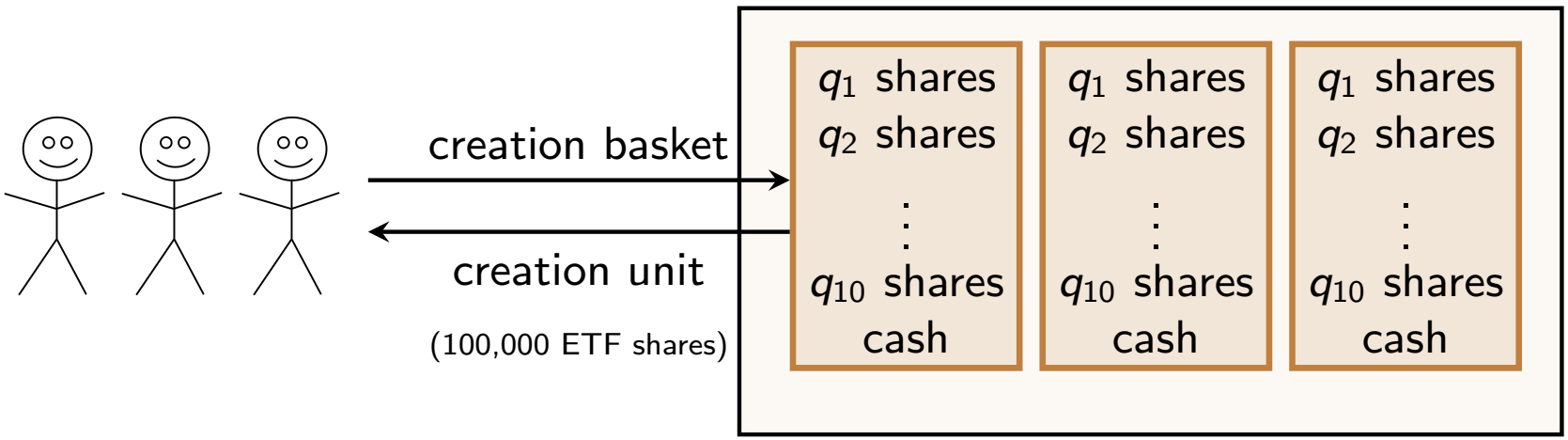


Investor Redeems

Existing investors bear the cost

Assume creation basket value = 2.5M, 1 creation unit = 0.1M ETF shares

Day 1 : Three investors buy one creation unit each.

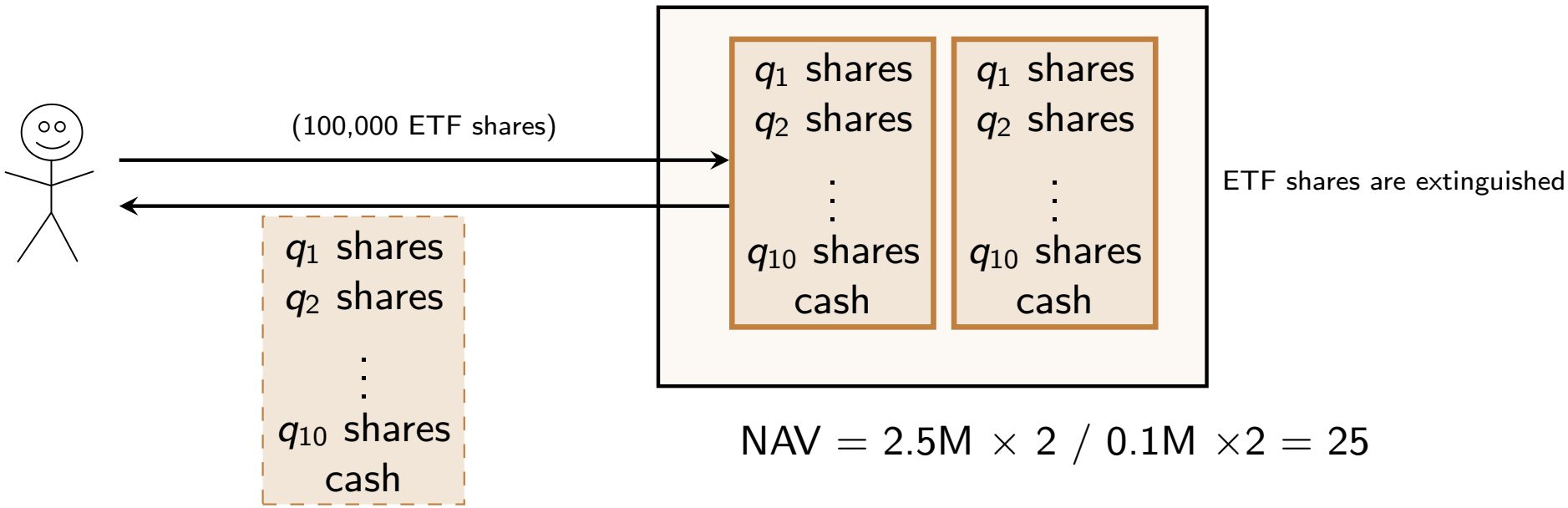


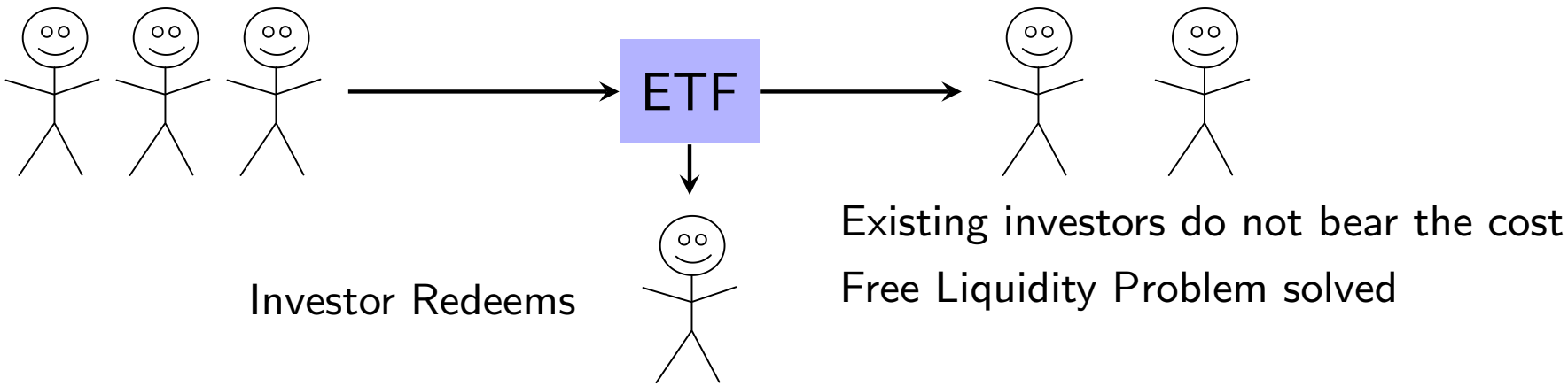
$$\text{Fund Assets} = 2.5M \times 3 = 7.5M$$

$$\text{Total ETF shares} = 0.1M \times 3 = 0.3M$$

$$\text{NAV per share} = \frac{7.5M}{0.3M} = 25$$

Day 2 : One of the three investors, redeems his creation unit





Tax efficiency issue resolved

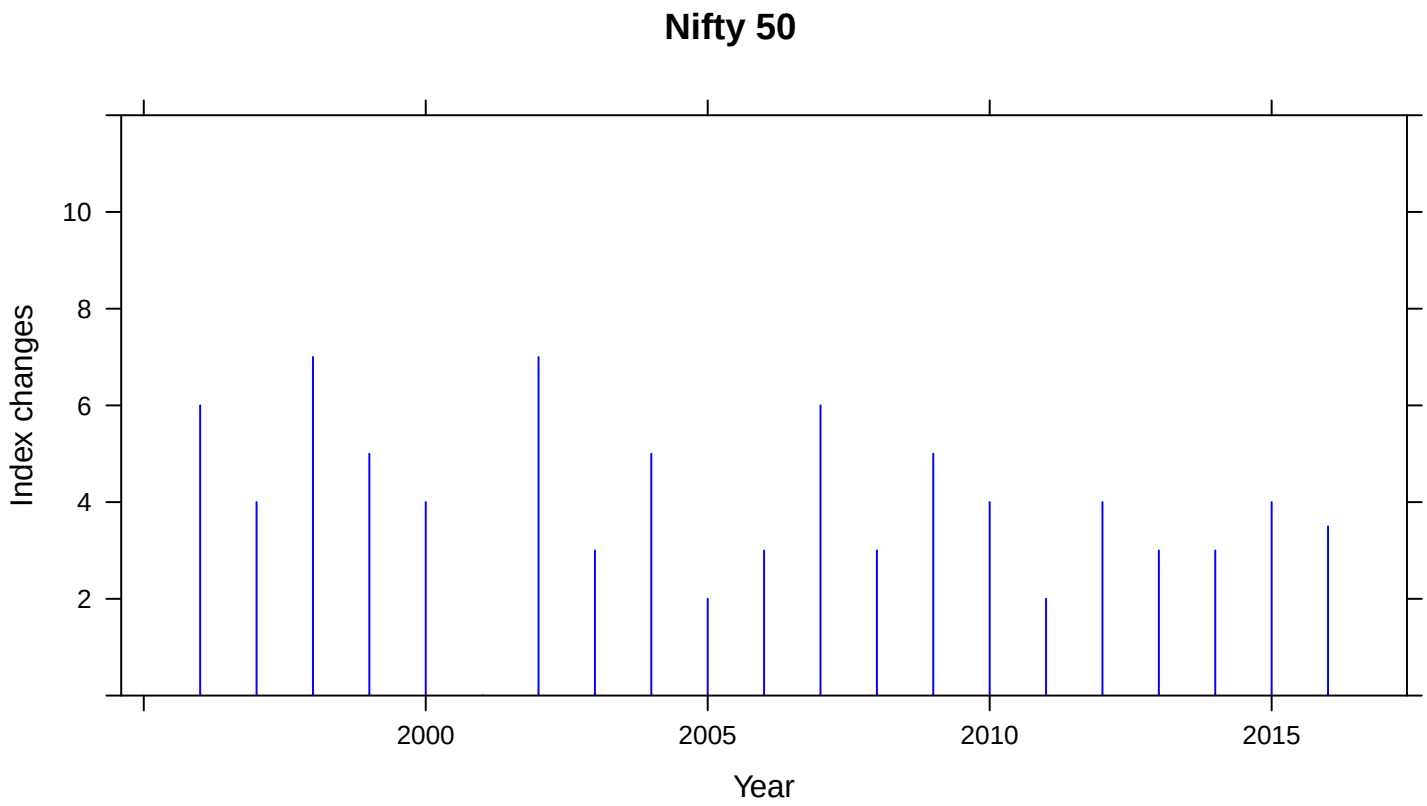
Portfolio run up

realize gains, distribute taxable gains

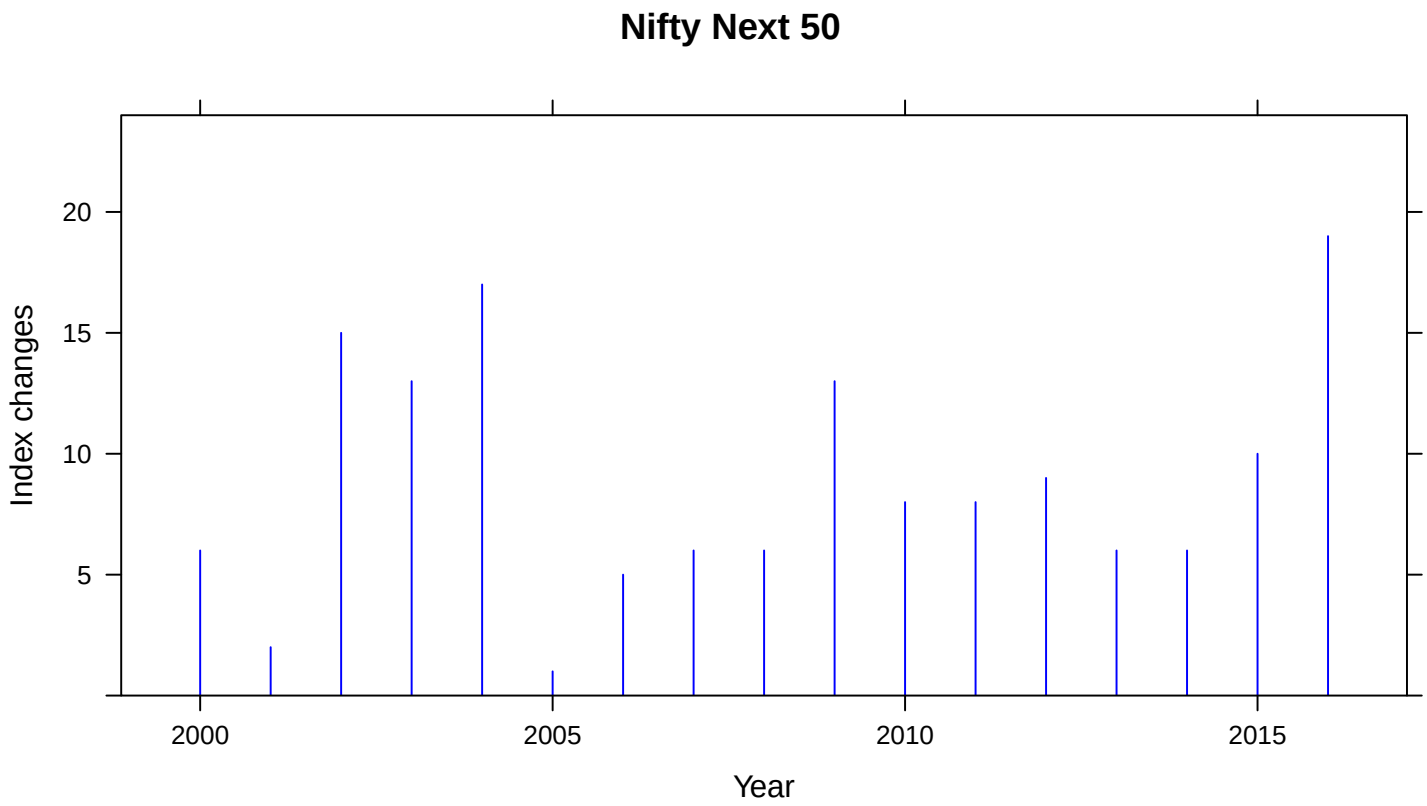
hold overvalued securities, avoid realizing capital gains

Mutual Fund manager

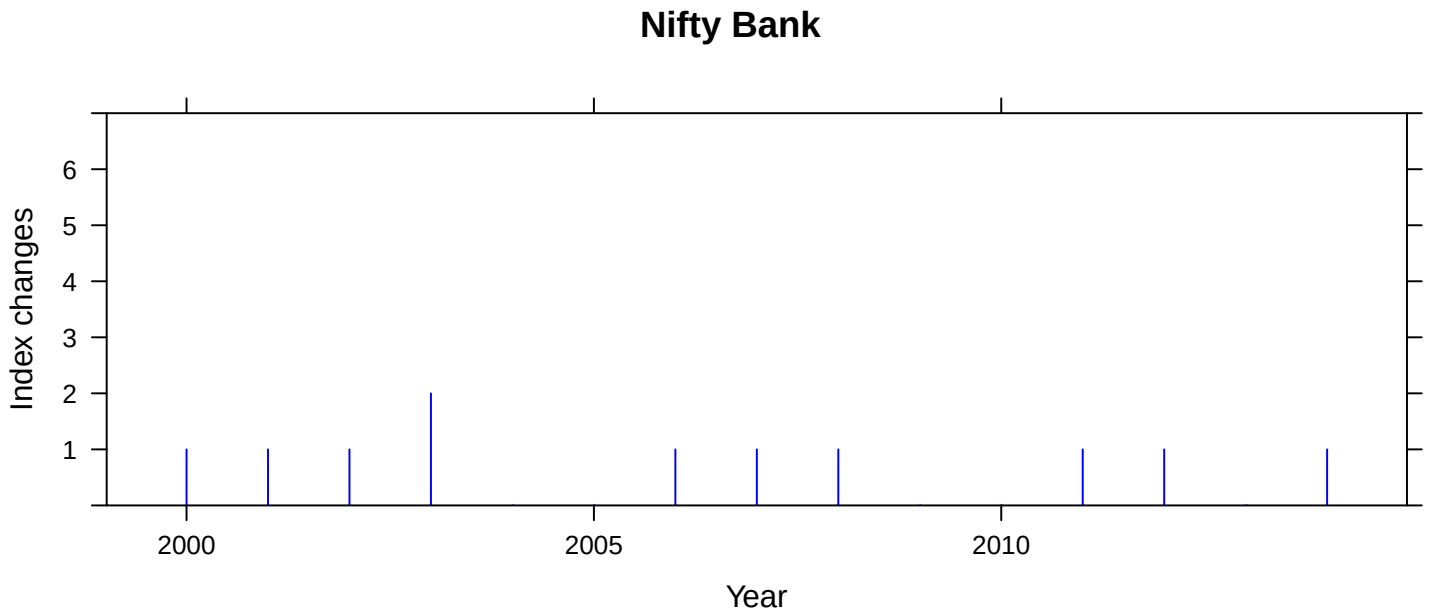
- ETF manager is indifferent to whether the portfolio goes up or down, as long as the fund tracks the index
- No active churn in the portfolio
- Portfolio changes only when the index component changes or because of corporate actions

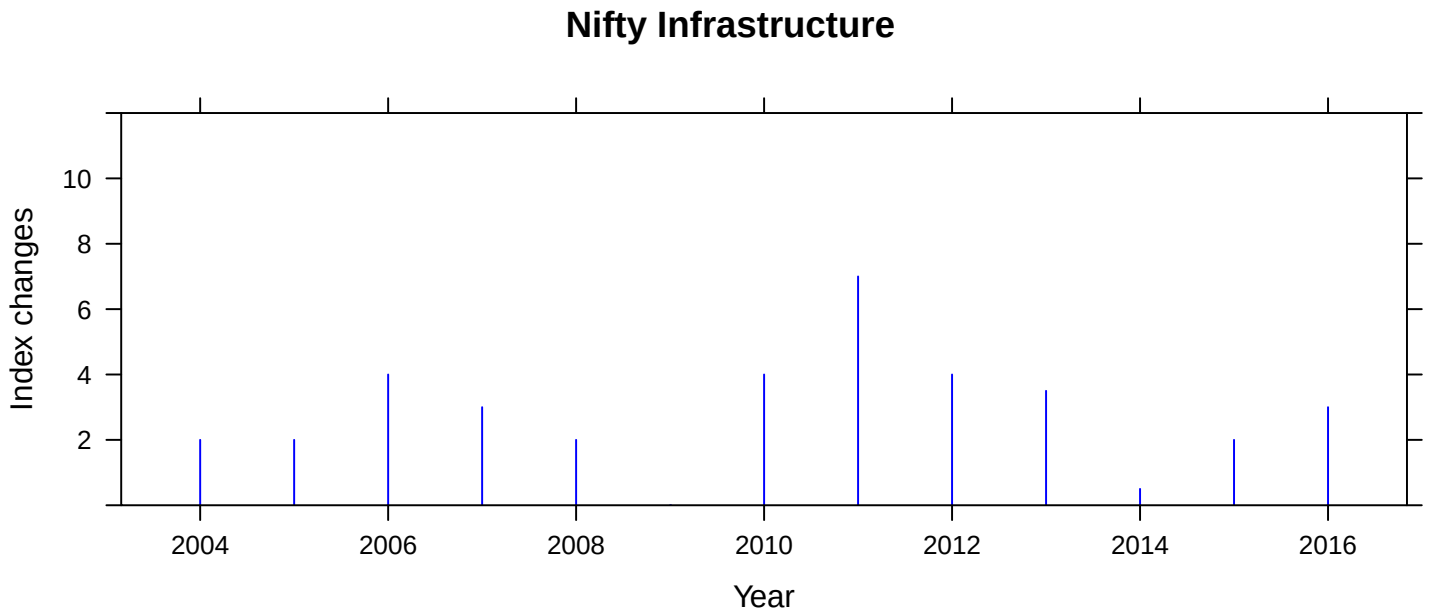


- *Index change* attributed churn is minimal
- Average of 4 trades per year



- *Index change* attributed churn is moderate
- Average of 8 trades per year


Nifty Bank
Index changes
1
2
3
4
5
6
2000
2005
2010
Year


Nifty Infrastructure
Index changes
2
4
6
8
10
2004
2006
2008
2010
2012
2014
2016
Year

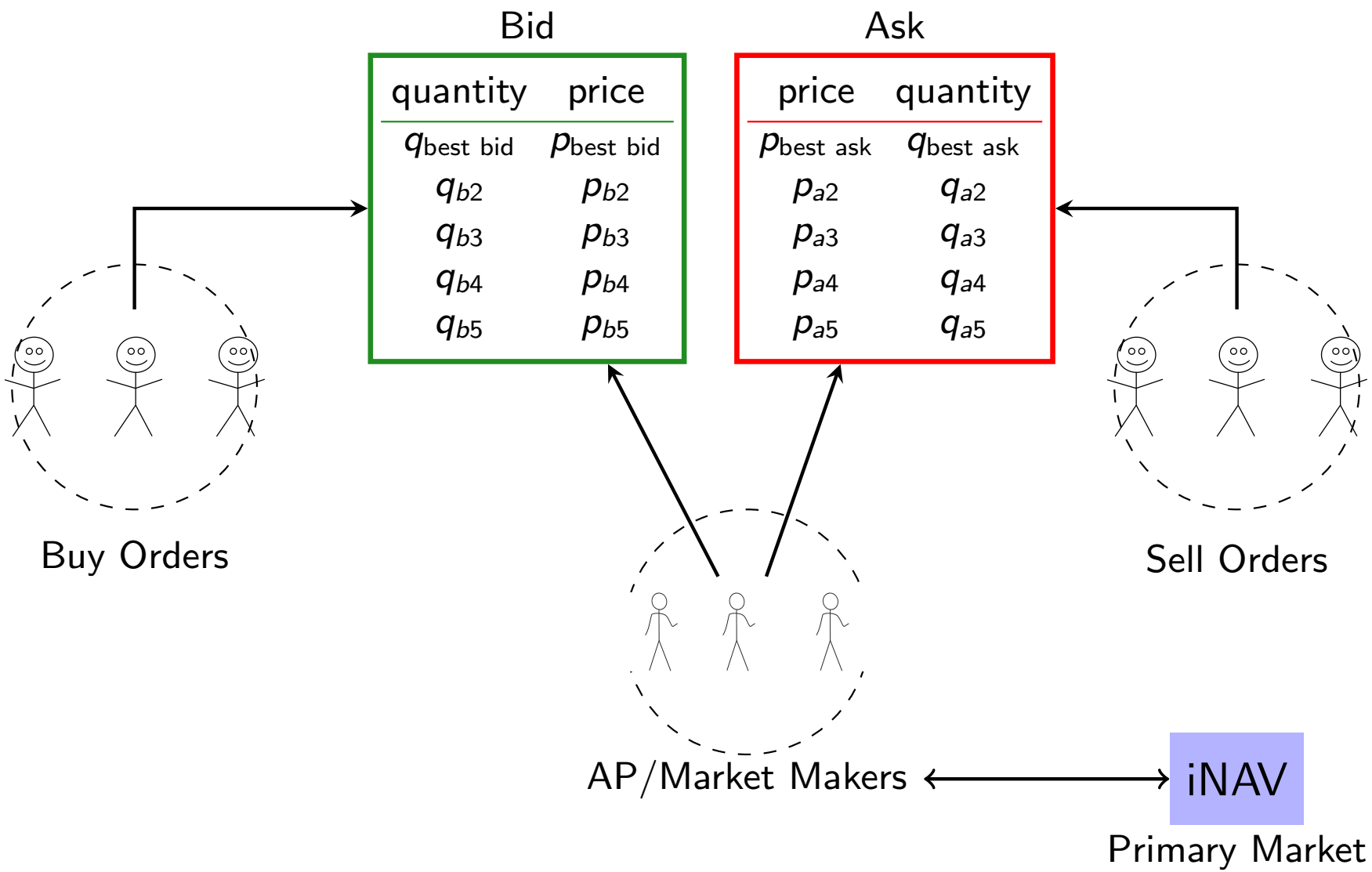
Fund  iNAV - Real time NAV

Stock	Quantity	Price	Value
BEL	33	3582.4	118,219
COALINDIA	1686	364.0	613,704
CONCOR	123	1482.2	182,310
ENGINERSIN	170	213.0	36,210
GAIL	767	402.9	309,024
IOC	411	348.7	143,315
OIL	232	492.7	114,306
ONGC	1706	320.0	545,920
PFC	593	294.9	174,875
RECLTD	560	350.8	196,448
Share value			2,434,333
Cash component			45,325
100,000 ETF shares			2,479,658

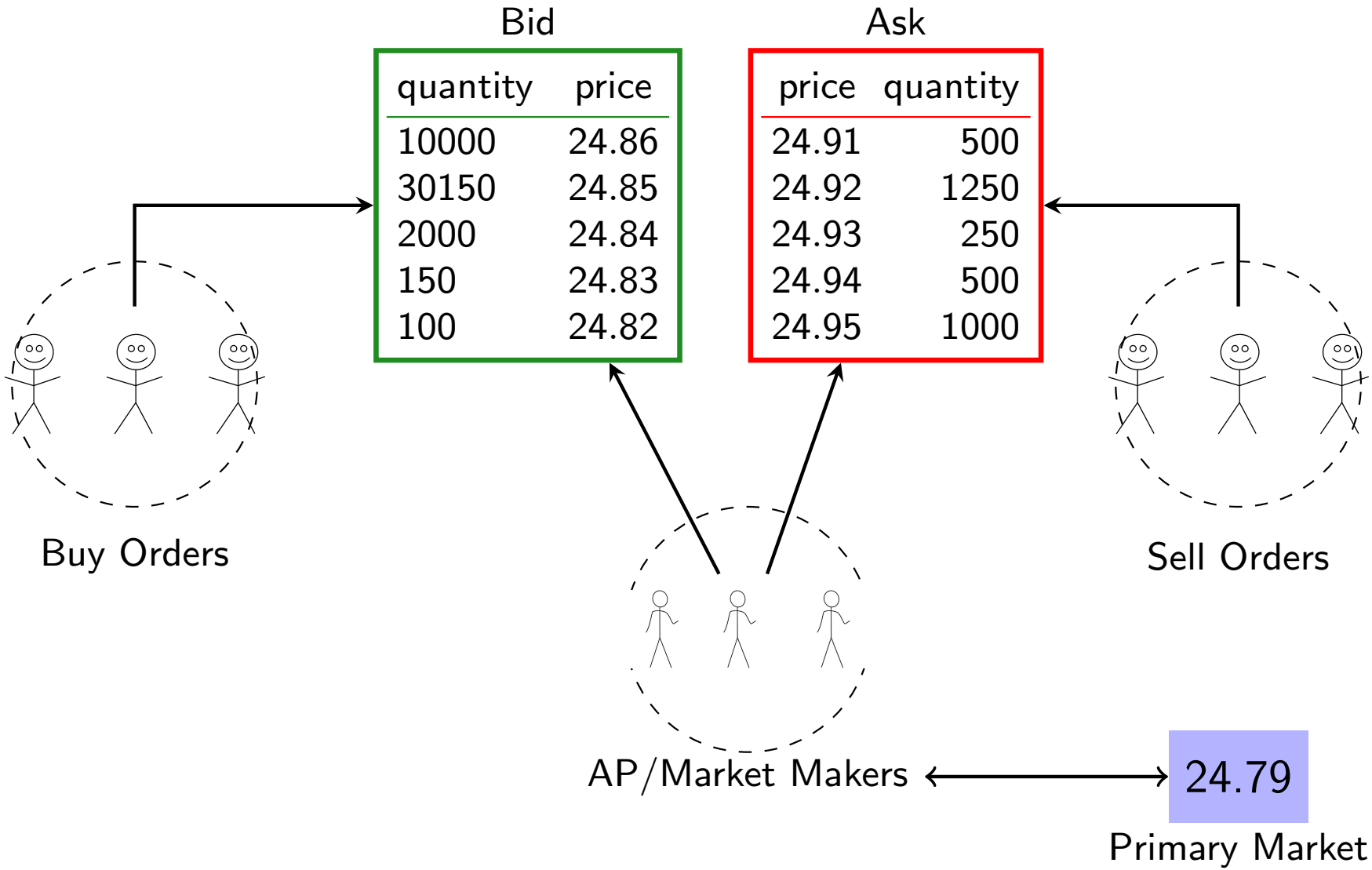
$$\text{iNAV} = 24.796589$$

- Fund disseminates iNAV to Reuters, Bloomberg and other subscribers
- It serves as a reference point for any buyers or sellers

ETF Seconday Market

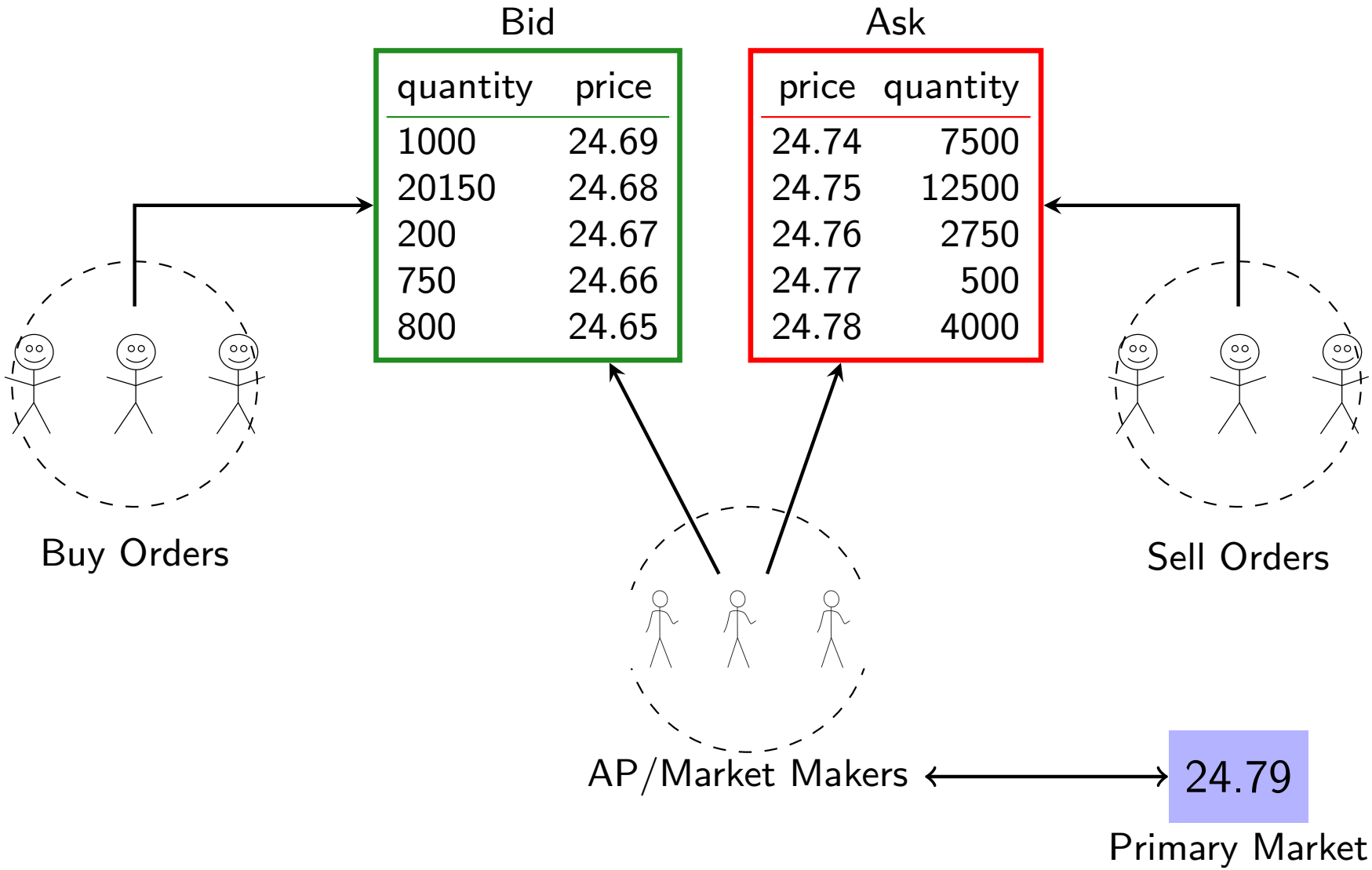


Market at Premium

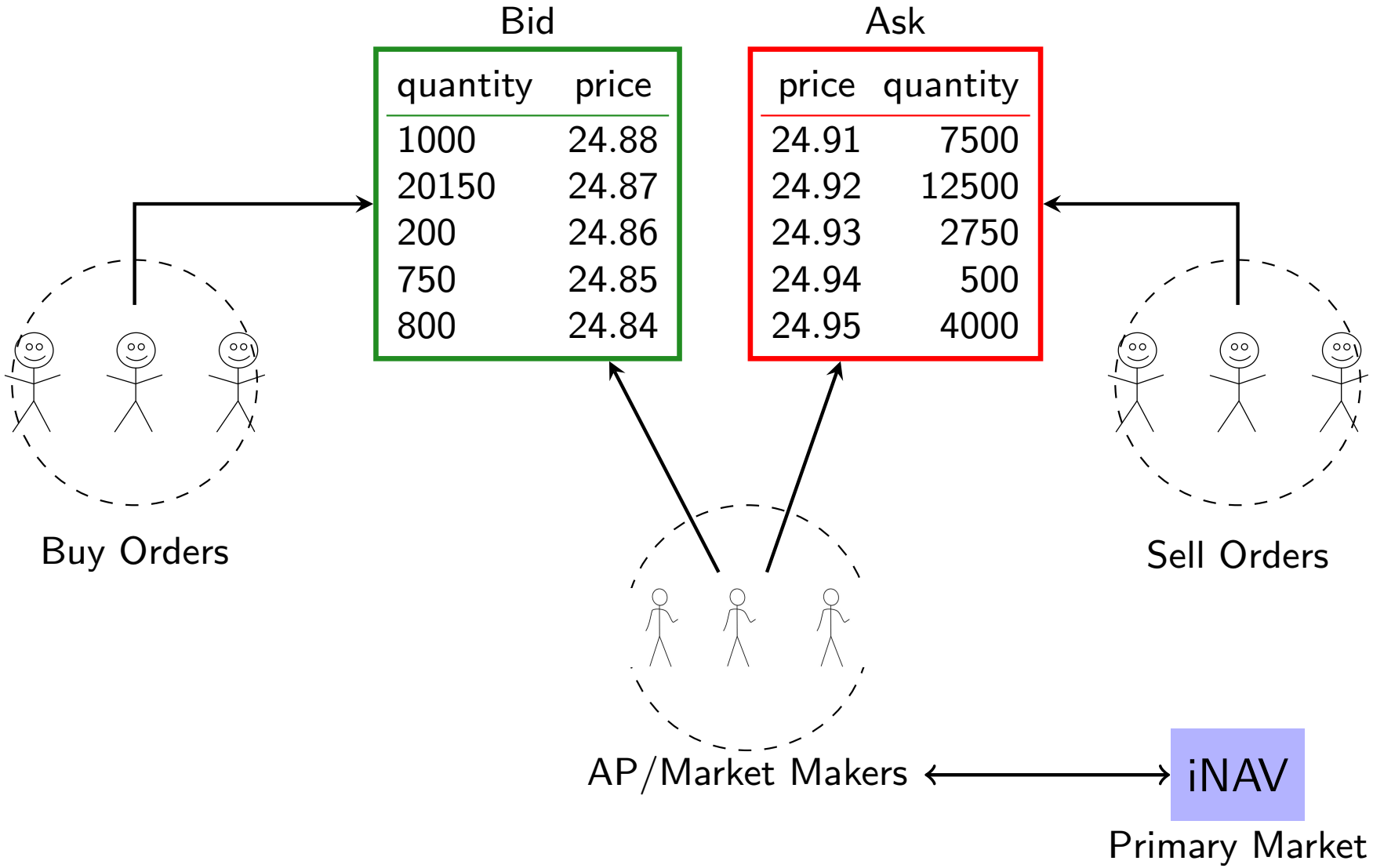


- Supply at 24.86
- Put a limit sell order at 24.9 and be the best seller

Market at Discount



- Buy at 24.74
- Put a limit buy order at 24.71 and be the best buyer



If you are a market maker, What would you do ?

- Market Buy / Limit Buy ?
- Market Sell / Limit Sell ?

Stock	Quantity
BEL	33
COALINDIA	1686
CONCOR	123
ENGINERSIN	170
GAIL	767
IOC	411
OIL	232
ONGC	1706
PFC	593
RECLTD	560
Cash component	45,325

Bid

quantity	price
1000	24.88
20150	24.87
200	24.86
750	24.85
800	24.84

Ask

price	quantity
24.91	7500
24.92	12500
24.93	2750
24.94	500
24.95	4000

Stock	Price
BEL	3558.31
COALINDIA	363.49
CONCOR	1495.01
ENGINERSIN	218.41
GAIL	398.90
IOC	357.39
OIL	506.12
ONGC	324.17
PFC	298.28
RECLTD	344.87

- Case 1 : You do not charge any premium to your cost
- Case 2 : You charge 35 bps as a markup

Assume there are no transaction charges

Primary Market

Stock	Quantity	Price	Value
BEL	33	3558.3	117,424
COALINDIA	1686	363.5	612,844
CONCOR	123	1495.0	183,886
ENGINERSIN	170	218.4	37,129
GAIL	767	398.9	305,956
IOC	411	357.4	146,887
OIL	232	506.1	117,419
ONGC	1706	324.2	553,034
PFC	593	298.3	176,880
RECLTD	560	344.9	193,127
Share value			2,444,588
Cash component			45,325
100,000 ETF shares			2,489,913

$$\text{Buying NAV} = 24.8991399$$

Secondary Market

Bid

quantity	price
1000	24.88
20150	24.87
200	24.86
750	24.85
800	24.84

Ask

price	quantity
24.91	7500
24.92	12500
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ONGC	1706	324.2	553,034
PFC	593	298.3	176,880
RECLTD	560	344.9	193,127
Share value			2,444,588
Cash component(+)			45,325
100,000 ETF shares			2,489,913

Buying NAV = 24.8991399, Markup 35 bps $\Rightarrow$ Sell at 24.9862869

Secondary Market

Bid

quantity	price
1000	24.88
20150	24.87
200	24.86
750	24.85
800	24.84

Ask

price	quantity
24.91	7500
24.92	12500
24.93	2750
24.94	500
24.95	4000

Primary Market

Stock	Quantity	Price	Value
BEL	33	3558.3	117,424
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ONGC	1706	324.2	553,034
PFC	593	298.3	176,880
RECLTD	560	344.9	193,127
Share value			2,444,588
Cash component(+)			45,325
100,000 ETF shares			2,489,913

Selling NAV = 24.8991399, Markup 35 bps $\Rightarrow$ Buy at 24.8119929

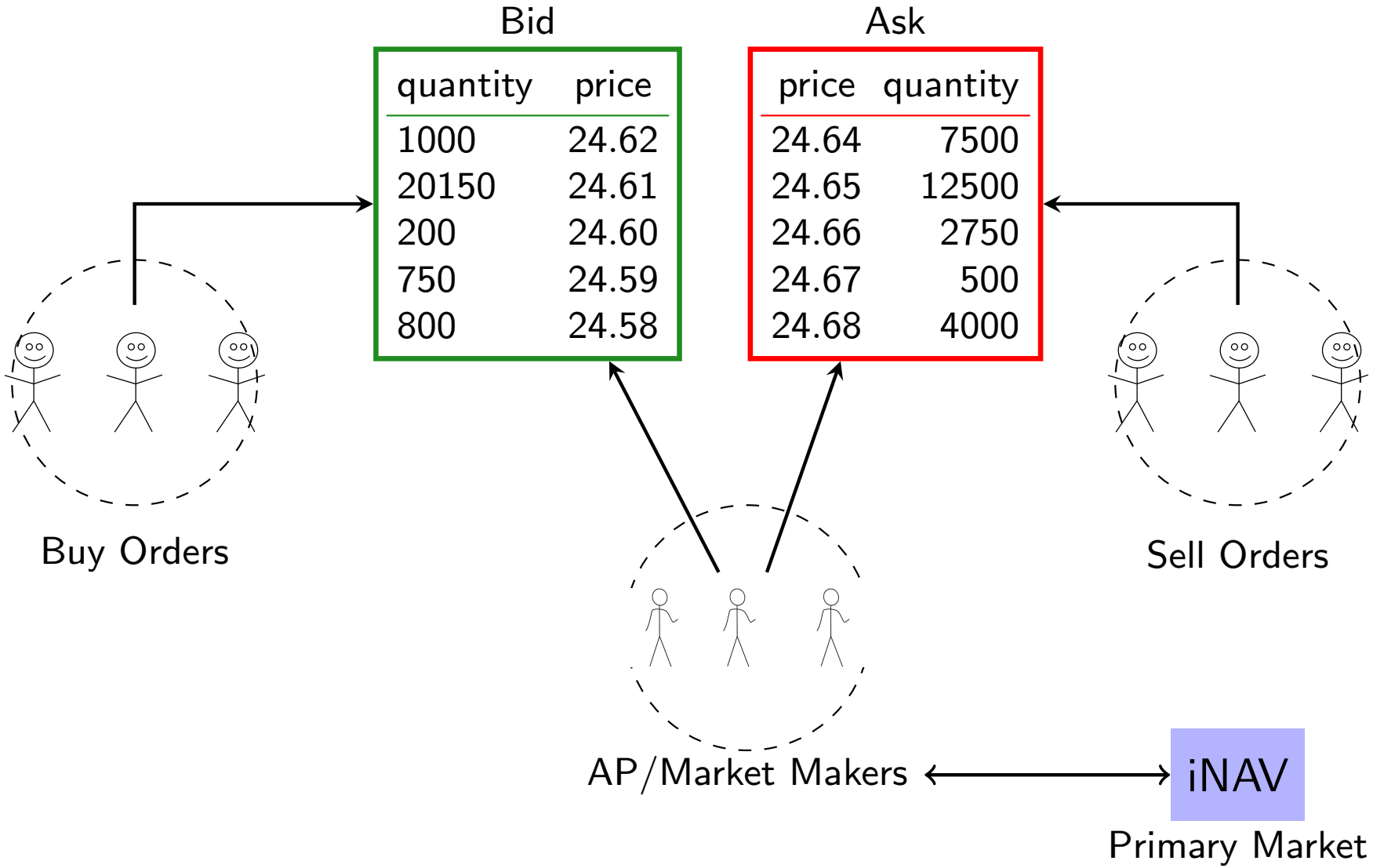
Secondary Market

Bid

quantity	price
1000	24.88
20150	24.87
200	24.86
750	24.85
800	24.84

Ask

price	quantity
24.91	7500
24.92	12500
24.93	2750
24.94	500
24.95	4000



If you are a market maker, What would you do ?

- Market Buy / Limit Buy ?
- Market Sell / Limit Sell ?

Stock	Quantity
BEL	33
COALINDIA	1686
CONCOR	123
ENGINERSIN	170
GAIL	767
IOC	411
OIL	232
ONGC	1706
PFC	593
RECLTD	560
Cash component	45,325

Bid

quantity	price
1000	24.62
20150	24.61
200	24.60
750	24.59
800	24.58

Ask

price	quantity
24.64	7500
24.65	12500
24.66	2750
24.67	500
24.68	4000

Stock	Price
BEL	3543.87
COALINDIA	369.50
CONCOR	1495.05
ENGINERSIN	210.53
GAIL	413.86
IOC	358.18
OIL	486.03
ONGC	326.94
PFC	295.90
RECLTD	353.43

- Case 1 : You do not charge any premium to your cost
- Case 2 : You charge 35 bps as a markup

Assume there are no transaction charges

Primary Market

Stock	Quantity	Price	Value
BEL	33	3543.9	116,947
COALINDIA	1686	369.5	622,977
CONCOR	123	1495.0	183,891
ENGINERSIN	170	210.5	35,790
GAIL	767	413.9	317,430
IOC	411	358.2	147,211
OIL	232	486.0	112,758
ONGC	1706	326.9	557,759
PFC	593	295.9	175,468
RECLTD	560	353.4	197,920
Share value			2,468,156
Cash component			45,325
100,000 ETF shares			2,513,481

$$\text{Buying NAV} = 25.1348166$$

Secondary Market

Bid

quantity	price
1000	24.62
20150	24.61
200	24.60
750	24.59
800	24.58

Ask

price	quantity
24.64	7500
24.65	12500
24.66	2750
24.67	500
24.68	4000

Primary Market

Stock	Quantity	Price	Value
BEL	33	3543.9	116,947
COALINDIA	1686	369.5	622,977
CONCOR	123	1495.0	183,891
ENGINERSIN	170	210.5	35,790
GAIL	767	413.9	317,430
IOC	411	358.2	147,211
OIL	232	486.0	112,758
ONGC	1706	326.9	557,759
PFC	593	295.9	175,468
RECLTD	560	353.4	197,920
Share value			2,468,156
Cash component(+)			45,325
100,000 ETF shares			2,513,481

Selling NAV = 25.1348166, Markup 35 bps $\Rightarrow$ Afford to Buy at 25.0468447

Secondary Market

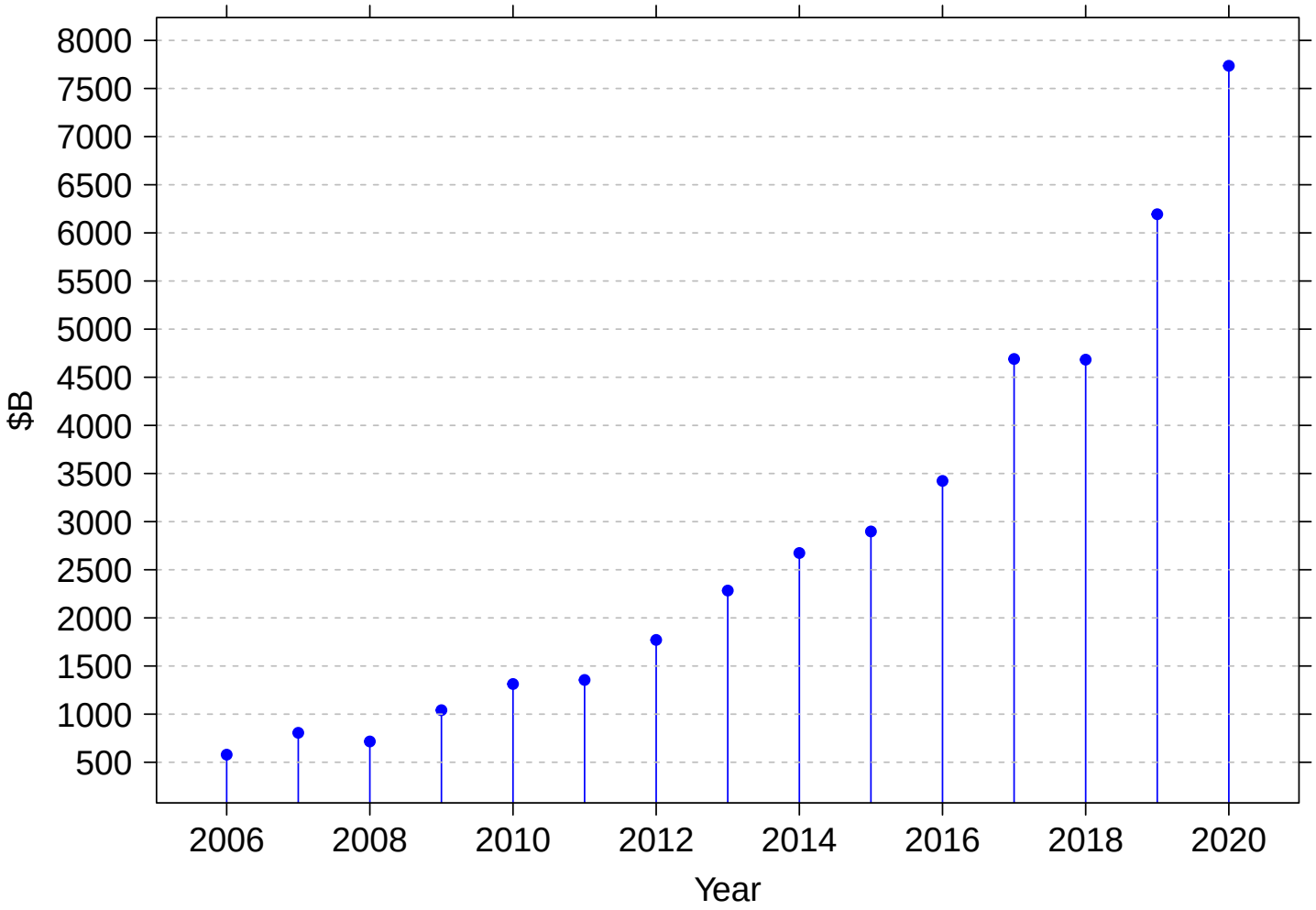
Bid

quantity	price
1000	24.62
20150	24.61
200	24.60
750	24.59
800	24.58

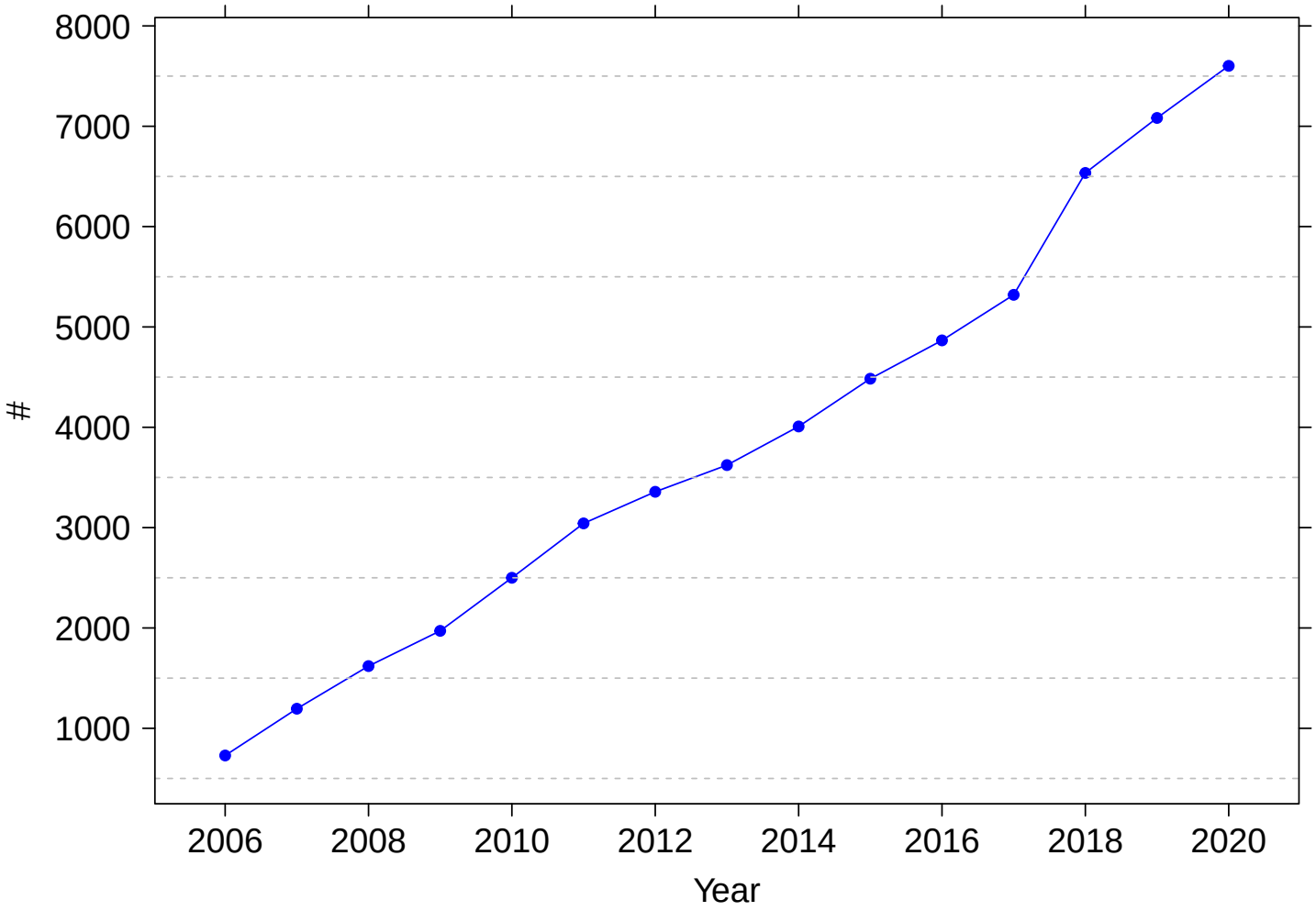
Ask

price	quantity
24.64	7500
24.65	12500
24.66	2750
24.67	500
24.68	4000

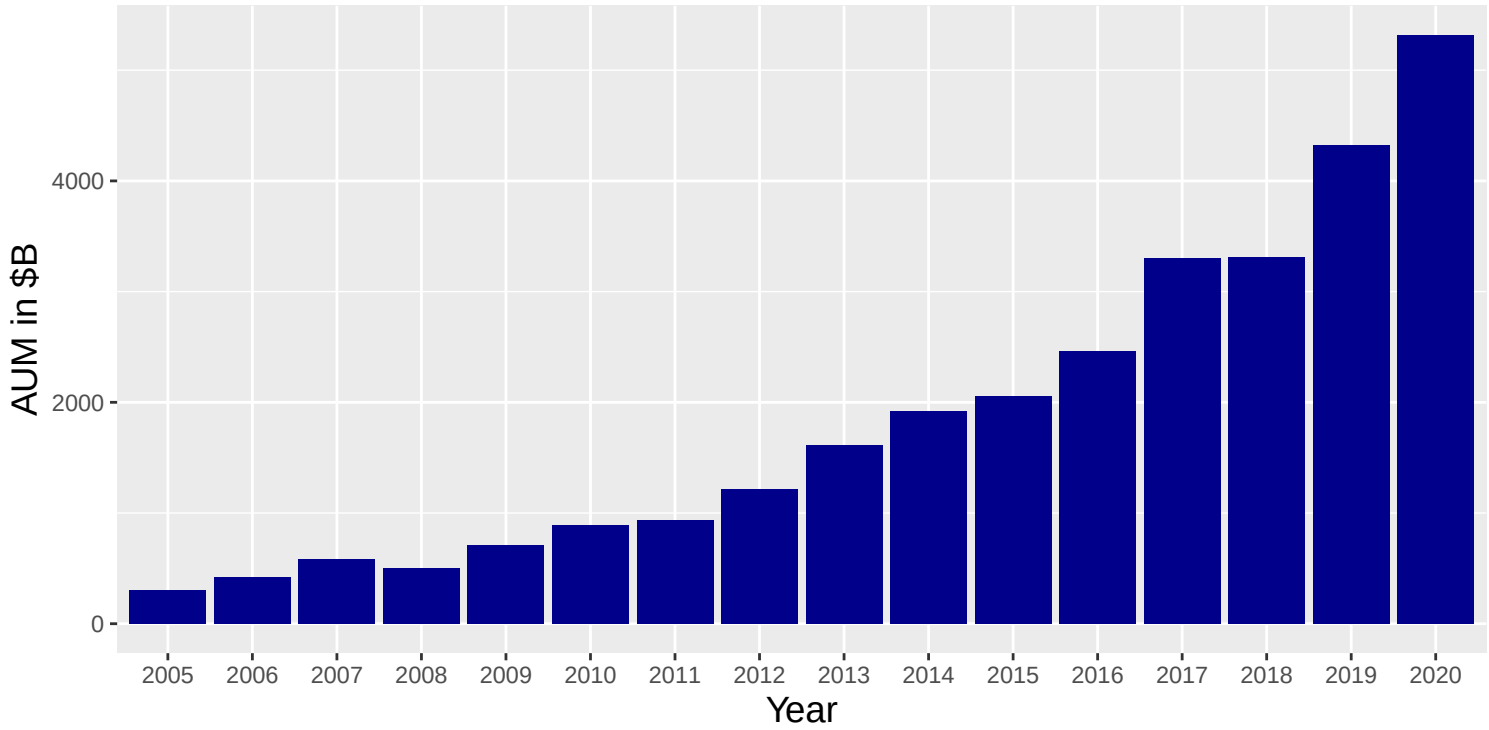
ETF Market- AUM



ETF Market


8000
7000
6000
5000
4000
3000
2000
1000
#
2006
2008
2010
2012
2014
2016
2018
2020
Year

US ETF AUM



Total AUM under US ETF's $\sim 2\cdot$ 

GDP of India

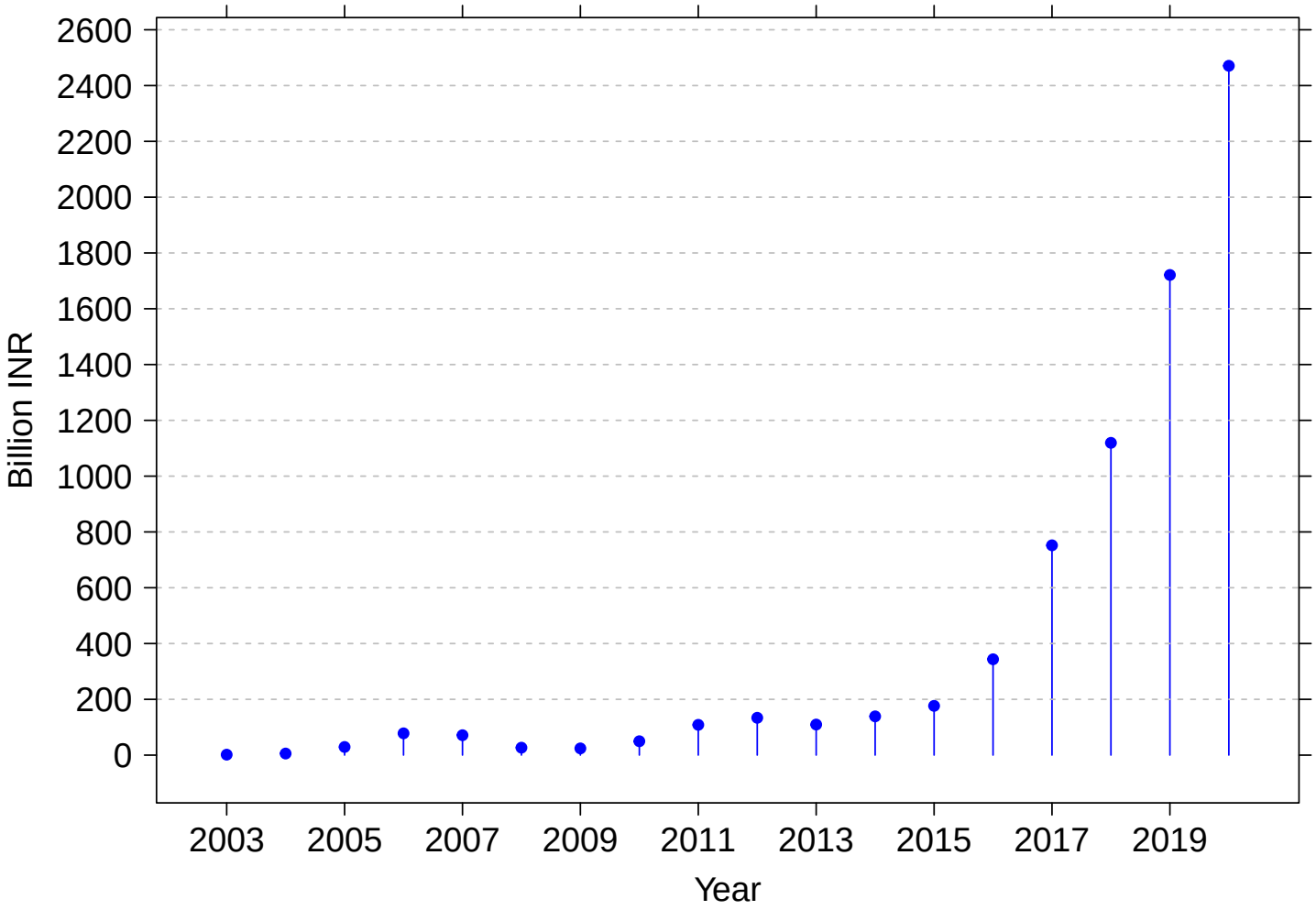
Indian Market - Collective Investment Vehicles

category	AUM($M)	%
Debt	211,632	45.50
Equity	125,587	27.00
Hybrid	47,137	10.10
Index	2,022	0.40
Gold ETF	1,887	0.40
Other ETFs	33,774	7.30
Fund of Funds	4,254	0.90
Other Schemes	38,864	8.40

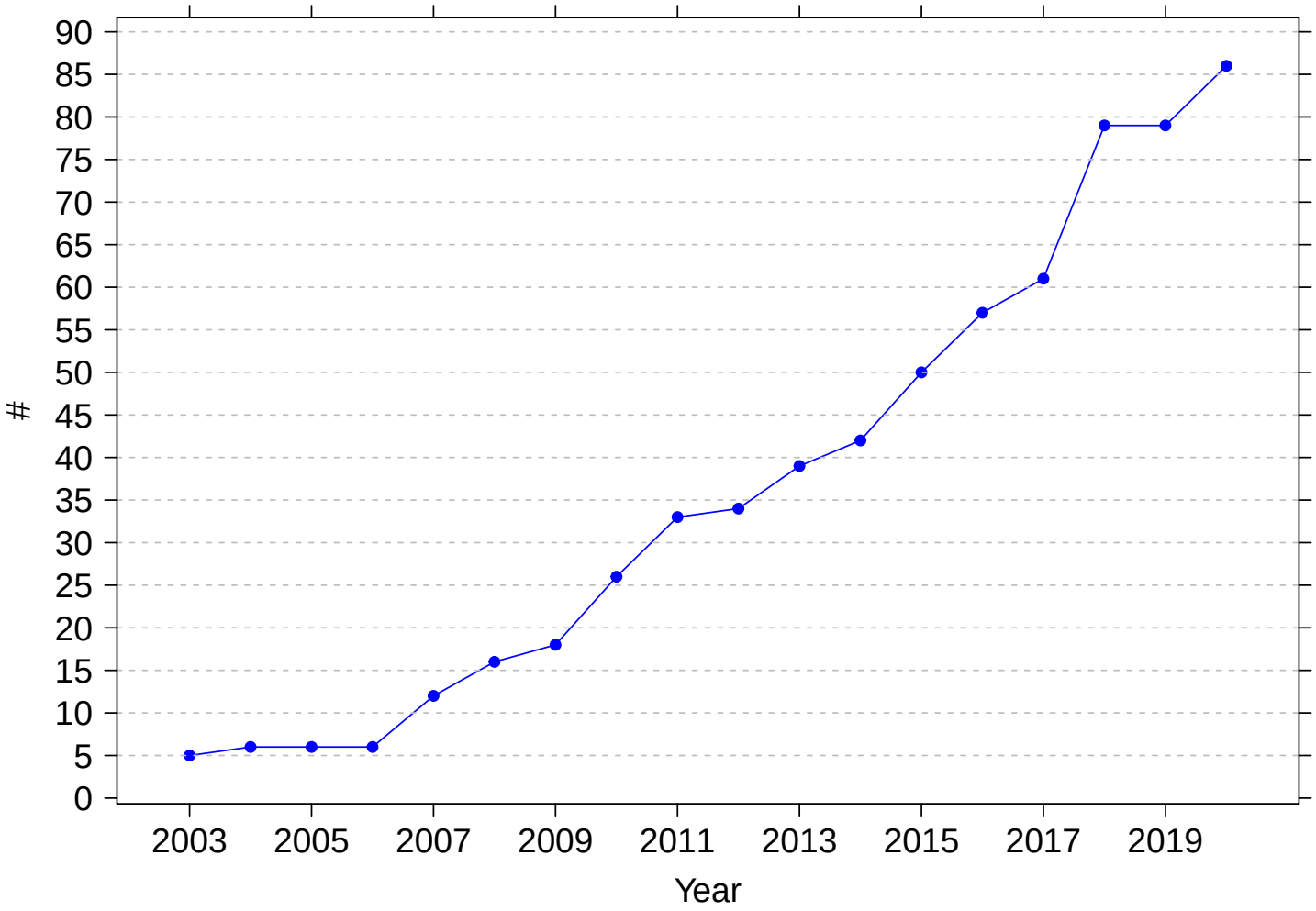
As on Dec 31, 2020

- Total AUM of Indian Market is about $465 B
- Total AUM of Gold ETFs is about $1.8 B
- Total AUM of Other ETFs is about $33 B

Indian ETF Market- AUM



Indian ETF Market -



Indian ETF Market - Funds by Underlying Asset

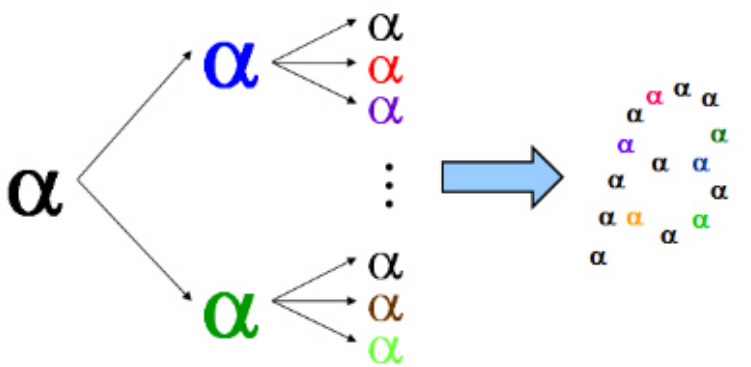
86 funds traded on NSE as of Feb 2020

Underlying Asset	#
Gold	15
NIFTY 50 Index	12
NIFTY Bank	6
NIFTY 100	5
NIFTY Next 50	5
NIFTY PSU BANK	5
NIFTY CPSE Index	4
NIFTY Dividend Opportunities 50	4
NIFTY India Consumption	4
NIFTY Infrastructure	4

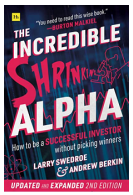
Underlying Asset	#
HangSeng	3
NIFTY 1 D rate Index	3
NIFTY 4-8 yr G-Sec Index	3
NIFTY50 Shariah Index	3
NIFTY50 Value 20 Index	3
S&P BSE Sensex	2
Nasdaq 100	1
NIFTY 50 Index	1
Nifty 8-13 yr G-Sec Index	1
NIFTY Midcap 100	1
S&P BSE BHARAT 22 index	1

Factor Models

- CAPM - 1 factor model : Market returns explain most of the variation
- French and Fama Three factor Model : Market, Size and Value factors
- Many research papers/books claim that there is no more alpha



Unique → Novel → Popular → Common



Factor Models

One factor model

$$R_{jt} - R_{ft} = \beta \left(R_{Mt} - R_{ft} \right) + \epsilon_t$$

French and Fama Three factor Model

$$R_{jt} - R_{ft} = \beta_1 \left(R_{Mt} - R_{ft} \right) + \beta_2 \, R_{SMBt} + \beta_3 \, R_{HMLt} + \epsilon_t$$

Four factor Model

$$R_{jt} - R_{ft} = \beta_1 \left(R_{Mt} - R_{ft} \right) + \beta_2 \, R_{SMBt} + \beta_3 \, R_{HMLt} + \beta_4 \, R_{WMLt} + \epsilon_t$$

R_{jt} : j^{th} stock return at time t

R_{ft} : Risk free return at time t

R_{Mt} : Market return at time t

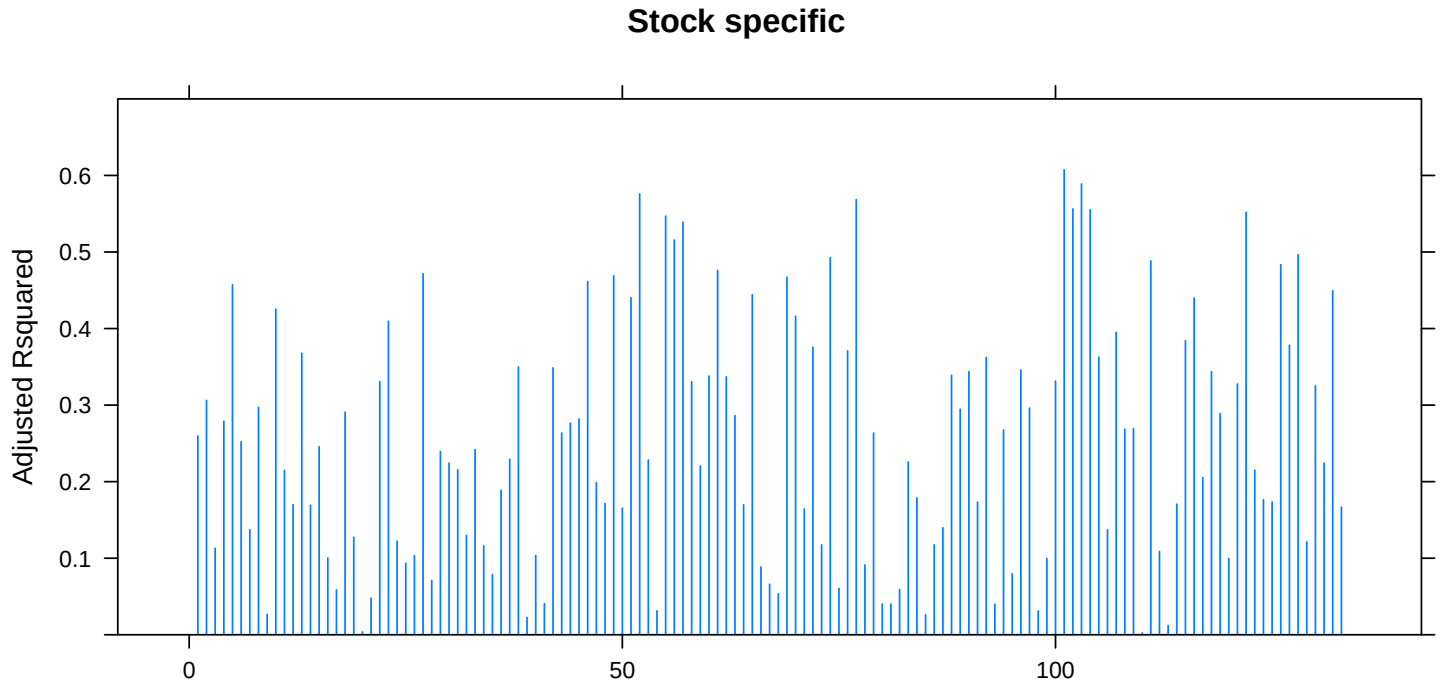
R_{SMBt} : Small minus Big portfolio return at time t

R_{HMLt} : High minus Low Book-to-Market portfolio value return at time t

R_{WMLt} : Winners minus Losers portfolio value return at time t

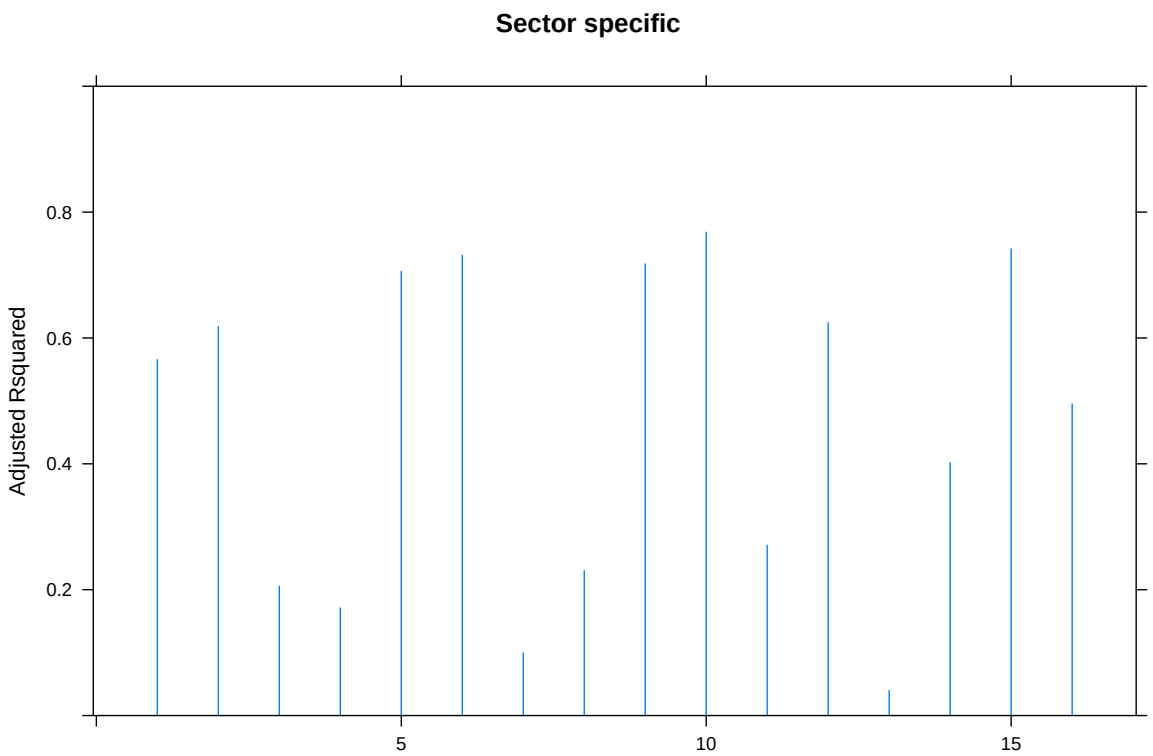
A simple exercise

- Shortlist stocks from CNX200 $\sim$ 130 odd stocks
- Is the return variation of individual stock explained by four factors ?
- Is the return variation of equal weighted stocks in a sector explained by four factors ?



% variation explained by the four factors for 133 stocks

A simple exercise



id	sector
1	automobile
2	cement
3	chemicals
4	construction
5	consumer goods
6	energy
7	fertilisers
8	financial services
9	industrials
10	it
11	media
12	metals
13	pharma
14	services
15	telecom
16	textiles

Takeaways :

- Four factors do capture a sizable proportion of explained variance at a sector level
- There is a large component of idiosyncratic risk at a stock level
- Best bet for the retail investor is to invest in factors/ETFs

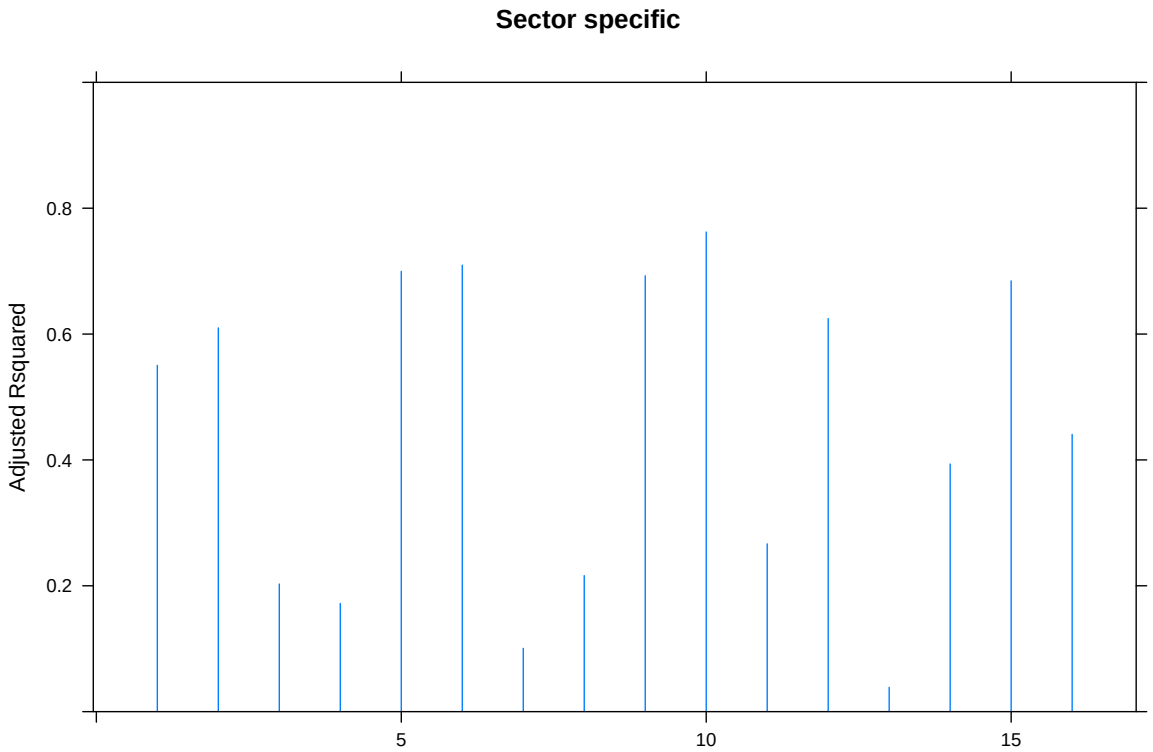
A simple exercise

A random sample of Mutual funds that are supposed to good!

	Mutual.Fund
1	HDFC Balanced Fund
2	Tata Balanced Fund
3	Birla Sun Life Top 100
4	Franklin India Oppor
5	SBI Blue Chip Fund
6	Tata Equity Opp. Fund
7	Can Robeco Emerg-Equities
8	Franklin High Growth Cos
9	Axis Long Term Equity Fund
10	HDFC Balanced Fund
11	Tata Balanced Fund
12	L&T India Value Fund

It's same story :Significant variance explained by the four factors

A simple exercise



id	sector
1	automobile
2	cement
3	chemicals
4	construction
5	consumer goods
6	energy
7	fertilisers
8	financial services
9	industrials
10	it
11	media
12	metals
13	pharma
14	services
15	telecom
16	textiles

Takeaways :

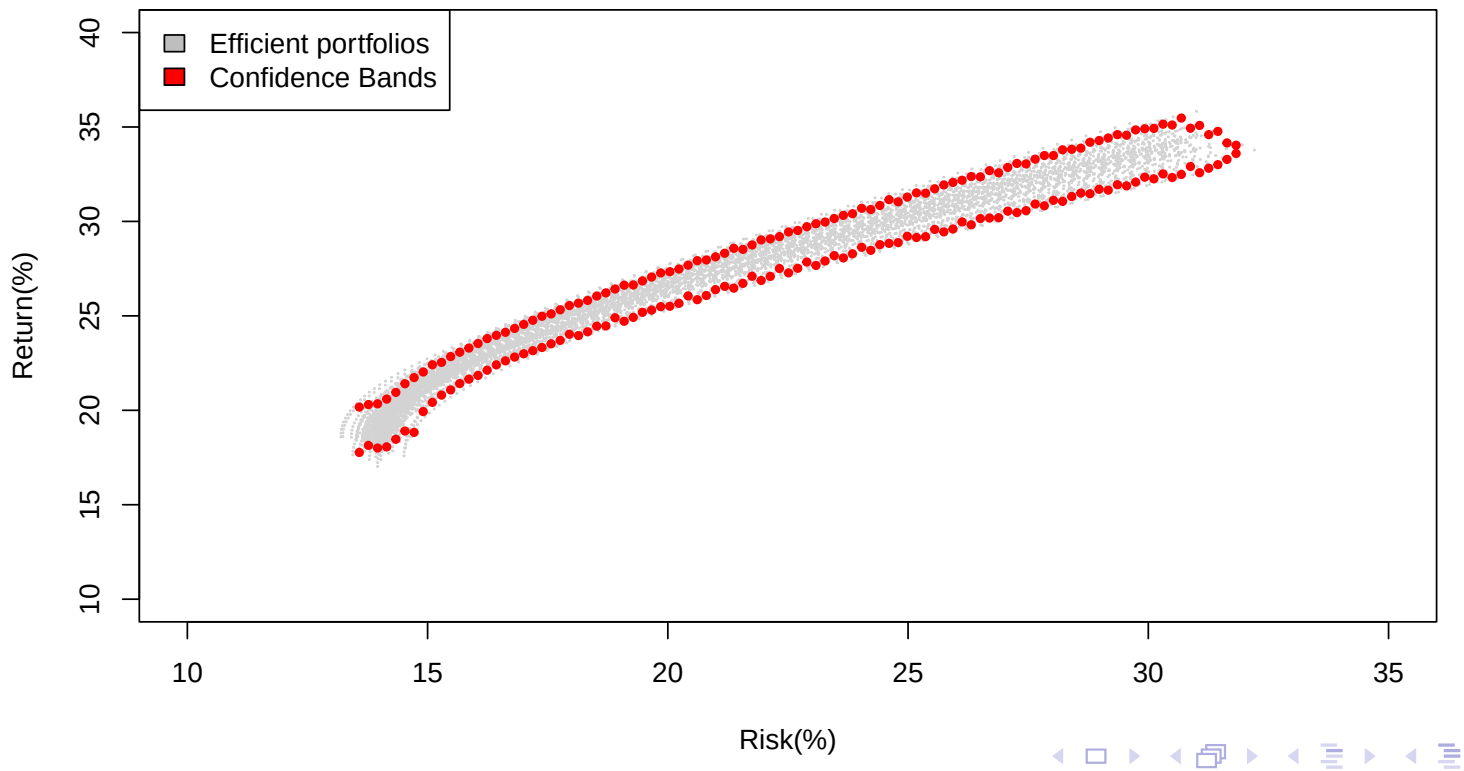
- Nifty BeES - proxy for Market return
- Junior BeES - proxy for Size premium
- Invest in these two factors to capture returns in a cost efficient manner

Asset Allocation Model

- Popular product offered by many fund houses
- Efficient Frontier on index based + liquid + commodity asset classes
- Ideal for Retail investors
  - Assess risk propensity
  - Set the allocation and do a periodic review (6 months/1 year)
  - Use ETFs to create a tax efficient and clean portfolio
- Can be a *good mid-frequency* strategy for institutional players
  - Tactical Allocation
  - Short term arb when constituents move away from the portfolio

Standard Recipe

- Shortlist the asset classes you want to hold
- Look at their historical returns and cross correlations.
- Compute efficient portfolios for various combinations of risk and return
- Generate portfolios to take care of statistical fluctations in covariance matrix



Order book Model for Market Makers

Assumptions :

- Assume that order arrival rate for limit buy at i ticks away from the opposite best quote be
$$\lambda(i) = \frac{k}{i^{\alpha}}$$
- Assume that cancellation per outstanding orders, at i ticks away from the opposite best quote be $\theta(i)$
- Assume the at market trades happen at μ
- The outstanding orders at various ticks is an ergodic Markov process.

Estimation

- Estimate $\hat{\lambda}(i)$, $\hat{\theta}(i)$ and μ, from the tick data
- Model the order book as a birth-death process
- Estimate various conditional probabilities such as
  - probability of increase in mid-price
  - probability of execution before mid-price moves

Looking forward . . .

- Leveraged and Inverse-Leverage indices are disseminated by IISL. Yet, no funds in India.
- Modeling and managing hybrid products is a challenge. Hence an opportunity in the Indian space.
- Active ETFs.
- Higher trading volumes will attract more algorithmic traders in to this space.

Thank You

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