The 5th International Conference on Behavioral, Economic, and Socio-Cultural Computing (BESC 2018)

http://besc-conf.org/2018/

Effect of Increasing Horizontal Shareholding with Index Funds on Competition and Market Prices Investigation by Agent-Based Model

Takanobu Mizuta SPARX Asset Management Co., Ltd.

Mail: mizutata[at]gmail.com
HP: http://mizutatakanobu.com

Note that the opinions contained herein are solely those of the authors and do not necessarily reflect those of SPARX Asset Management Co., Ltd. and Nomura Research Institute, Ltd.

You can download this presentation material from

http://mizutatakanobu.com/201811.pdf

Table of Contents of Today's Talk

You can download this presentation material from
http://mizutatakanobu.com/201811.pdf

(1) Introduction

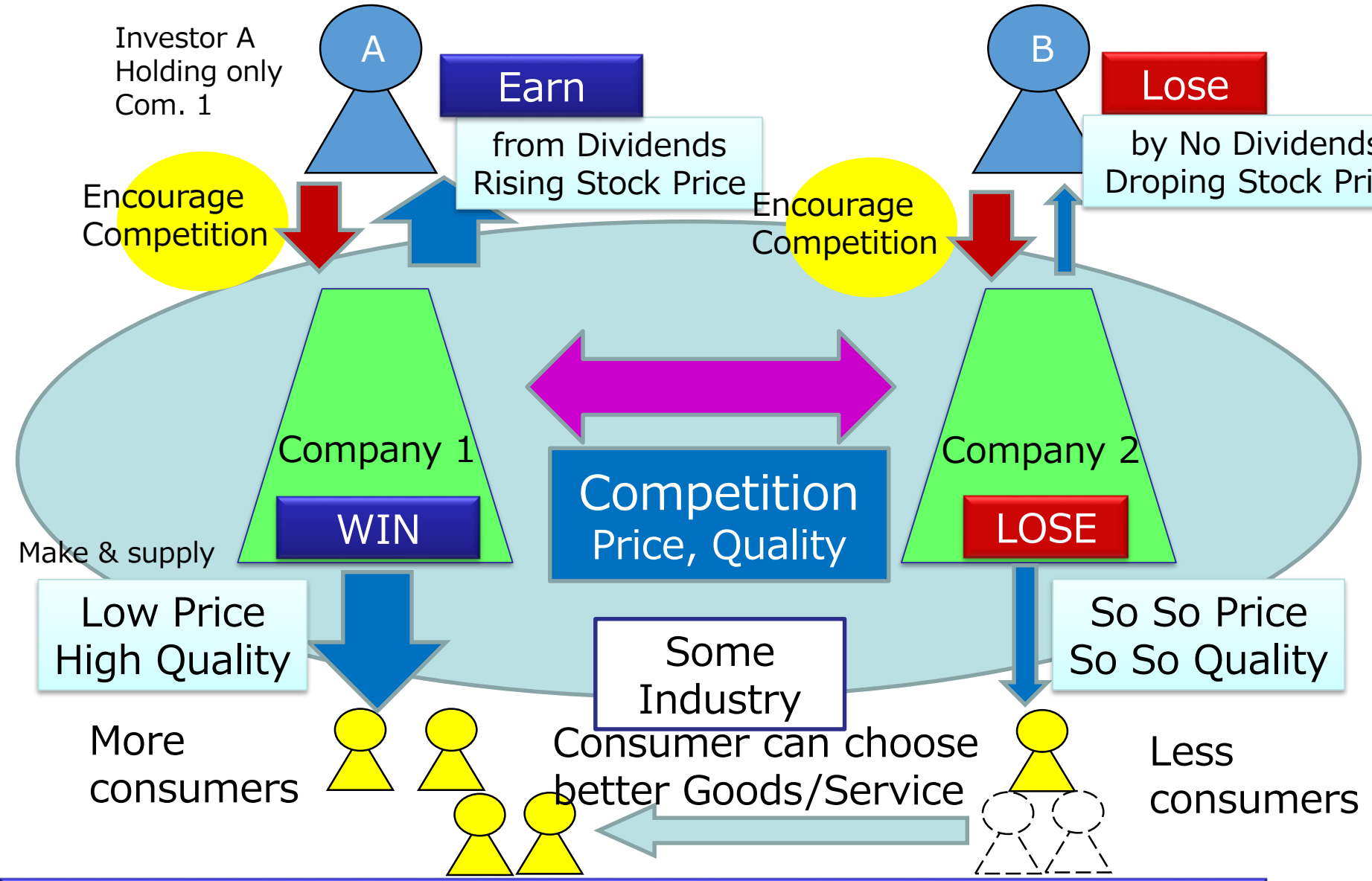
(2) Artificial Market Model

(3) Simulation Results

(4) Conclusion

You can download this presentation material from
http://mizutatakanobu.com/201811.pdf

Competition among Companies held by Different Investors

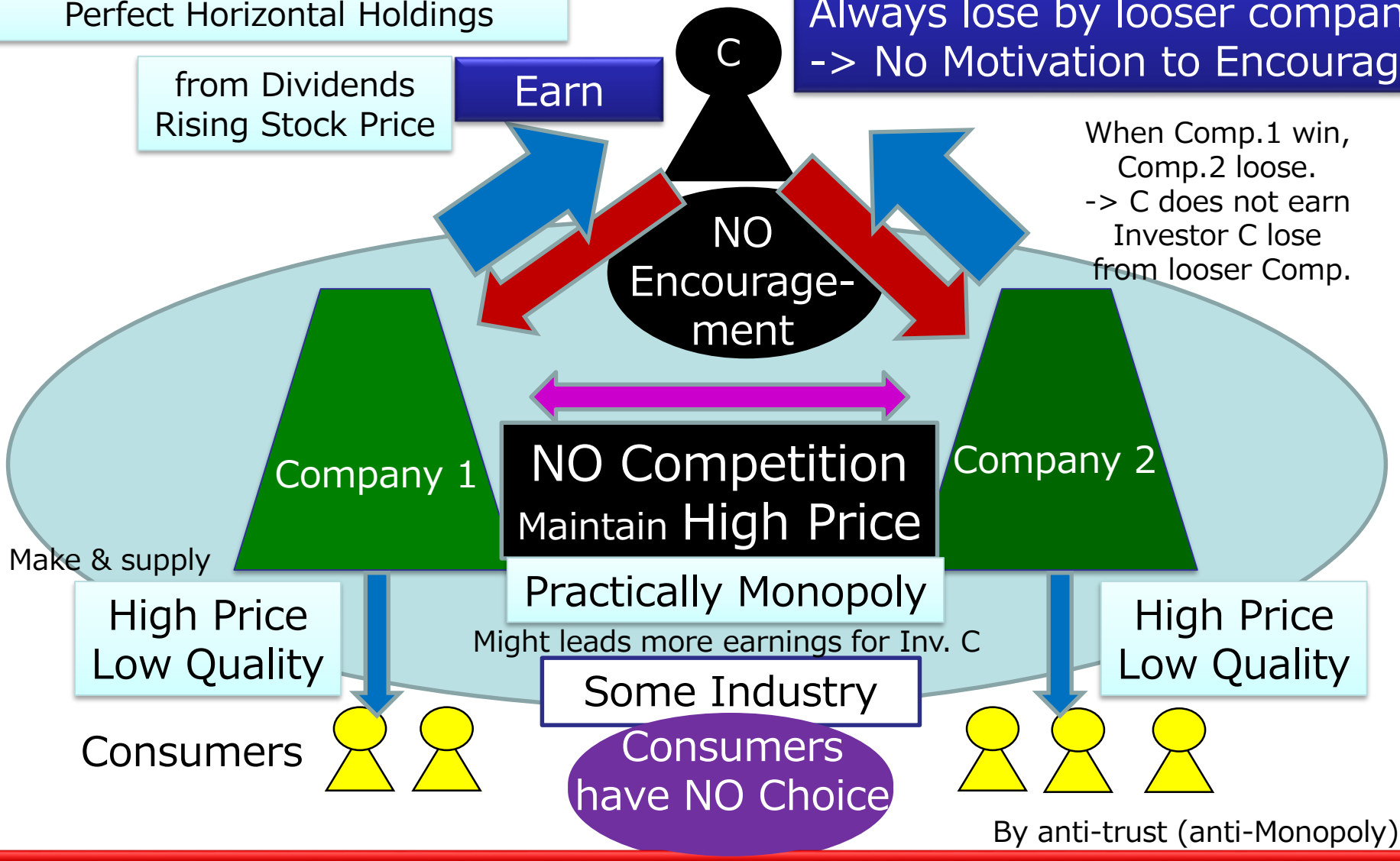


Price/Quality Competition by Separated Companies Benefits to Consumers

Competition among Companies held by SAME ONE Investors (All Shares)

Perfect Horizontal Holdings

Always lose by looser company
-> No Motivation to Encourage



By anti-trust (anti-Monopoly) act

Prohibited Perfect Horizontal Holdings due to disadvantage consumers

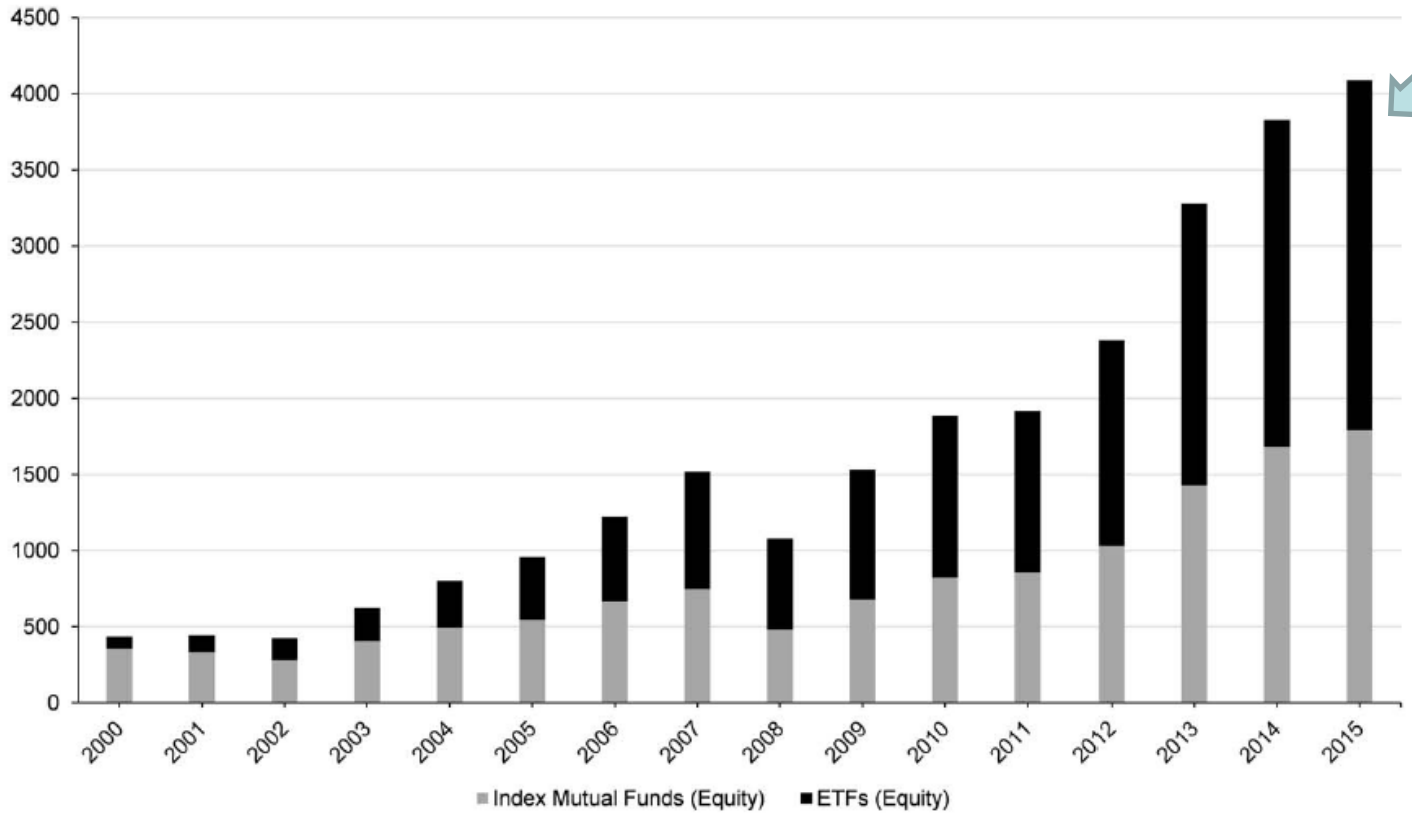
It has long been considered that there is NOT practically monopoly among Listed Companies (held by diversified shareholders)

Heavily Increasing INDEX FUNDS

From [Fichtner 17]

Index Funds are managed a return becomes same as a market index, e.g., the Dow Jones industrial average

Index Funds horizontally shareholding all companies in Index



Index Funds
4 trillion US$
Only in USA

Figure 1: Assets under management by equity passive index funds 2000–2015, bn U.S.$.
Source: Investment Company Institute Fact Book; BlackRock Global ETP Landscape Report Dec. 2015.

Most of 4 trillion US$, BIG3(Index Funds management company) managing

This means only 3 fund manager groups exists

Therefore, most companies held by same shareholders

From [Fichtner 17]

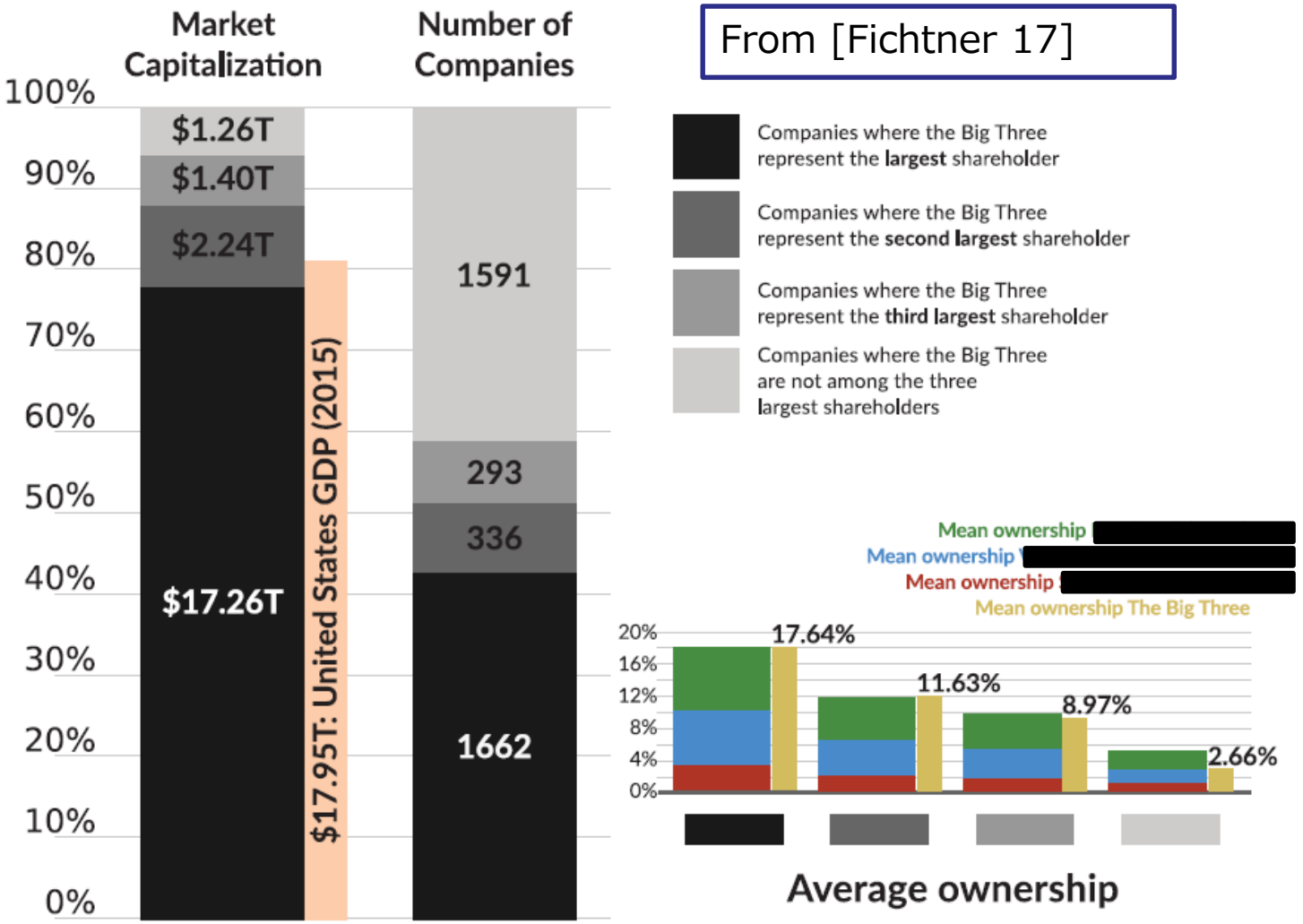


Figure 2: Statistics about the ownership of the Big Three in listed U.S. companies.
Source: Authors calculations based on Orbis.

BIG3 constitute the largest shareholder with 40% of all listed US companies
BIG3 hold 15% of all shares of all companies

Many Empirical Studies

Show existing Practically Monopoly by horizontal shareholdings

Funds are limited holding only one company for one industry? [Elhauge 16]

lessening of hiring competition -> economic inequality? [Elhauge 16]

Many private engagements
Pressure maintaining Price? [Fichtner 17]
Existing Silent Pressure? [Elhauge 16]

Hypothesis of [Piketty 13] is wrong?

Company 1

Company 2

Most important study

Airline ticket prices are 3-7% higher? [Azar 14]

due to horizontal shareholding, compared with a counterfactual world in which companies are separately owned.

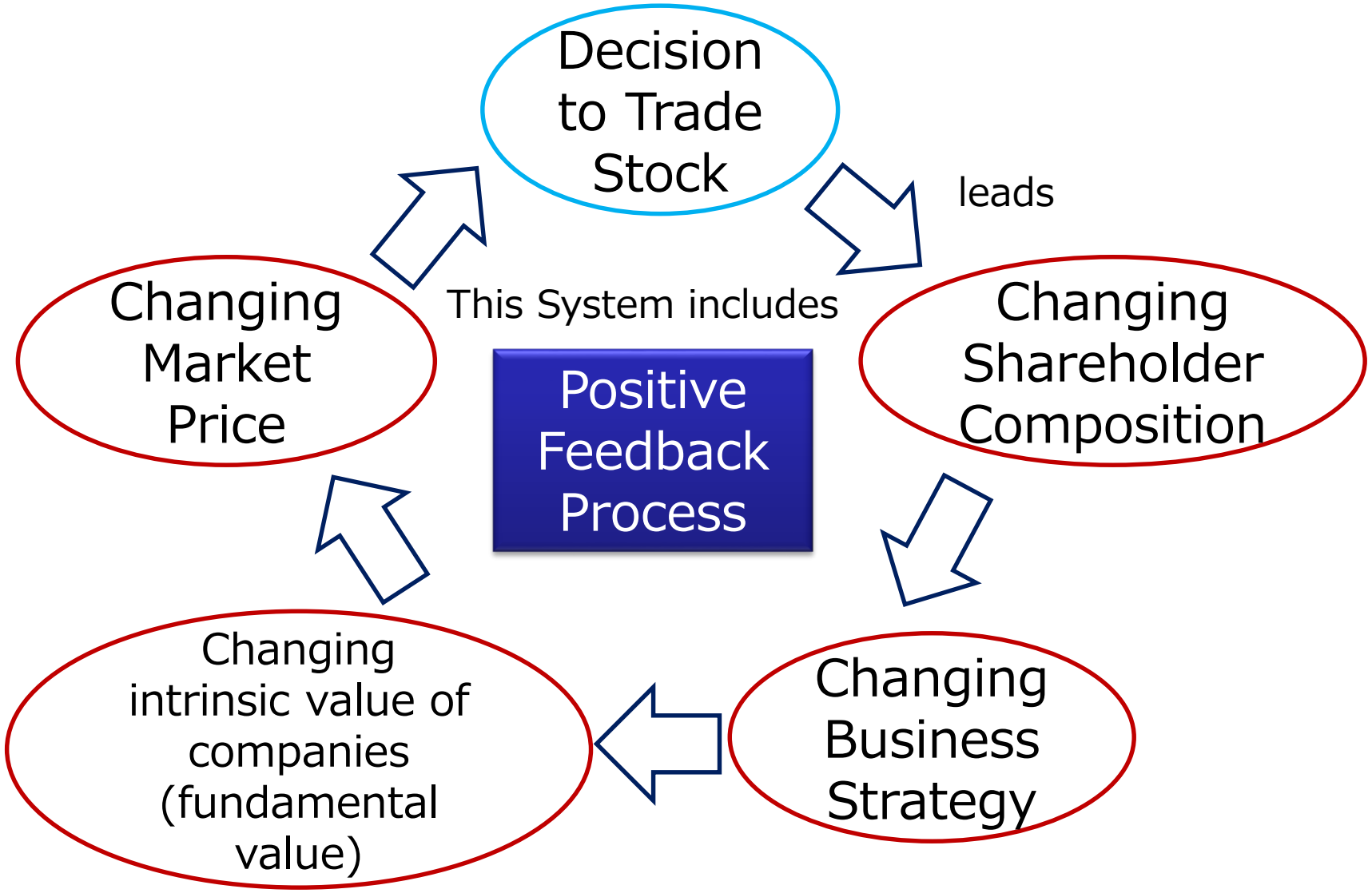
US Airline Ind.

No rising wage,
Rising commodity Price?
[Elhauge 16]

Already, Violate Anti-Monopoly act ? [Elhauge 16]

However, there are many arguments against, so no conclusion has been reached yet.

Positive Feedback Process in horizontal shareholding



The Positive Feedback Process makes the System heavily Complex

Horizontal Shareholding induces Heavily Complex System

Difficulty of Empirical Study

Difficulty of Empirical Study

- ✓ such discussion on the mechanism between the micro-macro feedback of certain types of investors is very difficult
- ✓ cannot be conducted to investigate situations that have never occurred in actual financial markets, such as ones in which passive investors are more than present
- ✓ cannot be conducted to isolate the direct effect of changing the distribution of investor types on price formation because so many factors cause price formation in actual markets

Therefore, in this study,

I implemented a competition model, in which horizontal shareholding changes the business strategy of companies and lessens competition among companies, into the artificial market model of [Mizuta and Horie 2018].

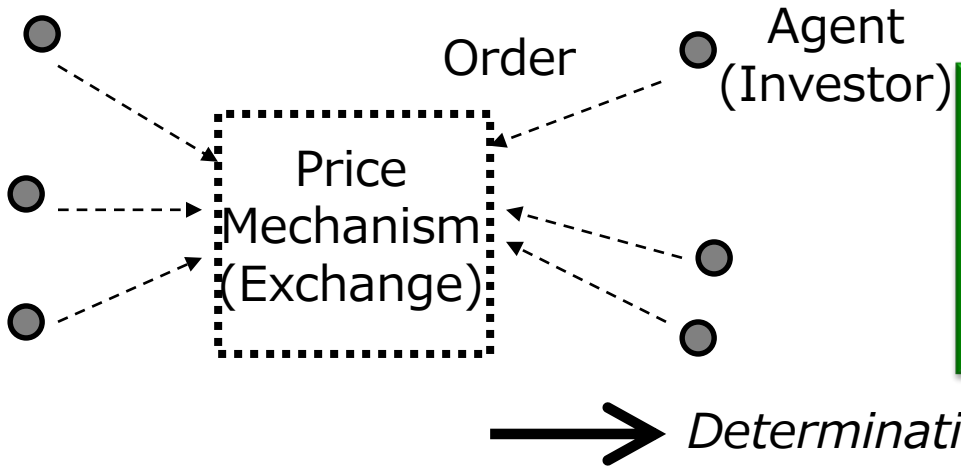
I investigated the effect of increasing horizontal shareholding with index funds on competition and market prices

Artificial Market Simulation (Agent-Based Model)

Virtual and Artificial financial Market built on Computers

Models Include

Agents (Artificial Investors)
+
Price Mechanism (Artificial Exchange)



Each Agent determines an order by some rules, Price Mechanism gather agents orders and determines Market Price

Complete Computer Simulation needing NO Empirical Data

- ✓ can discuss on the mechanism between the micro-macro feedback
- ✓ can be conducted to investigate situations that have never occurred in actual financial markets
- ✓ can be conducted to isolate the direct effect of changing the distribution of investor types on price formation

Previous Contributions of Artificial Market Simulations

Many studies have investigated the effects of several changing financial regulations and rules by using artificial market,

Reduction of Tick Size, Up-Tick Rule,
Price Variation Limit, Dark Pool, Frequently Batch Auction,
Contribution of HFTs for share competition among Exchanges,
Suitable Latency of Exchange System, VaR Shock,
Chain Bankruptcy of Banks,
Regulations and Rules to prevent Financial Crush

- Mizuta (2016) A Brief Review of Recent Artificial Market Simulation Studies for Financial Market Regulations And/Or Rules, SSRN Working Paper Series http://ssrn.com/abstract=2710495

NATURE/SCIENCE articles argued Importance of Simulations

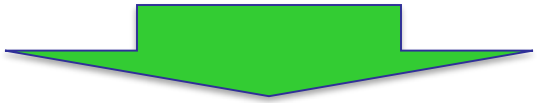
- Farmer and Foley (2009) **NATURE**, Vol. 460, No. 7256, pp. 685-686.
  https://www.nature.com/articles/460685a

  In today's high-tech age, one naturally assumes that US President Barack Obama's economic team and its international counterparts are using sophisticated quantitative computer models to guide us out of the current economic crisis. They are not. There is a better way: agent-based models.

- Battiston et al. (2016) **SCIENCE**, Vol. 351, Issue 6275, pp. 818-819.
  http://science.sciencemag.org/content/351/6275/818

  Traditional economic theory could not explain, much less predict, the near collapse of the financial system and its long-lasting effects on the global economy. Since the 2008 crisis, there has been increasing interest in using ideas from complexity theory to make sense of economic and financial markets.

Traditional economic theory could not explain, much less predict, the near collapse of the financial system



Agent-Based Model is needed

Practical Persons have began to use Agent-Based Model to solve Urgent Real Problem

Regulators, Central Bankers, Stock Exchanges

JPX
JAPAN EXCHANGE GROUP
日本取引所グループ
東京証券取引所
大阪取引所
日本取引所自主規制法人
日本証券クリアリング機構

JPX Working Papers Series

JPX(Tokyo Stock Exchange) shows Working Papers,
6 papers of all 23 are Agent-Based Studies
Reduction of Tick Size, Frequently Batch Auction,
Suitable Latency of Exchange System, and so on
https://www.jpx.co.jp/english/corporate/research-study/working-paper/

So many Examples,

Working Paper by Bank of Japan

Toshiyuki Sakiyama and Tetsuya Yamada Market Liquidity and Systemic Risk in Government Bond Markets: A Network Analysis and Agent-Based Model Approach
http://www.imes.boj.or.jp/research/abstracts/english/16-E-13.html

Project by EU

Integrated Macro-Financial Modelling for Robust Policy Design Work Package 7: Bridging agent-based and dynamic-stochastic-general-equilibrium modelling approaches for building policy-focused macro financial models http://www.macfinrobods.eu/research/workpackages/WP7/wp7.html

(1) Introduction

(2) Artificial Market Model

(3) Simulation Results

(4) Conclusion

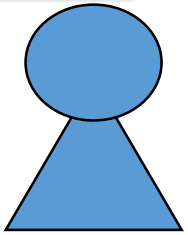
You can download this presentation material from
http://mizutatakanobu.com/201811.pdf

Model of this study

model of [Mizuta and Horie 2018]

succeeded to model agents who trade infrequently on the basis of the fundamental value

They constructed an artificial market model that is as simple as possible having these characteristics



The simplicity of the model is very important for this study because unnecessarily replicating macro phenomena leads to models that are over-fitted and too complex.

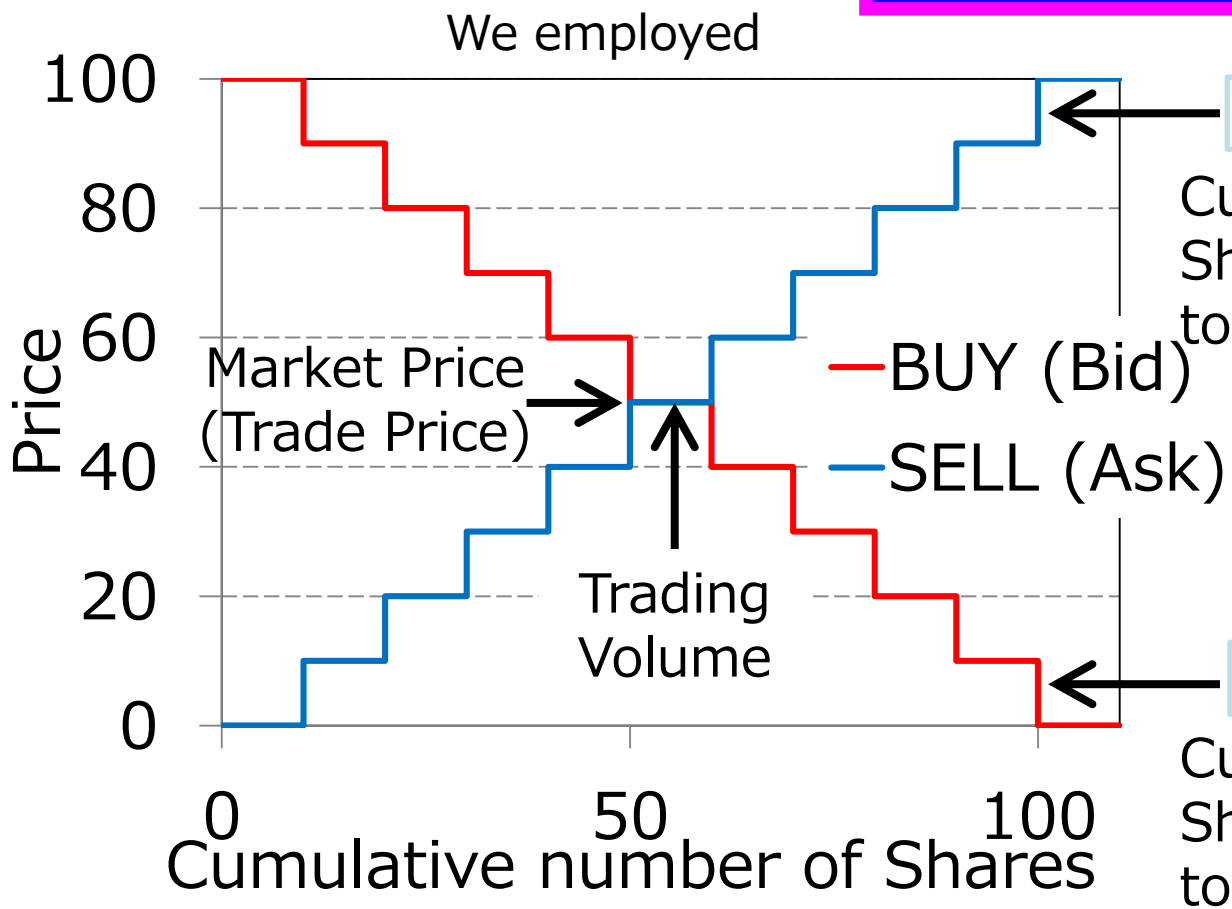
The agent feature is same as Active funds encouraging Companies Competition in Real Financial Market

Therefore, in this study

I implemented a competition model among **2 companies**, in which horizontal shareholding changes the business strategy of companies and lessens competition among companies, into the artificial market model of [Mizuta and Horie 2018].

Price Determination Model

Call Market (Batch Auction)



Supply Curve

Cumulative number of Shares that sellers want to **sell over** this price

Demand Curve

Cumulative number of Shares that buyers want to **buy under** this price

In a call market, buy and sell orders are grouped together and then executed at specific times (rather than executed one by one continuously).
We determine Market Price and Trading Volume at the crossing point of supply and demand curves.

Our Agent Model: Common Setting for every Agent Types

Initial Holdings of Agents

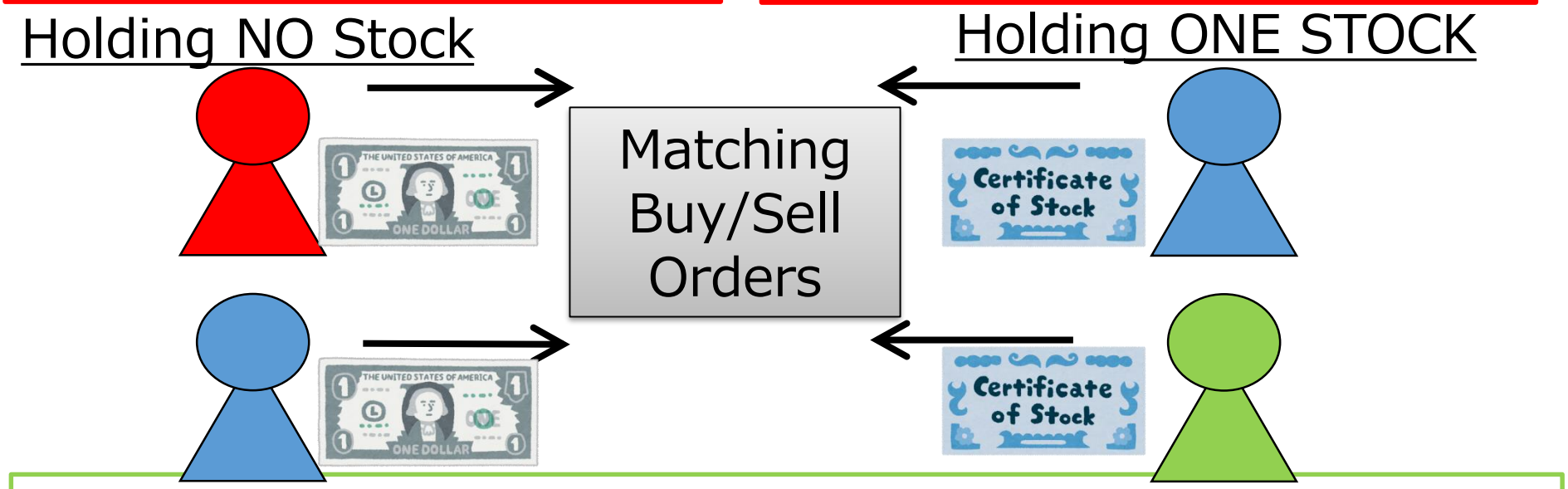
One share or Cash 10,000
← Half and Half of all agents
(Initial Market price=10,000)

Determining Buy/Sell

Holding One Share stock: SELL
Holding no stock : BUY
(No more than 2 shares, no negative no.)

Always place a BUY order

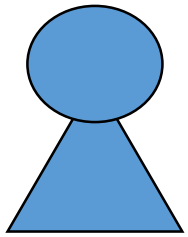
Always place a SELL order



The number of shares and buy or sell of orders are determined not depending on Agent Types. Agent Types only differ in terms of how an order price is determined. We can focus difference from the ways determining order prices.

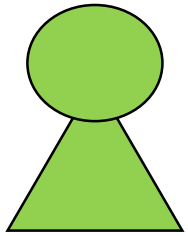
Our Agent Model: Three Agent Types

Agent Types only differ an Order Price



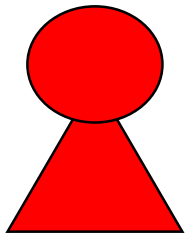
Noise Agents

Around Market Price Randomly



Technical Agents

Referring only Historical market prices



Fundamental Agents

Corresponding

Active & Index Funds
In real financial market

They trade very infrequently than noise and technical investors

Explain Details of Three Agent Types in Following some Slides

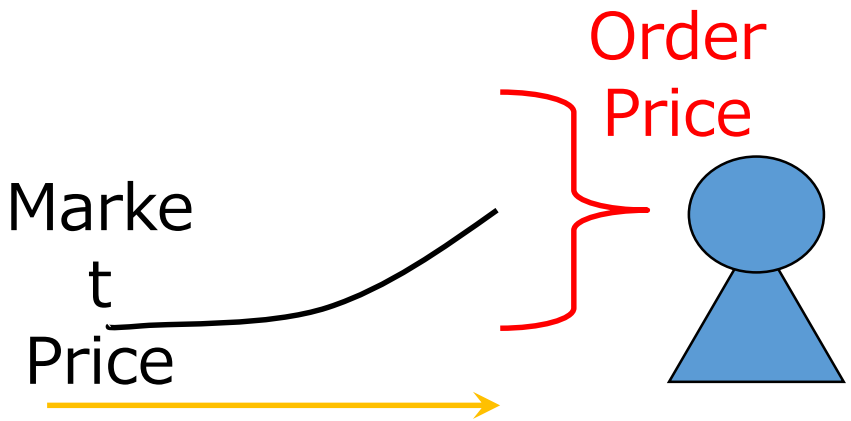
Noise Agents

Number of Agents = 1,000

Order Price

$$P_{o,j} = P_t \exp(\eta \sigma_{t,j})$$

P_o : Order Price
P_t : Market Price
η : Constant (=10%)
$\sigma_{t,j}$: random variables that follow a standard normal distribution
t: time
j: Agent no.



They order around Market Price Randomly.

In this study, we handle a stock traded at a high enough volume.
We introduce noise agents to supply enough liquidity.
(Also, in real financial markets, there are such many liquidity suppliers)

Technical Agents

Number of Agents = 100

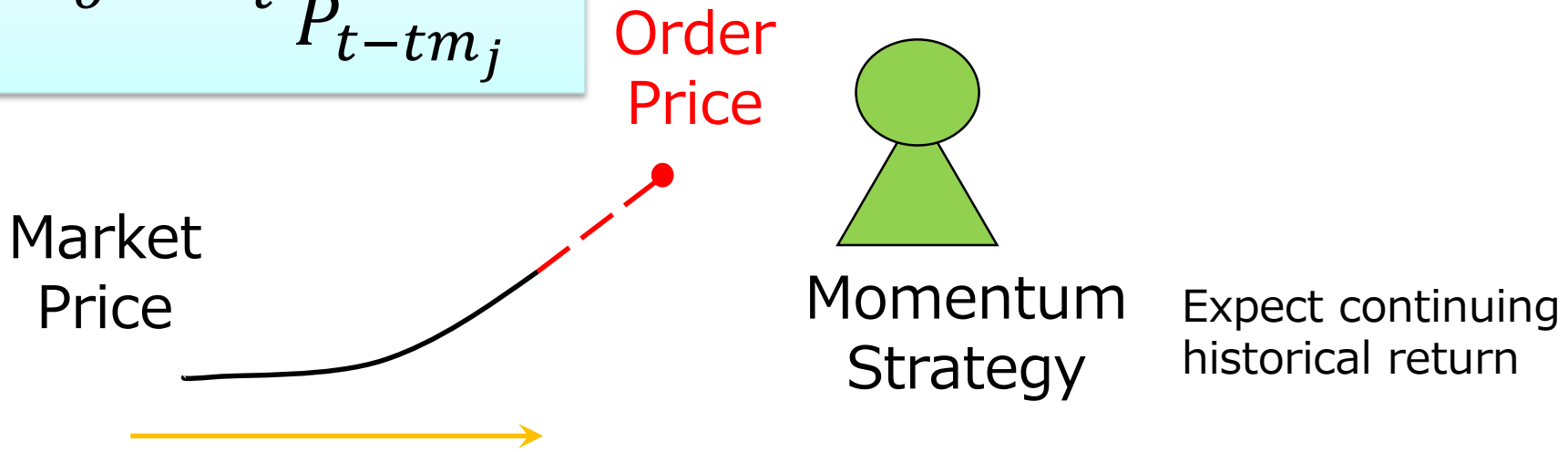
employ Momentum Strategy

Order Price

$$P_o = P_t \frac{P_t}{P_{t-tm_j}}$$

tm_j: reference term

given by random(1～100) for each agent



Determine Order price Referring only historical market price

Previous studies showed that such technical agents are needed to replicate price formations observed in real financial markets

Fundamental Agents

Number of Agents = 400

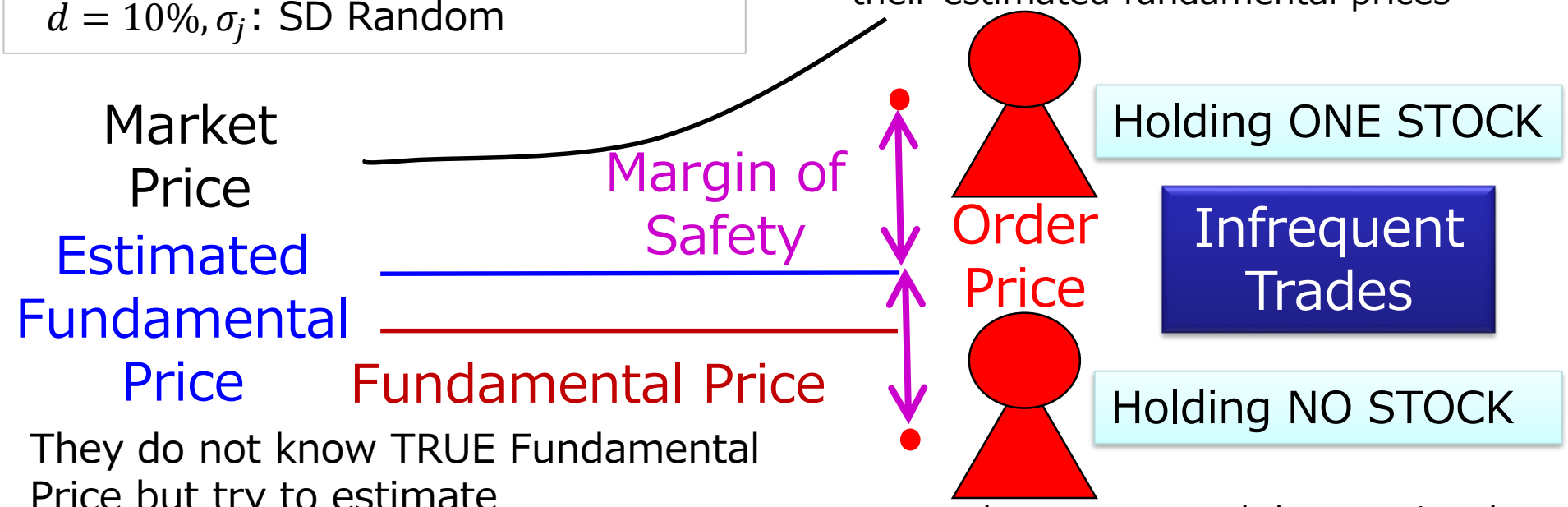
Order Price

$$P_o = P_f \exp\left[d\sigma_j \pm m_s\mu_j\right]$$

$m_s\mu_j$: Margin of Safety
$m_s = 10\%$
μ_j: Uniform Random(0～1)
±: when holding stock "+"
when holding No stock "-"

$P_f = 10{,}000$: Fundamental Price
$d\sigma_j$: Difference estimated fundamental price with true Pf
$d = 10\%, \sigma_j$: SD Random

want to sell at a enough higher price than their estimated fundamental prices



They do not know TRUE Fundamental Price but try to estimate

want to buy at a enough lower price than their estimated fundamental prices

Determine order prices by depending not on the market price, but on the Estimated Fundamental Price with Enough Margin of Safety which leads Infrequent Trades.

Competition Model

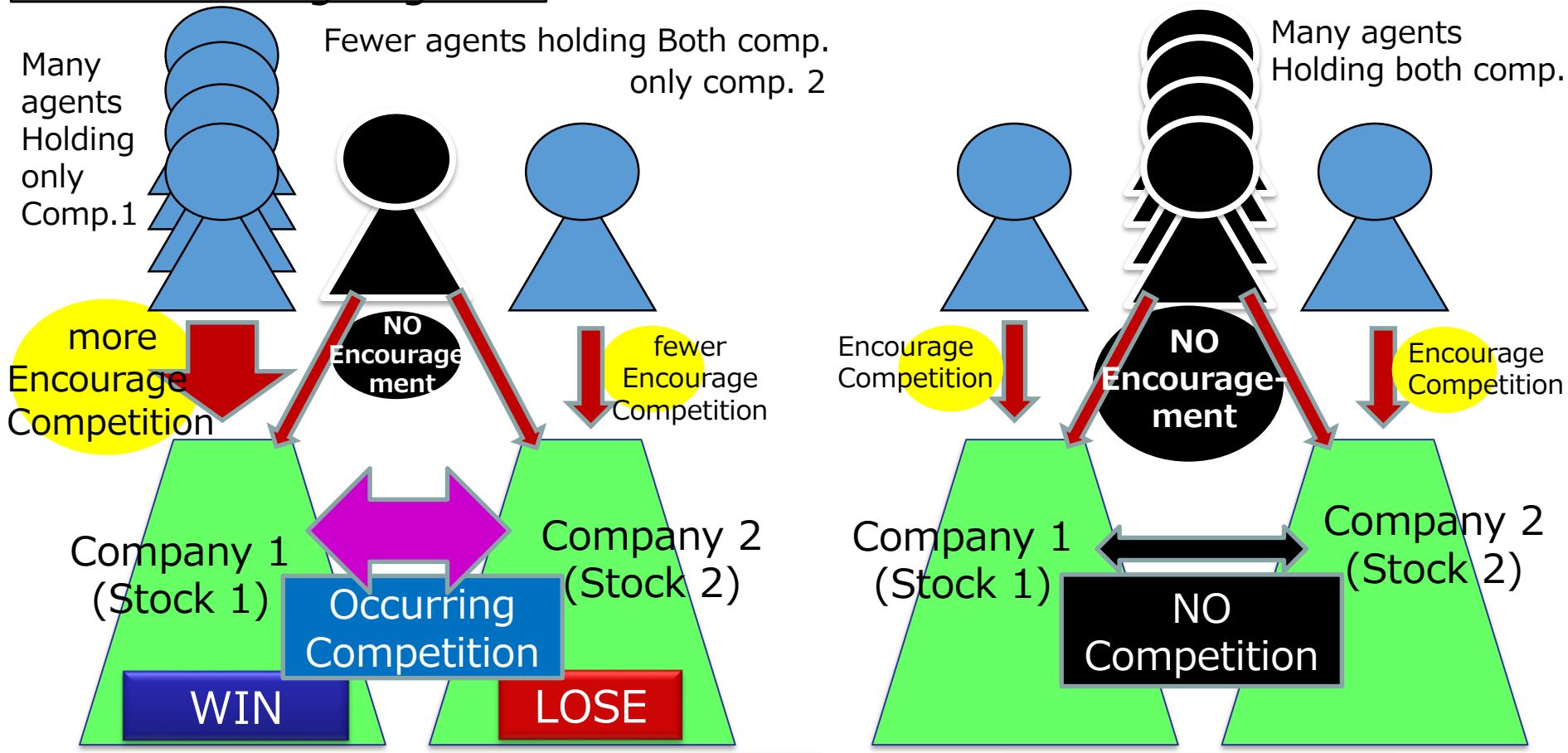
Previous empirical studies has showed no conclusion yet
Therefore, this Competition Model is strong assumption

(for last 100 steps) No. of holders decides whether occur competition or not (by 100 steps)

A Few Horizontal Shareholdings Agents

(Count for Only Fundamental agents)

Many Horizontal Shareholdings Agents



UP
Fundamental Price

Down
Fundamental Price

NO Change
Fundamental Price

price change width is 2500

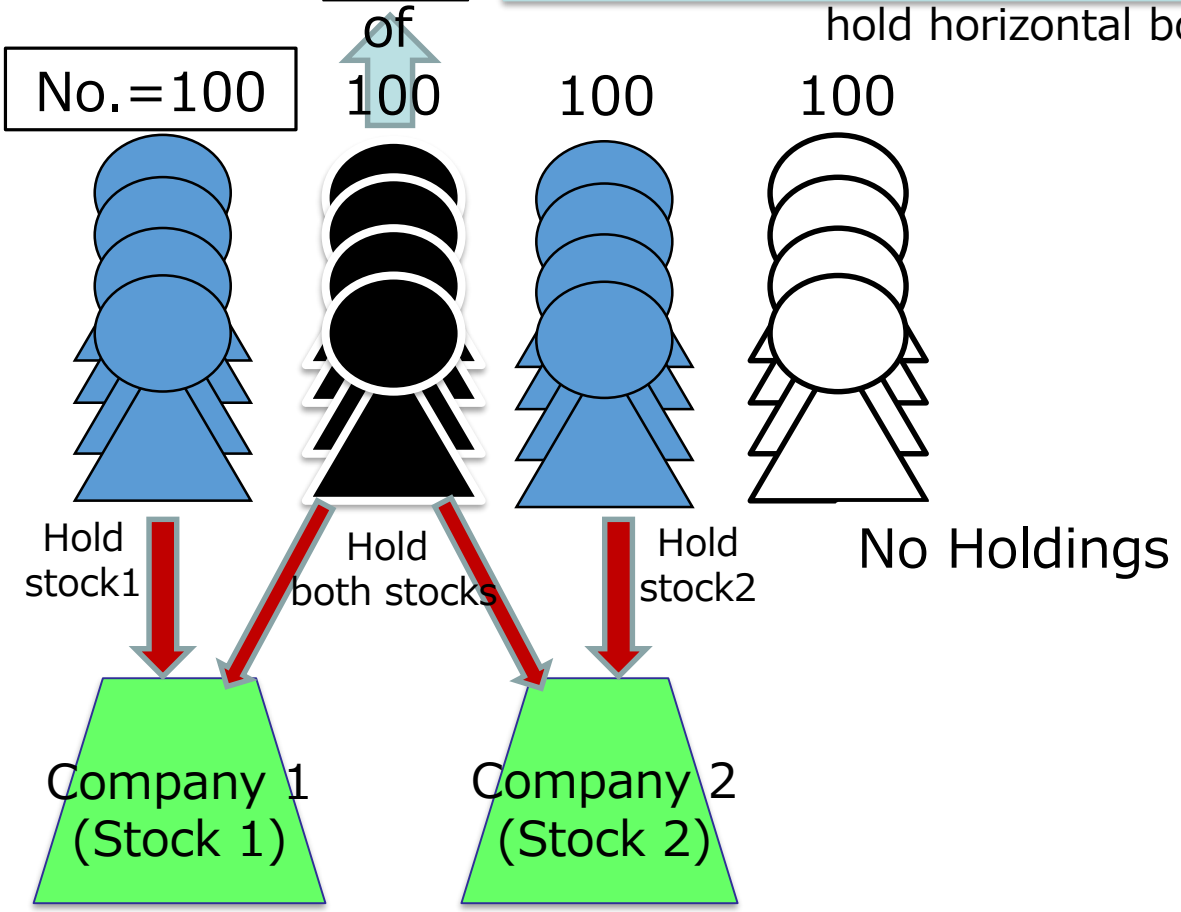
Index Agent Model

Initial Holdings of Fundamental Agents

Some of 100, N_{FP} of No.=100

Index Agents **never trade**

hold horizontal both stock forever



Changing N_{FP}, I investigated the effect of increasing horizontal shareholding with index funds on competition and market prices

(1) Introduction

(2) Artificial Market Model

(3) Simulation Results

(4) Conclusion

You can download this presentation material from
http://mizutatakanobu.com/201811.pdf

Verification of Model

Stylized Facts In the case of No. of Index agents = 100

standard deviation of returns	1.25%
kurtosis of price returns (Fat-Tail)	1.29

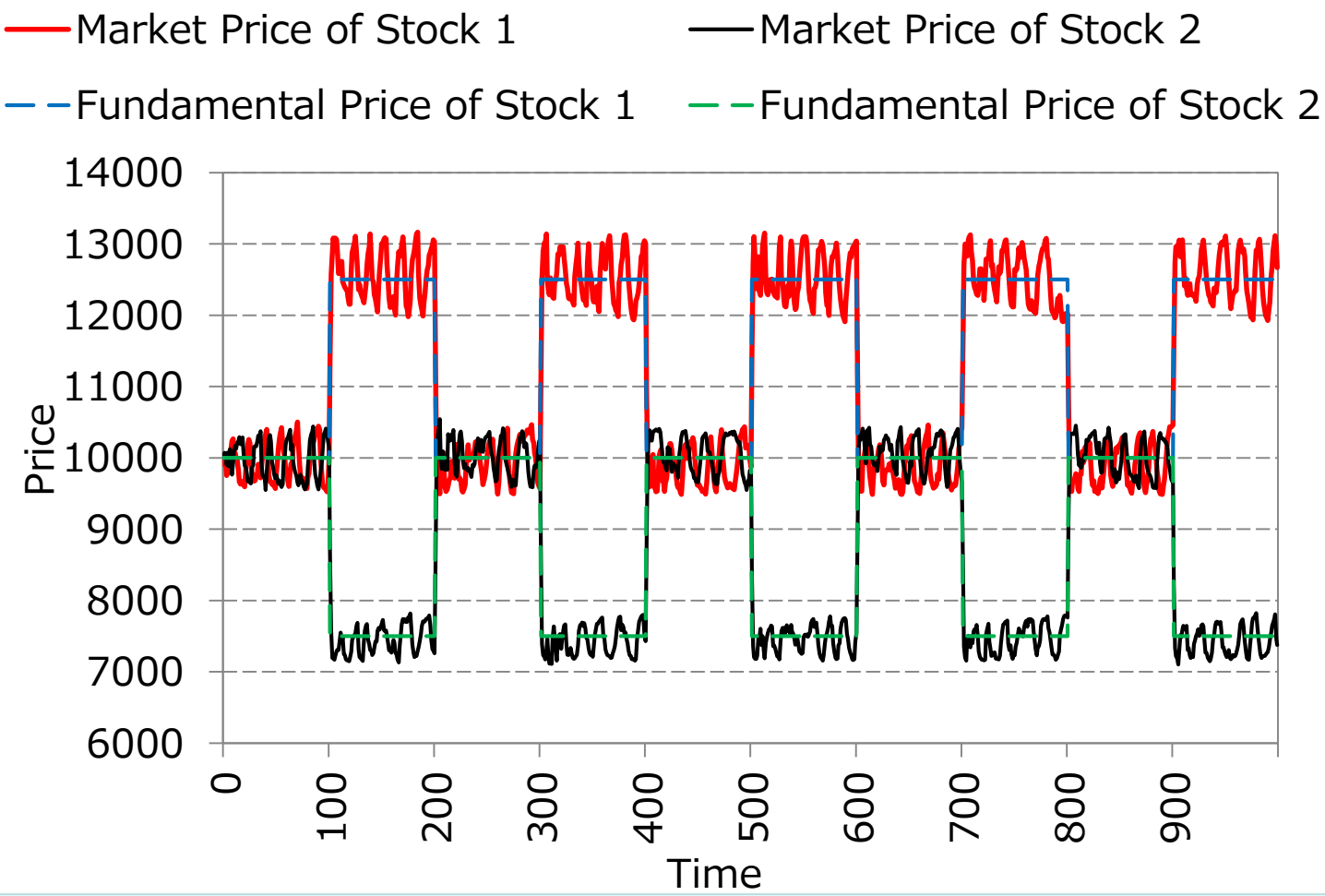
autocorrelation coefficient for square returns (Volatility-Clustering)

lag	
1	0.22
2	0.03
3	-0.09

Our model replicated the statistical characteristics (Stylized Facts), fat-tails, and volatility-clustering, observed in real financial markets.

Time evolution of market prices & fundamental prices

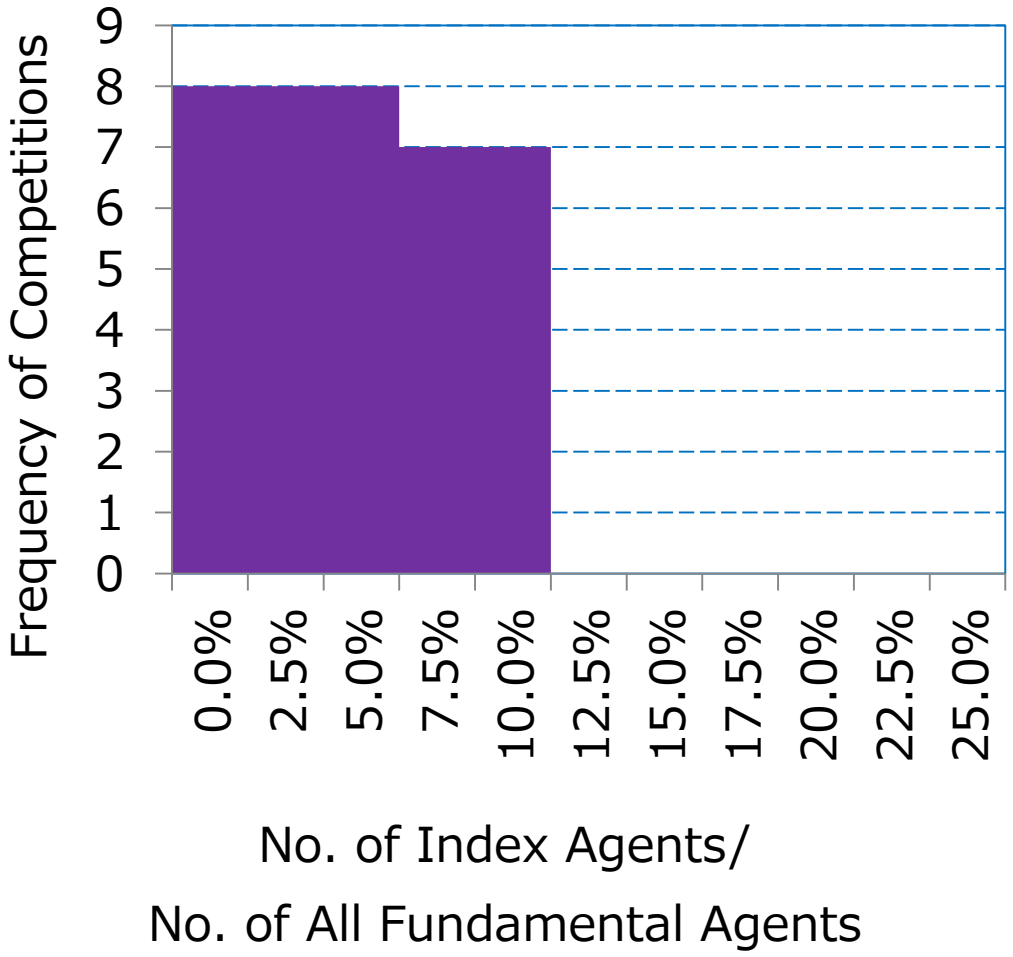
In the case of No index agents ($N_{FP}=0$)



The fundamental prices changed many times, and competition occurred frequently. Furthermore, the two companies won alternately.

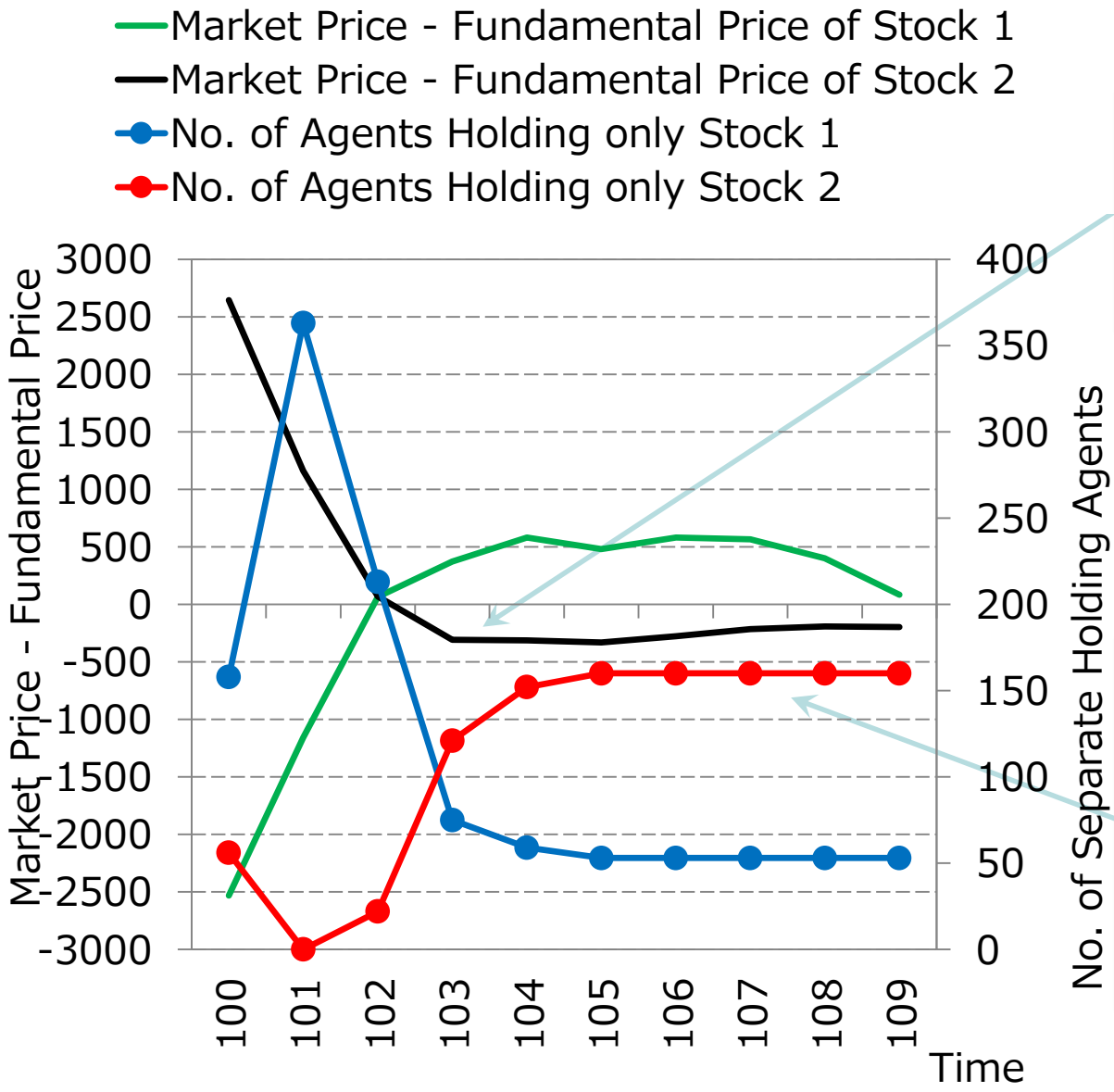
A mechanism that balances competition powers among corporations

Frequency of competitions for various No. of Index Agents



When the ratio >12.5%, competition never occurred.
Even when the existing ratio of index funds is not that large, the funds lessen competition.

Time evolution (expanding from t=100-110) of market price minus fundamental price and No. of Agents Holding only a Stock

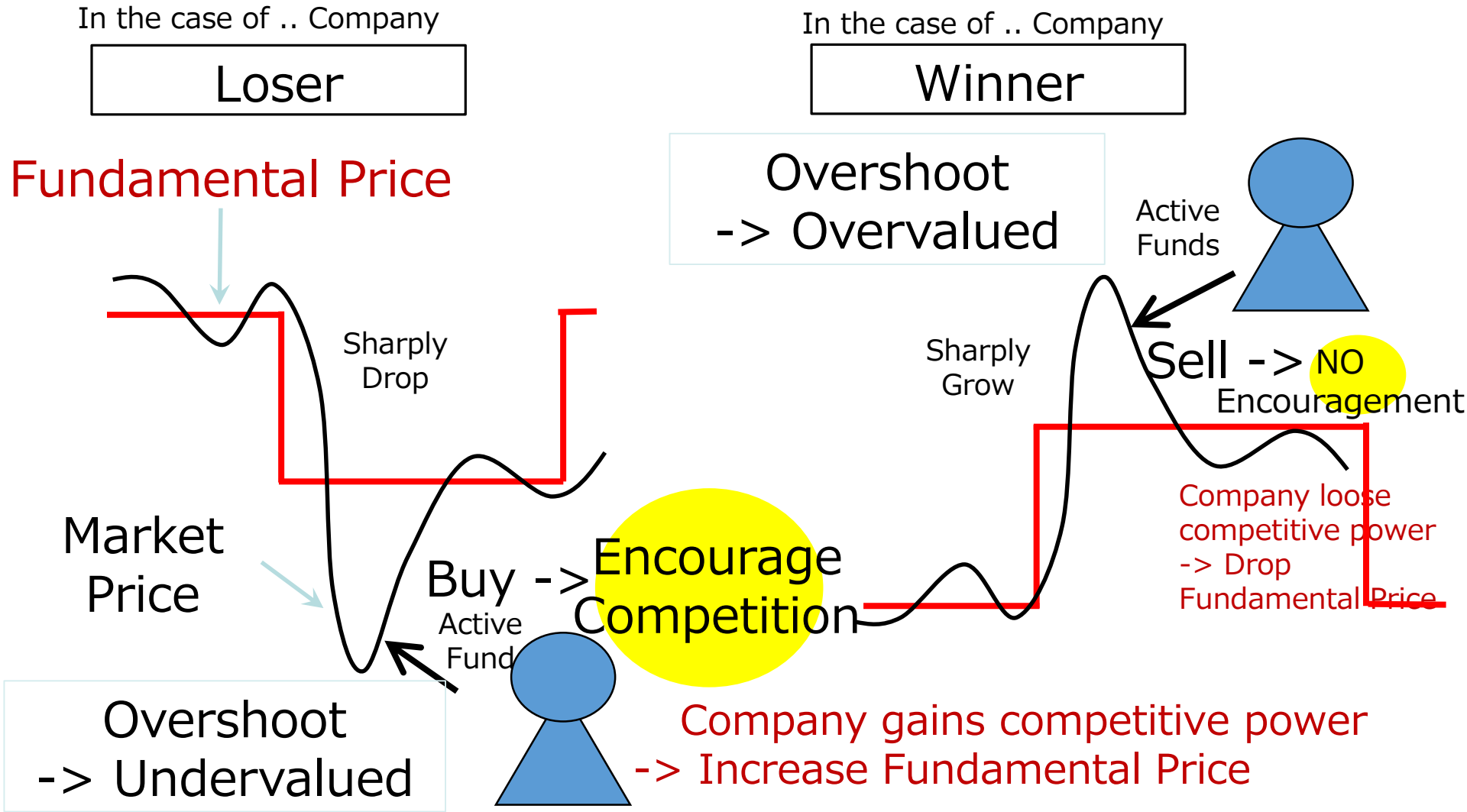


Stock 2 Prices:103-Orvershooted
(market price falls deeper than the company value)

Stock 2
-> Undervalued
No. of agents holding only Stock2 Increases
-> Stock(Company) 2 is Encouraged Competition

Overshoot leads to Buy Looser company

Mechanism to balance competition powers



This mechanism balances competition powers among corporations

Growing index funds may possibly weaken this balancing mechanism

(1) Introduction

(2) Artificial Market Model

(3) Simulation Results

(4) Conclusion

You can download this presentation material from
http://mizutatakanobu.com/201811.pdf

Conclusion

- ✓ In this study, I implemented a competition model, in which horizontal shareholding changes the business strategy of companies and lessens competition among companies, in the artificial market model of [Mizuta and Horie 2018]. I investigated the effect of increasing horizontal shareholding with index funds on competition and market prices.

- ✓ The result shows that even when the holding ratio of index funds is not that much, the funds lessen competition.

- ✓ When the value of a company unsuccessful at competition drops, its market price falls deeper than the company value (overshoots), and the company becomes undervalued; then, the number of shareholders who encourage competition increases, and the company gains competitive power, vice versa.

- ✓ My simulation result indicated that such a mechanism balances competition powers among corporations. Growing index funds may possibly weaken this balancing mechanism.

That's ALL, Thanks!!

Reference

Empirical Study for Horizontal Shareholdings

- [Azar 14] Azar, S. M. C., Jose and Tecu, I.: Anti-Competitive Effects of Common Ownership, SSRN Working Paper Series (2014), https://ssrn.com/abstract=2427345
- [Elhauge 16] Elhauge, E.: Horizontal Shareholding, Harvard Law Review, Vol. 129, No. 5, p. 1267 (2016), https://harvardlawreview.org/?p=4185
- [Fichtner 17] Fichtner, J., Heemskerk, E. M., and GarciaBernardo, J.: Hidden power of the Big Three? Passive index funds, re-concentration of corporate ownership, and new financial risk, Business and Politics, Vol. 19, No. 2, p. 298326 (2017), https://doi.org/10.1017/bap.2017.6
- [Piketty 13] Piketty, T.: Le Capital au XXIe siècle, Éditions du Seuil (2013), https://www.msz.co.jp/book/detail/07876.html

Artificial Market Model (Agent-Based Model)

- Mizuta (2016) A Brief Review of Recent Artificial Market Simulation Studies for Financial Market Regulations And/Or Rules, SSRN Working Paper Series http://ssrn.com/abstract=2710495
- [Mizuta 18] Mizuta, T. and Horie, S.: Mechanism by which active funds make market efficient investigated with agent-based model, Evolutionary and Institutional Economics Review https://doi.org/10.1007/s40844-018-0102-0
  Full Text: https://rdcu.be/7mVh

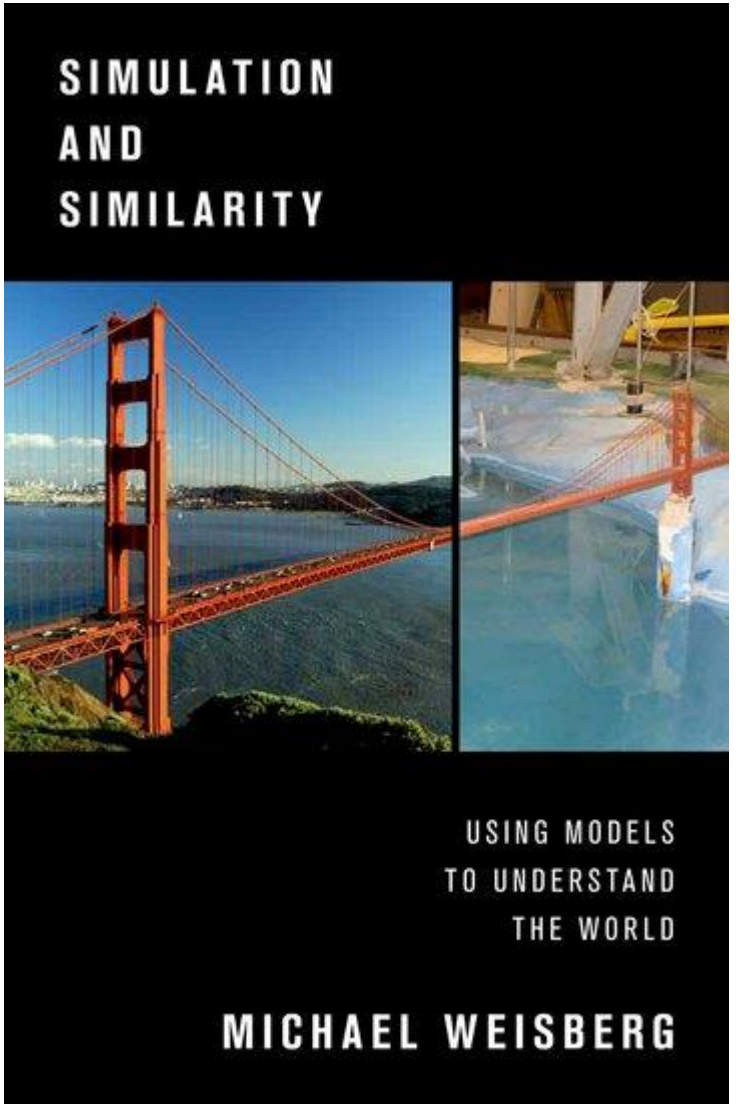
You can download this presentation material from
http://mizutatakanobu.com/201811.pdf

Appendix

You can download this presentation material from
http://mizutatakanobu.com/201811.pdf

What is a role of Simulation Models?

This book answer the question.
And also answer “What is a model?”



Simulation and Similarity Using Models to Understand the World, 2012
https://global.oup.com/academic/product/9780199933662

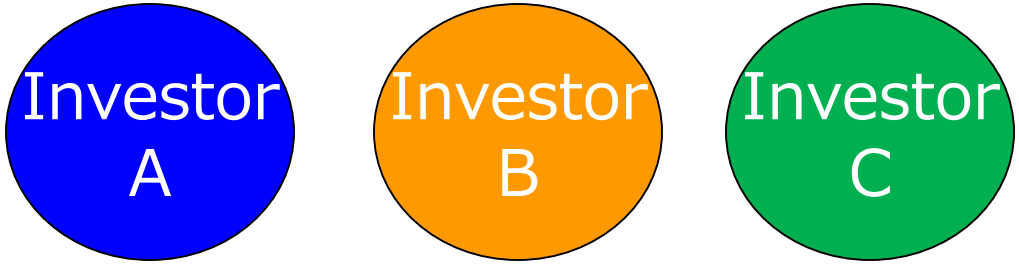
Aim is not replicating nor forecasting real world

In time, those Unconscionable Maps no longer satisfied, and the Cartographers Guilds struck a Map of the Empire whose size was that of the Empire, and which coincided point for point with it . . . In the Deserts of the West, still today, there are Tattered Ruins of that Map, inhabited by Animals and Beggars;

On Exactitude in Science Jorge Luis Borges

* Modeling, (is) the indirect study of real-world systems via the construction and analysis of models.
* Modeling is not always aimed at purely veridical representation. Rather, they worked hard to identify the features of these systems that were most salient to their investigations.
* Textbook model of the cell is both abstract and idealized relative to any real cell. It is abstract because it isn't a model of any particular kind of cell; it is a model of properties shared by all eukaryotic cells. Relatedly, it is idealized because its generality forces some parts of the model to be distorted relative to any real cell. I think these are both interesting properties,

Role of Model (in the case of Agent-Based Artificial Market Model)



Inherit Only Important Properties
(Behaviors, Algorithms) for Investigating Phenomena

Model of Investors

Never Real-Existing Investor
For Understanding Properties
of Real-Existing Investors

e.g.: Fashion Model: Understanding Closes
Model Home: Understanding Home

Other Investigating
Phenomena,
Other Important Properties,
Other Good Models

An Aim is to understand how Important Properties (Behaviors, Algorithms) affect Investigating Macro Phenomena and play Roles in System.

It is NOT aim Replicating real-existing Investors A, B and C.
It is aim Understanding real-existing Investors.

Other Focusing Phenomena, Other Good Models

What simulation(computational) model can do and mathematical model can not do

* When one invokes a computational model to explain some phenomenon, one is typically using transition rules or algorithm as the explanans. Schelling explained segregation by pointing out that small decisions reflecting small amounts of bias will aggregate to massively segregated demographics. Neither the time sequence of the model's states nor the final, equilibrium state of the model carries the explanatory force; the algorithm itself is needed.

Algorithms: The As want at least 30% of their neighbors to be As and likewise for the Bs. An agent standing on some grid element e can have anywhere from zero to eight neighbors in the adjoining elements

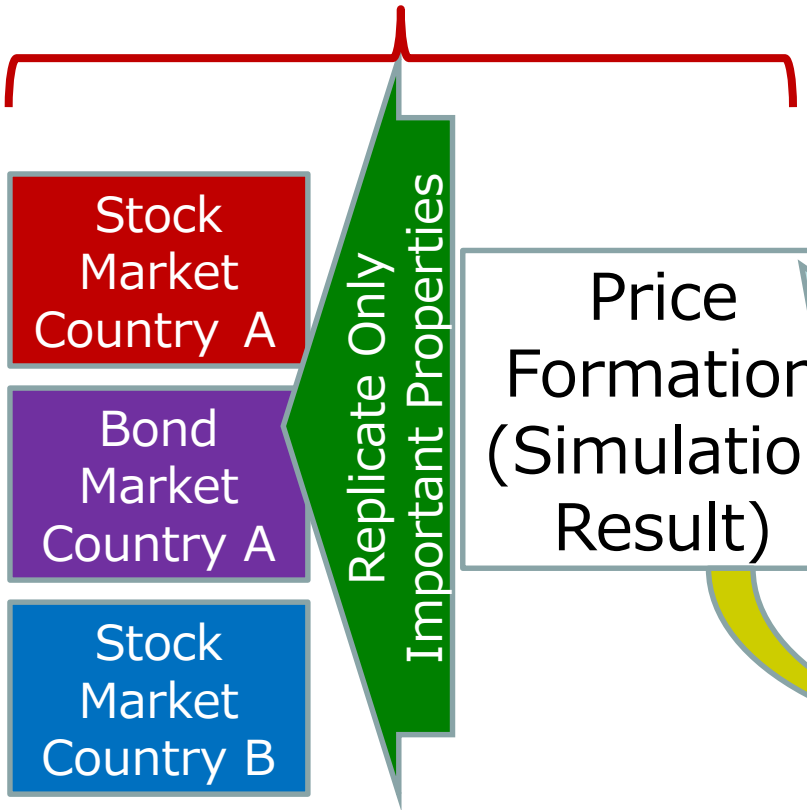
Figure 2.2 An example of Schelling's model of segregation on a 51 × 51 grid with 2000 agents. Each agent prefers 30% of its Moore neighbors to be the same shape and color. The initial distribution of agents was random, and the model equilibrated after fourteen time steps.

Role of Model (cont.)

We want know a relationship between
Micro Process:
Deciding Orders, Rules of Exchange
& Macro Phenomena: Price Formation

Mathematical Model
Macro Model

can treat only this region



Model of Investors

Inherit Only Important Properties

Investor A

Investor B

Investor C

Deciding Orders
(Algorithms)

Model of Exchange

Change Rules

Price Formation (Simulation Result)

Matching Orders
(Aggregation of Algorithms)

We want know a relationship between them