Complexity in Financial Markets

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Presentation Outline

- Introduction to financial markets
- Characterizing complexity in financial markets
- Methods of modeling
- Conclusion
Why care?

- Strong ties between financial markets and Economic Growth.
- Historically one of the best investing Options
- Strong growth in Swedish financial sector
- Pension
From Simple Trade to Currencies
Beginning of stock market

- More advanced ship technology opened up lucrative spice trade
- High risk / high reward
- Dutch East India Company
  - First Joint Stock Company 1602
  - Later traded at Amsterdam Stock Exchange
Financial Market

- Platform for buying or selling financial instruments
- Currency, stocks and obligations
- Room for speculation
- Example stock market
  - Stocks give dividends
  - Not known in advance
Outlining the complexity

- Some areas of complexity
  - Investor (agent) interaction complexity
  - Asset Complexity
  - Intermarket complexity
- Emergence of trends
Agent Interaction Complexity

- Many types of Investors
  - Long Term investors
  - High frequency trading bots
  - Large and small investors
- Investors able to adapt to previous market events
- Decision making
  - Limited information
  - Bounded rationality
  - Herd Behaviour
Asset Complexity

- Modern case study of a contemporary financial instrument
Asset Complexity - The Modern Case of Ericsson B

- Swedish ICT Company
  - Wide range of products including cars
  - Most revenue from telecom networks
  - Traded as ERIC-B at NASDAQ Nordic
- Crisis
  - Mass layoffs announced
  - CEO replaced
- What will affect the company's earnings and dividends?

Lynk & Co 01 - Collaboration between Ericsson and Geely
Asset Complexity - The Modern Case of Ericsson B

- Weak growth in key markets Europe (1.9 %) and Latin America (-0.2 %)
- Competition
  - New arrivals from China (Huawei & ZTE)
  - Mergers Nokia-Siemens & Acatel-Lucent → Nokia
- Exchange rate: Strong euro benefits Ericsson
- Geopolitics: Huawei and ZTE banned in Australia, India and USA
- Rumour: Cisco buyout
- Technology: 5G and WiFi
- New CEO and layoffs
Asset Complexity - The Modern Case of Ericsson B

- Is Ericsson B over or undervalued?
- How will other investor react, rationally and irrationally?
Asset Complexity

- Many parameters to consider
- Determinism vs randomness
- Can future performance be known?
Intermarket Complexity

- All financial markets are interconnected
- Financial crisis 2008
  - Sub-prime mortgage obligations
  - Banking collapse
  - Stock market crash
  - Global recession
- Global Macro
  - Interprets global large scale events
  - Politics, GDP, interest rates

George Soros - Prominent Global Macro speculator
Modeling the System

● Many ways to model a financial system
● In general very difficult because of the complexity
● Some categories include
  ○ Intelligent agents
  ○ Different models in Quantitative Finance
  ○ Different models in Financial Econometrics
Modeling the System - Intelligent agents

- Model investors with artificial intelligent agents
- Simplify levels of complexity
- Used for simple instruments
- Simulation of Market Crash
Modeling the System - Finding Emergent Trends

- Two approaches
- Quantitative Finance
  - Focus on mathematical theory with limited financial theory
- Financial Econometrics
  - Parameterization of financial theory
Modeling the System - Quantitative Finance

- Focus on mathematical theory with limited financial theory
- How would the price of a stock option change when the underlying stock change?
- Bad at predicting large scale events such as market crash
Modeling the System - Quantitative Finance

- Time series stochastics
  - STO, DYNSYS, ANN
- Order information
  - Game Theory

Order information

Some kind of time series analysis
Modeling the System - Timber Hill Trials

- Timber Hill Europe AG had trading bots watching order statistics at Oslo Stock Exchange
- Catch any market move
- Without knowing the algorithm in detail two Norwegian day traders managed to systematically place counter orders
- Found guilty of market manipulation and sentenced to six years in prison by the Norwegian Royal Court
- Repealed by Norwegian Supreme Court
Modeling the System - Financial Econometrics

- Financial theory in general unspecific
- Parameterization on financial theory
- How will lowered ECB interest rates affect American Collateralized Debt Obligations (CDOs)?
  - Federal funds rate affects mortgages
  - ECB rates affect the Federal funds rate

![Graph showing US and Euro(pan) policy rates](Image)
Modeling the System - Financial Econometrics

- Capital Asset Pricing Model
- Data Scraping
  - Yoshinori Nomura
  - AI predicted Brexit using web scraping
  - Short selling Japanese Index Futures

\[ \frac{E(R_i) - R_f}{\beta_i} = E(R_m) - R_f \]

Decorative equation

Hedge Fund Manager Yoshinori Nomura
Conclusion

- Simple one to one bartering has grown into a global financial system
- Financial markets are complex in many ways
- Attempts have been made using intelligent agents, financial econometrics and quantitative finance
References

Cristelli, Matthieu (2014), Complexity in Financial Markets

E Samanidou, E Zschischang, D Stauffer, and T Lux, (2006), Agent-based models of financial markets

Jie Wang, Jun Wang, (2014), Forecasting stock market indexes using principle component analysis and stochastic time effective neural networks

1. Machines are taking an increasingly larger role on financial markets. Is it safe to trust machines with such a key role in today's society? Who bears responsibility when things go wrong?

2. Does the existence of AIs on financial markets in some way actually improve the quality of people's lives?

3. If we had a way of predicting financial crashes with high certainty, would these crashes still happen?
Uppdelning:

Mattias

- Modern Case och analys (7-13)
- Methods of Modeling (14-23)

Oskar

- Introduktion till första aktiemarknaden (1-6)
- Sammanfattning och Diskussion (22-23)
Övrigt?

- Arbitrage
- Kaosteori
- Tidsserier och liknande försök
- Spelteori
- Web scraping
- Tre nivåer: underliggande tillgång, andra spelare och andra marknader
Stock market

- TimeSeries - Trend for specific stock between all investors
- Cross correlation
- Collective behaviour during extreme market events
Herd Behaviour

Theory in which relies on local interactions

Usually from recommendations, articles, etc

Based on social behaviour, as we like to follow the herd

Usually not a good strategy
Discussion points

Given the behaviour of the financial markets, what can be done to minimize the risk associated with financial markets?

- Is it OK to trust machines with such an important role in society?
- What kind of regulation is needed?
- Is it too complex to be safe
- Given all information, is the result certain? (determinism)
- Will machines improve investment decision (AI mot AI)
Dynamics of Stock market

Split in global interactions and local interactions.

Local interactions
Herd Behaviour

Global interactions
The Three Levels of complexity

- Formally the complexity can be divided into three levels
- Trend for specific stock between all investors
- Correlation
- Cross correlation
- Collective behaviour during extreme market events
Complex Network

Stock price dynamics before crashes: A complex network study on the U.S. stock market

Dynamics of Chinese stock market from a complex network perspective

Samma som data mining?
Chaos Theory

Asien krashen

The dynamics of a complex system: The exchange rate crisis in Southeast Asia

Ersätter finanskrisen 2008

Teknisk analys

Quantative finance