Financial traders' network and Systemic risk spillover channels

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Abstract

This paper estimates financial network among 8 types of traders across 5 different capital markets, which are stock, stock derivative, bond, bond derivative, and foreign exchange derivative market. In order to overcome the limit of VAR and reflect real trading decision making procedures, expectation forecasting of traders' net trading volume on next day is included in analyses. Expectation forecasting values are predicted with LSTM (Long Short Term Memory), one of the most popularly used machine learning method. In addition, the systemic risk spillover channels are investigated using network measures. 3-phased systemic risk spillover channels which is the link of the volatility of financial indexes, traders' network measure and traders' daily net trading volumes, are modeled. I find potential systemic risk spillover channels which are through influential traders and their trading volumes.

Introduction

- **Motives**

1) Foreign investors' influence to local mkt.
2) Over-concern on foreigners' outflow
3) Systemic risk spillover channel (foreign investors? or others?)

- **Research Questions**

1) How do the traders inter-relate across capital markets?
2) If there's a shock in capital market, which channels do the risk spill over?

- **Research Gaps**

1) Foreigners: no relation with others
2) VAR assumption: not real trading
3) Network : not much trader's network
4) Systemic risk: not spill over channels

- **Contribution**

1) Estimated traders' network
2) Reflected real trading decision making
3) Found risk spill over channels(traders)
4) Provided information for policy makers

Data

1. **Daily net trading volume** in 5 Korean Capital markets (1/1/2006 ~ 31/12/2015)

2. **Traders**
IND(individual), BANK, FI(securities company), CIS(mutual fund), OTH(others)
INS(insurance company), GOV(government), FOR(foreign investors)

3. **Markets**
SU(stock, KOSPI), SD(stock derivative, KOSPI 200 futures), BU(bond),
BD(bond derivative, KTB 3yrs futures), FXD(FX derivative, KRW/USD futures)

Methodology

1. **Gaussian kernel regression (nonlinear approach)**

$$X^{u}_{t+1} = \Phi(X_t, E_t[x_{t+1}|X_t]) + \varepsilon_t$$

Φ : Gaussian kernel, X_t : traders' daily net trading volume vector
$Et[y_{t+1}|X_t]$: traders' expectation forecast on trader x's trading volume on next day

2. **Expectation forecast : LSTM (Long Short Term Memory)**
As a proxy of expectation forecast on trader x's trading tomorrow, forecasted value with LSTM is used.

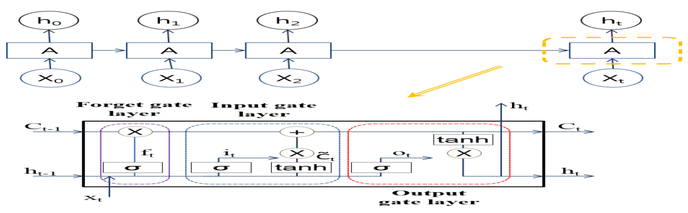


Figure1: The structure of an LSTM

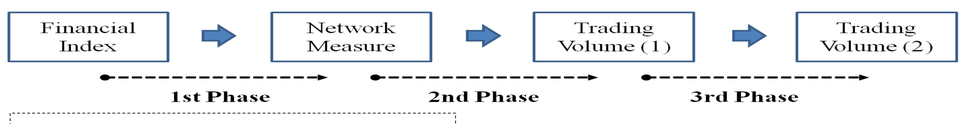
3. **Granger causality Matrix(C_{ij}) : trader x_i's influence on trader x_j**

$$C(x_i \rightarrow x_j) = C_{i,j} = ln\left(\frac{\sigma^2(x_{j,t+1}|X_t)}{\sigma^2(x_{j,t+1}|X_t, E_t[x_{i,t+1}|X_t])}\right)$$

(numerator) forecast error of RHS without expectation forecast
(denominator) forecast error of RHS with expectation forecast

4. **Connectedness measure**
OUT : trader x_i's influence to others, row sum of Granger causality Matrix
IN : Other traders' influence on x_i', column sum of Granger causality Matrix

5. **Systemic risk spillover channels : 3-phased impulse response analysis**



1st Phase : Shock at financial index
➔ Traders' connectedness measure

2nd Phase : Shock at connected measure
➔ Traders' daily net trading volume

3rd Phase : Shock at trading volume
➔ Traders' daily net trading volume

Network Estimation Result

1. Monthly Connectedness measure
(Monthly average values)

(OUT) Influential (central) traders
(orange circles)
4 Foreign investors
2 Banks, 2 Individual trader
1 Financial Investment
➔ **Foreign investors' influence** is found.

(IN) Not much difference (blue circles)

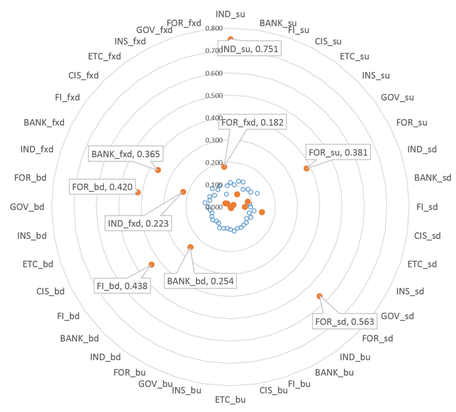


Figure 2 : Average Monthly Connectedness /measures

2. Daily Connectedness measure
(Daily average values)

Almost same results with Monthly connectedness measures Only with one exception, which is Collective investments scheme in Stock derivative market is added to influential traders.

(Result)
Influential traders are found within the Network structure.

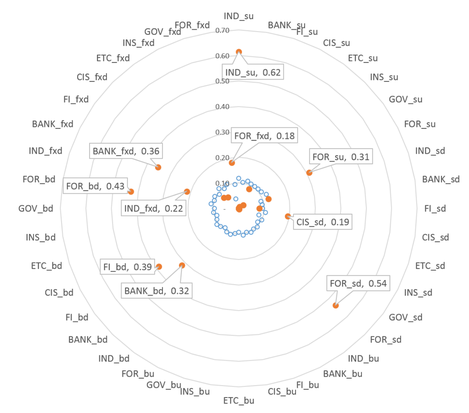
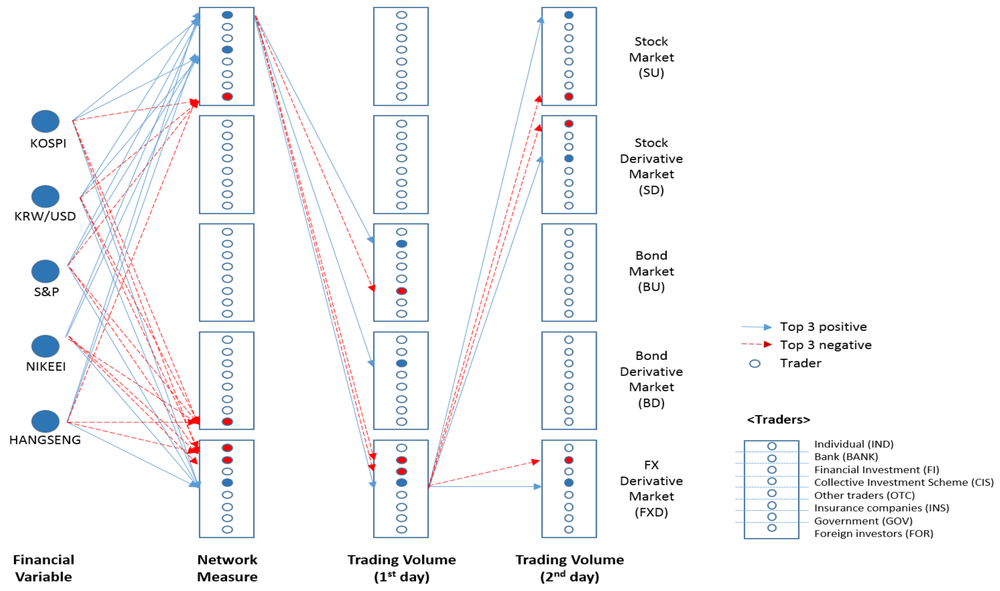


Figure 3 : Average Daily Connectedness /measures

Systemic risk spillover channels



1. 1st Phase : The positive and negative shocks in financial indexes **"converge"** to **relative 3 traders'** connectedness measures. (**Foreign investors** in **stock** and **bond derivative** market are included and react **negatively**.)

2. 2nd Phase : The shocks of connectedness measures **"diverge"** to other traders' trading volumes **in different markets.**

3. 3rd Phase : **"Strong autocorrelation"** is found at the shock of a trader's trading volume and same traders' **trading volume** on next day.

Conclusion and Discussion

[Conclusion]

1. Systemic risk in financial market can spillover through the network measures and trading activities of influential traders'.

2. Foreign investors in local market are influential but they function in the direction that systemic risk decreases.

[Policy Suggestion]

1. Influential traders within the network structure can be the tool for market stabilization, if policy makers are well aware of their influence and the role in the market.

2. Imposing a restriction on the trading of positively reacting traders to the systemic, or incentivizing the traders who respond negatively, can be an effective financial market stabilization policy.