

Structural Differences of the Brazilian Stock Market

Shawn Leahy, Sary Levy-Carciente,
H. Eugene Stanley, Dror Y. Kenett

Outline

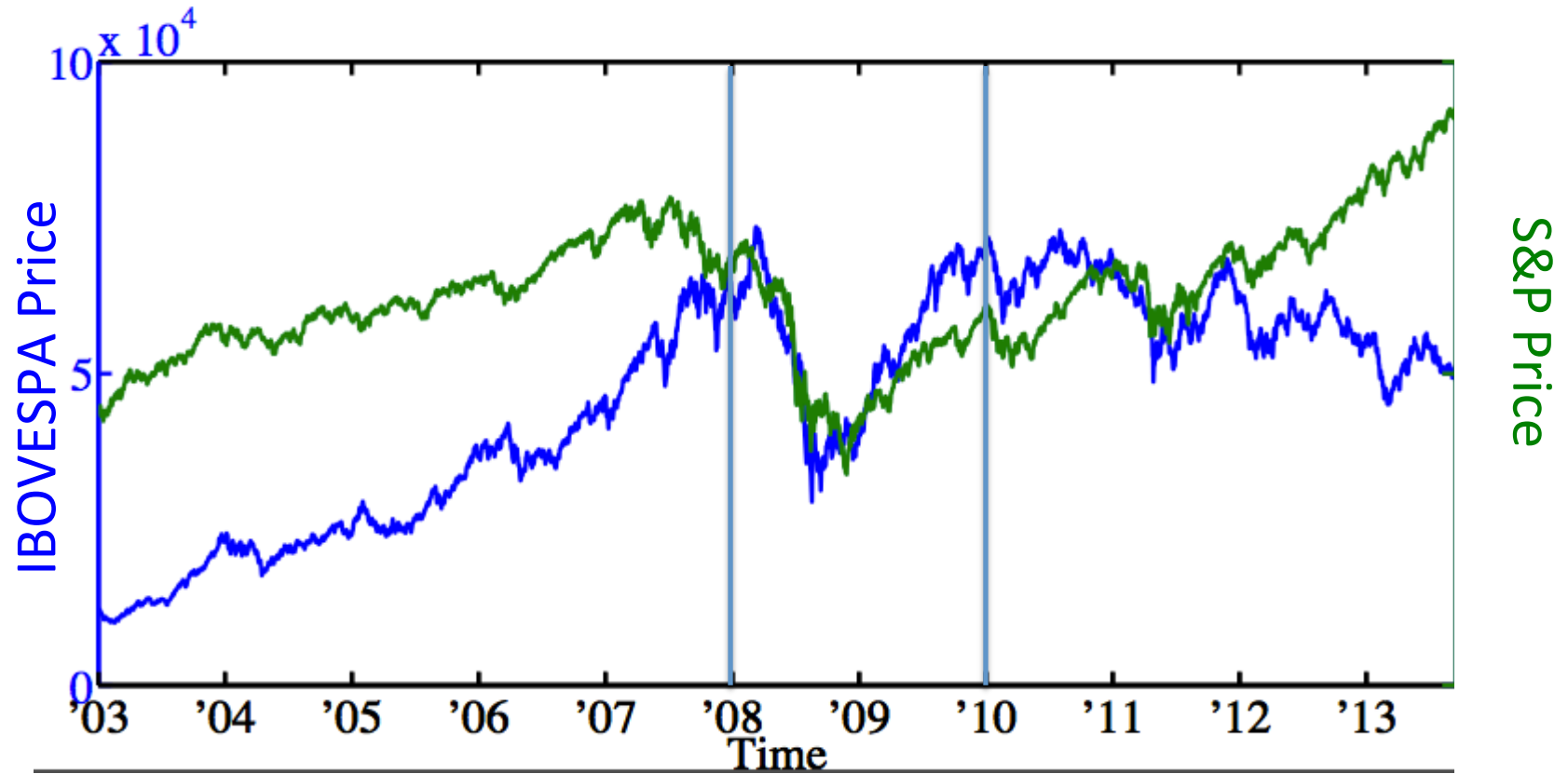
- Purpose
- Theoretical Perspective
- Methodology
- Similar Analyses
- Brazil at a glance
- Results
- Conclusion

Purpose

- Understanding the structure and dynamics of financial markets
- We look at the effect of the market index on the correlations of its components and how they change over time
- There are different types of markets with different types of connections and relationships so the results of one market do not necessarily hold for all
- We use the Brazilian stock market as it has a better behavior before, during and after the most recent financial crisis
- Can we find a way to distinguish stock market healthy growth from the formation of a bubble?

Theoretical Perspective

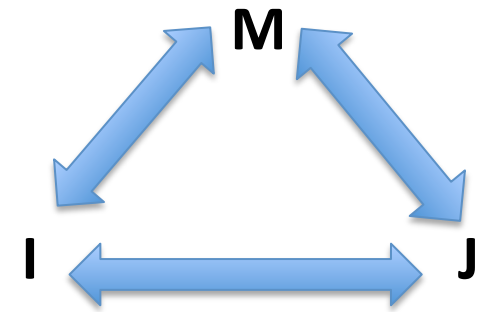
Brazilian Index Price and S&P 500 Price



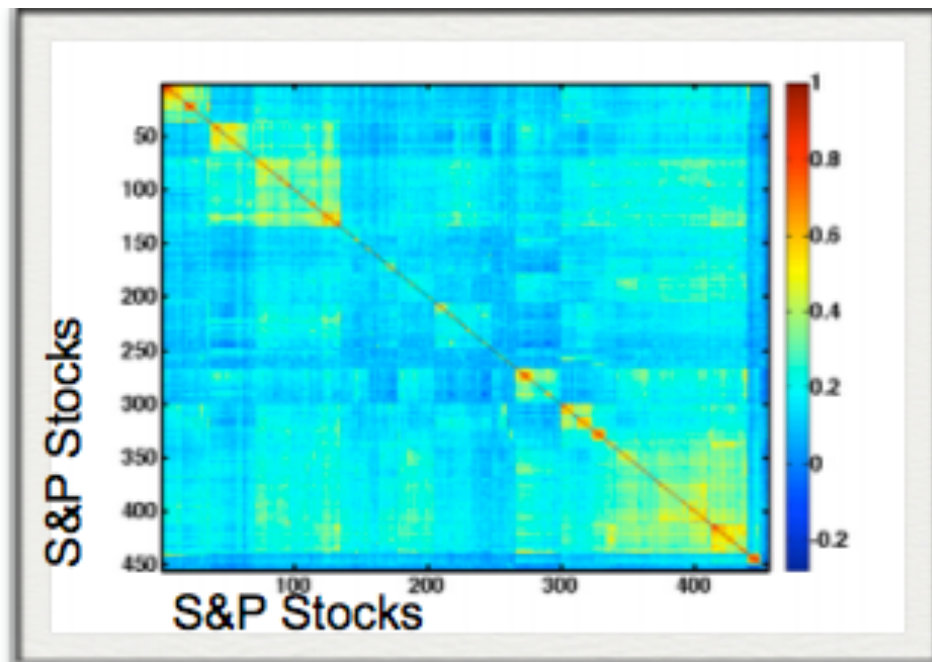
Transform using:

$$r_i(t) = \log P_i [(t)] - \log P_i [(t - 1)]$$

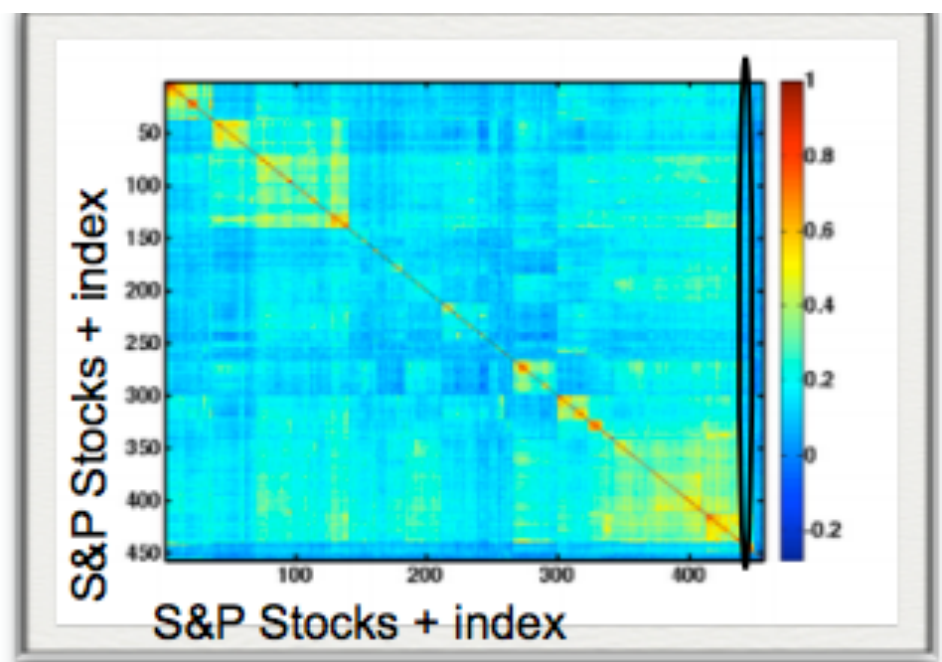
Stock Correlations



- $$C(i, j) = \frac{\langle (r(i) - \langle r(i) \rangle) \cdot (r(j) - \langle r(j) \rangle) \rangle}{\sigma_i \cdot \sigma_j}$$



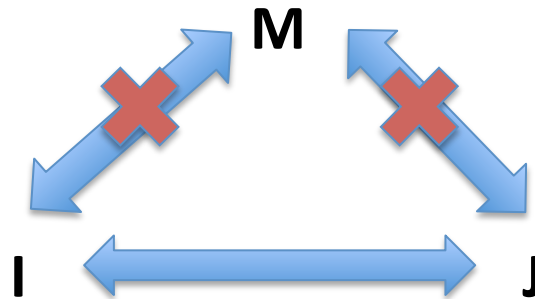
Without Index



With Index

Partial Correlations

- The partial correlation (residual correlation) between i and j given a mediating variable m , is the correlation between i and j after removing their dependency on m ; thus, it is a measure of the correlation between i and j after removing the affect of m on their correlation

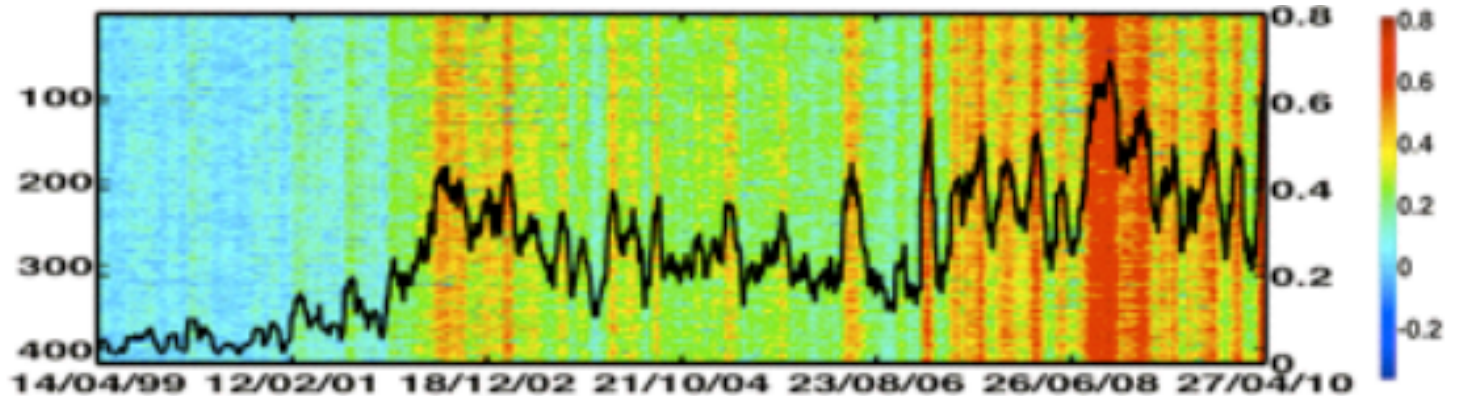


$$PC(i, j | m) = \frac{C(i, j) - C(i, m) \cdot C(j, m)}{\sqrt{(1 - C^2(i, m)) \cdot (1 - C^2(j, m))}}$$

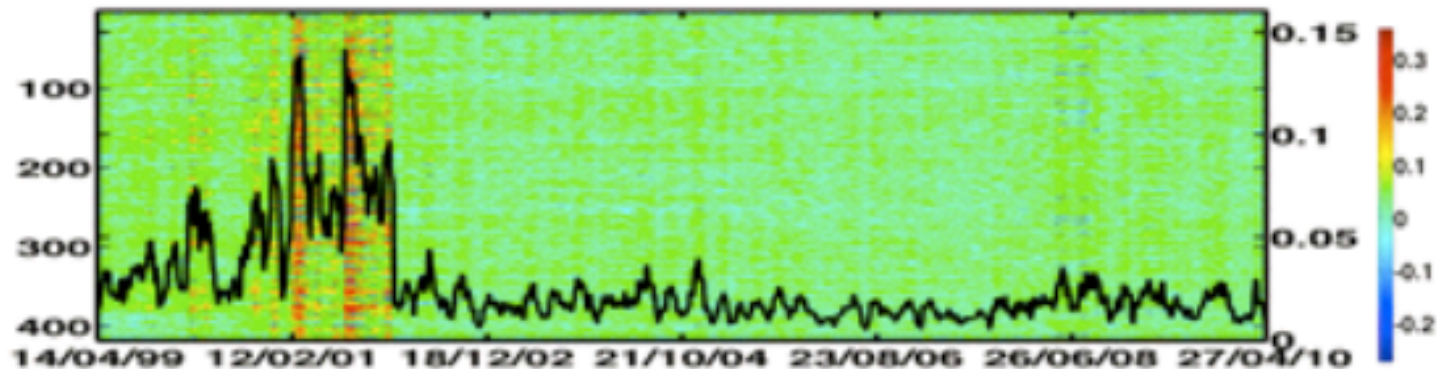
Similar Analyses

Correlations over time of S&P 500 stocks in U.S.

Correlations
Among stocks



Partial
Correlations
Excluding
The index



Dror Y. Kenett, Yoash Shapira, Asaf Madi, Sharron Bransburg-Zabary, Gitit Gur-Gershgoren, and Eshel Ben-Jacob (2011), *Index cohesive force analysis reveals that the US market became prone to systemic collapses since 2002*, PLoS ONE 6(4): e19378

- Similar results have been found for other markets such as U.K., Germany, Japan, and India
- U.K. Germany, and U.S. all track each other closely
- Japan and India are not as uniform, but still follow time dependence

Kenett DY, Raddant M, Lux T, Ben-Jacob E (2012) [Evolution of Uniformity and Volatility in the Stressed Global Financial Village](#). PLoS ONE 7(2): e31144. doi:10.1371/journal.pone.0031144

Data for Brazilian Stock Market

- 29 Brazilian Stocks from 1/03 - 12/13

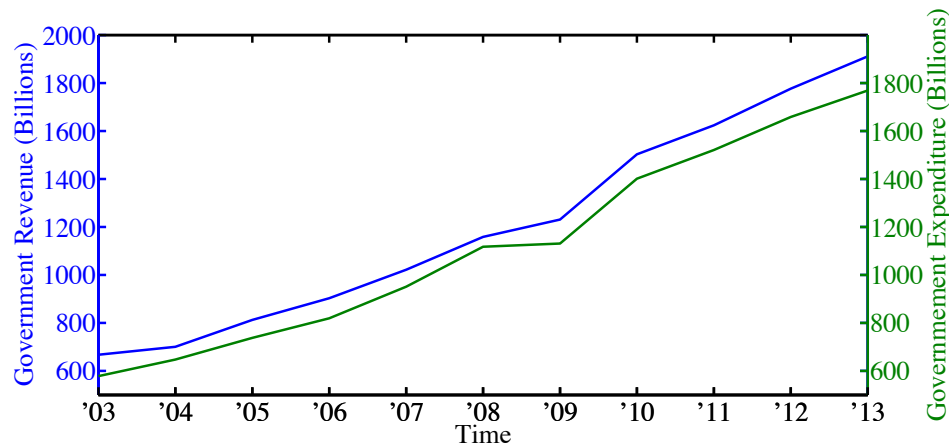
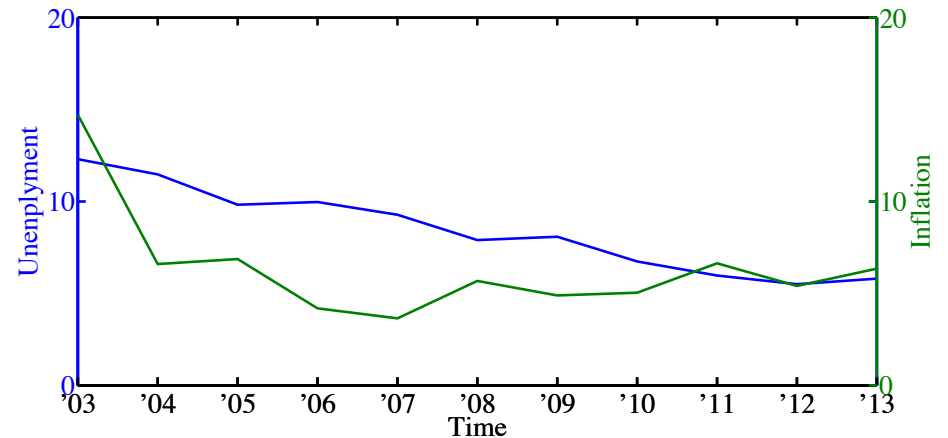
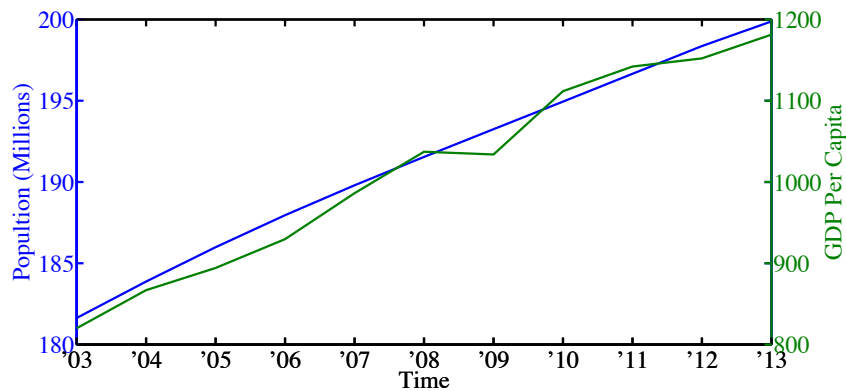
1	ALL AMERICA LATINA LOGISTICA S.A.	16	CIA HERING
2	BCO BRASIL	17	TAUSA
3	BRADSPAR	18	ITAUUNIBANCO
4	BRF SA	19	LOJAS AMERIC
5	CCR SA	20	LIGHT S/A
6	CEMIG	21	OI
7	CPFL ENERGIA	22	OI
8	COPEL	23	PETROBRAS
9	SOUZA CRUZ	24	ROSSI RESID
10	SID NACIONAL	25	SABESP
11	CYRELA REALT	26	SUZANO PAPEL
12	ELETROBRAS	27	USIMINAS
13	EMBRAER	28	VALE
14	GERDAU	29	TELEF BRASIL
15	GERDAU MET		

Methods For Analyses of Brazilian Stock Market

- Adjusted stock daily closing prices → logarithmic returns
- A short time window, of 22-trading days used
- Correlations of all stocks and partial correlations between the stocks excluding the index
- At each window we calculate stock correlation (partial) matrices, and average them to obtain a vector of correlations (partial)
- Also we take another average of the correlations (partial) to obtain the overall market correlation for that window

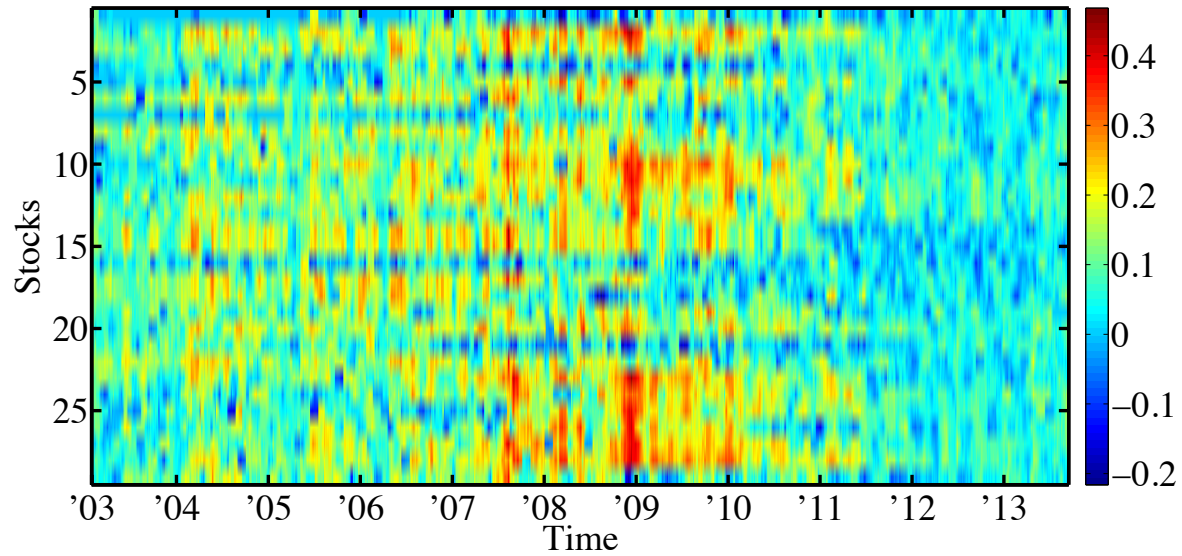
Brazil at a Glance

- Sao Paulo Stock Exchange Index (IBOVESPA)
- 8th-13th largest stock exchange in the world

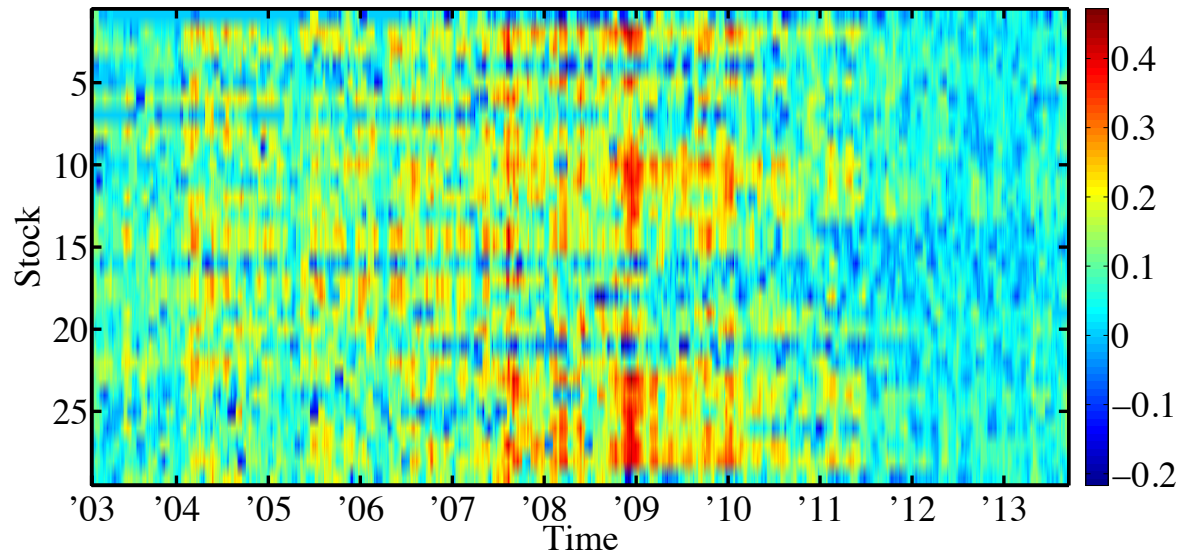


Results

Correlations
Among stocks



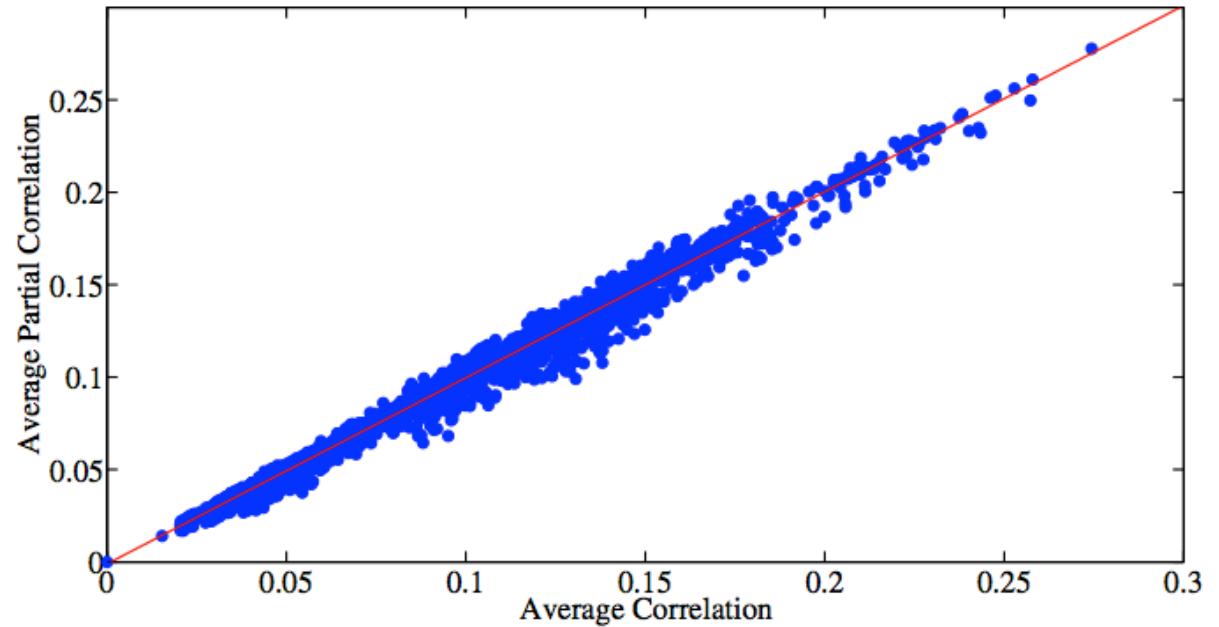
Partial
Correlations
Excluding Index



Identical

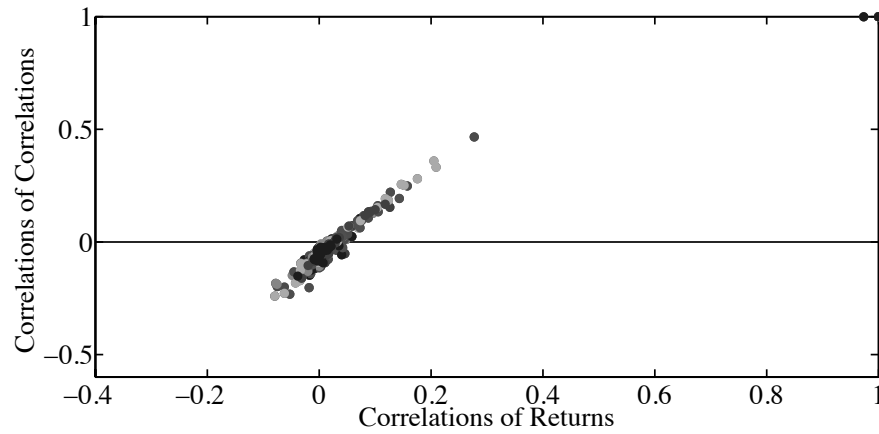
How similar are the two measures?

This market then cannot be said to be index driven, and the jump in correlations are not being pushed by feedback from the index.



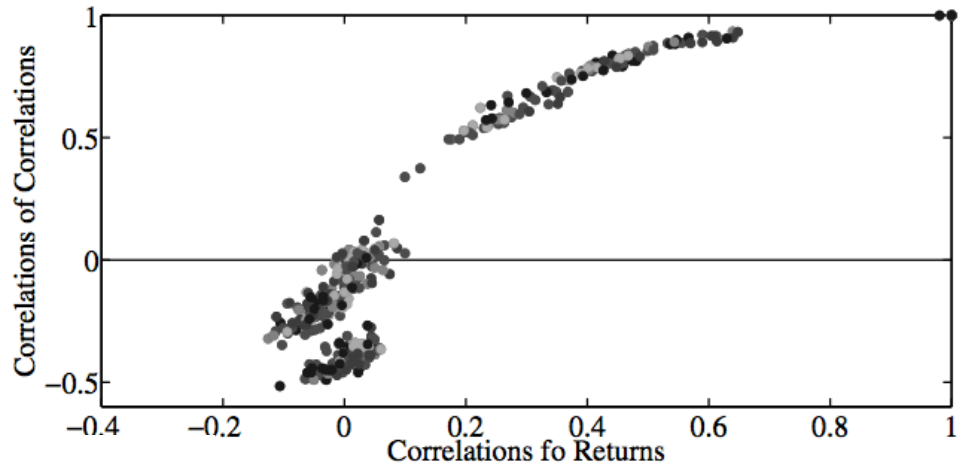
Before, During, and After Crisis

Correlation of stock correlations as a function of correlation of stock returns for pre-crisis period of 2003-2007 (top), crisis period of 2008-2009 (middle) and the post-crisis period of 2010-2013 (bottom).

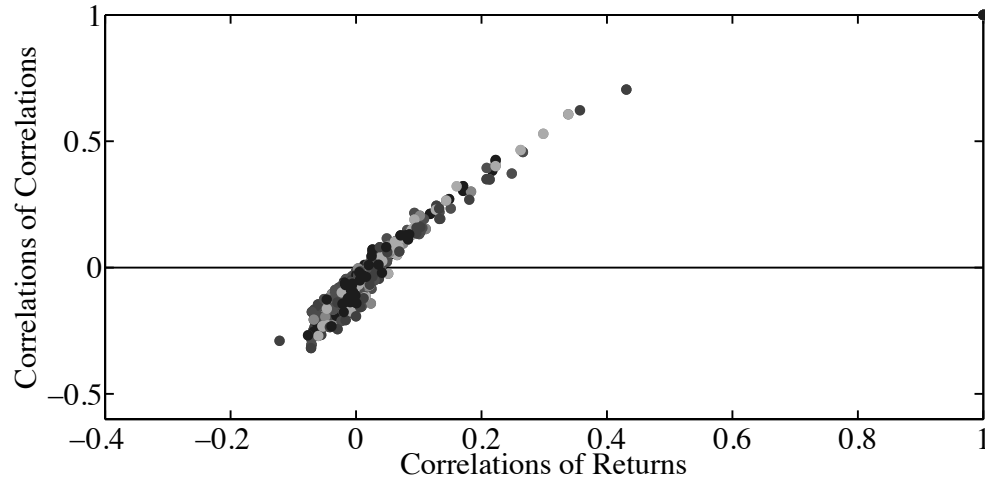


Pre-Crisis

During Crisis



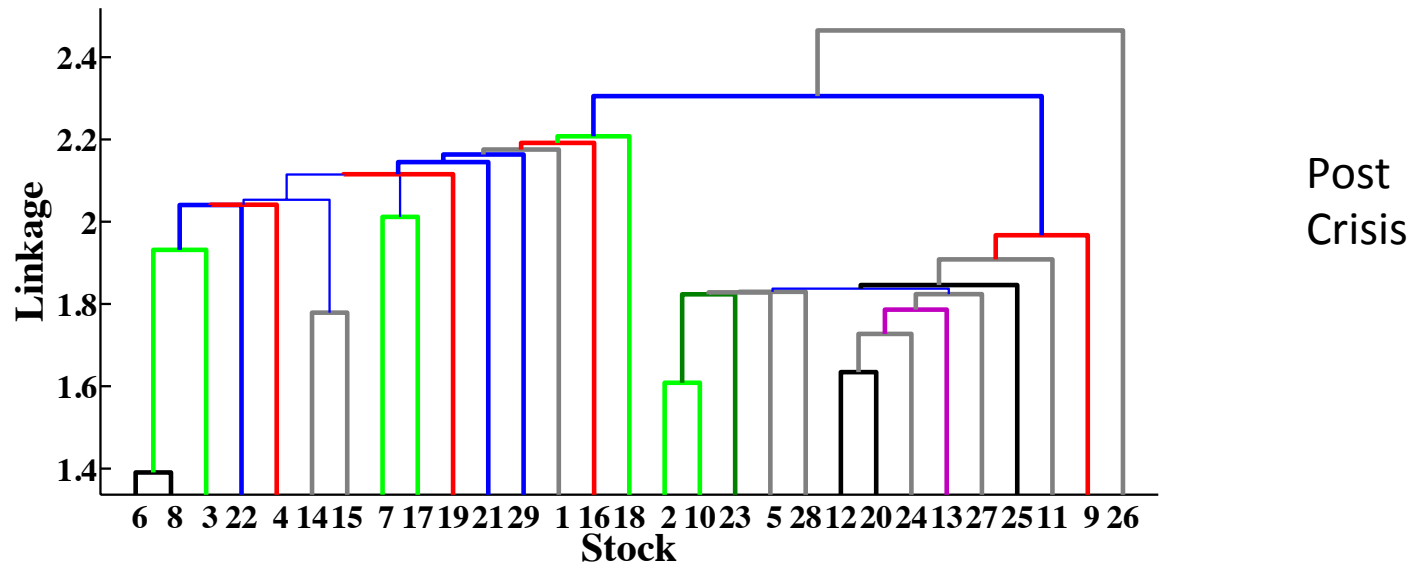
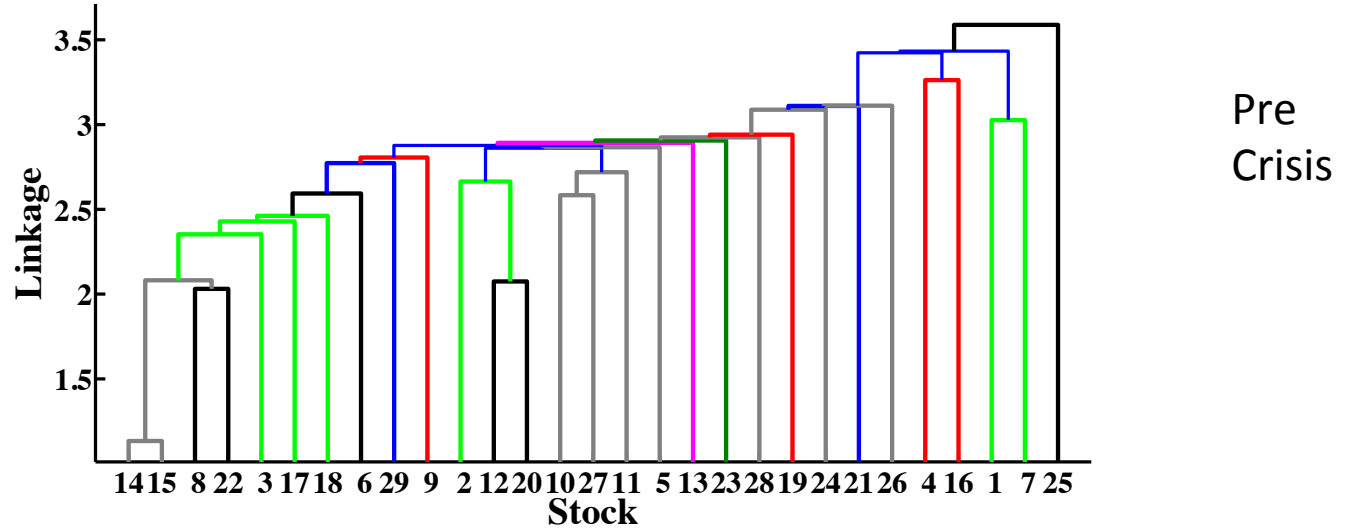
Post Crisis



What does the structure of a non-index driven market look like?

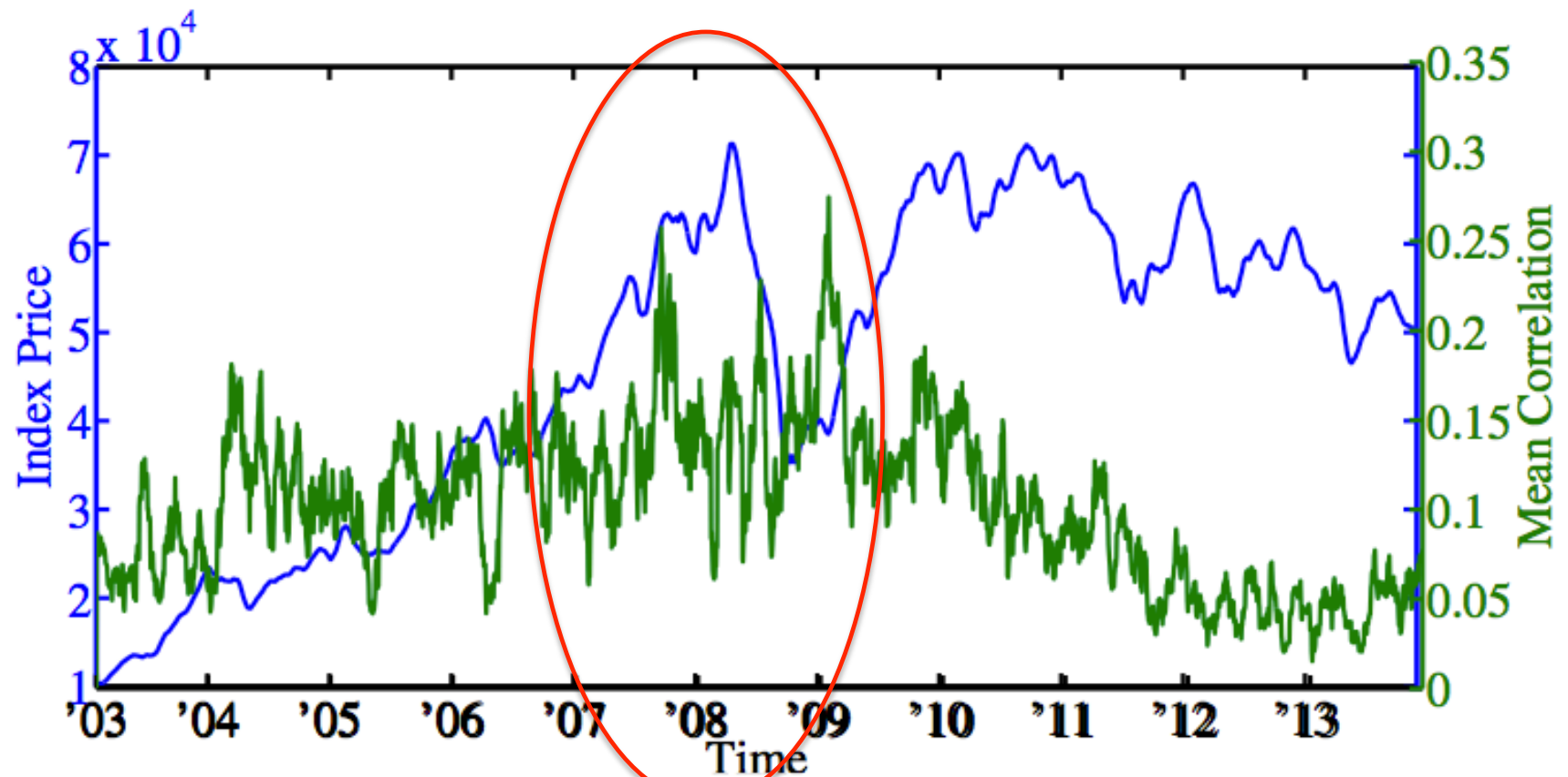
A hierarchical tree where the linkage to discern differences is the magnitude of the average correlations

- Finance
- Utilities
- Telecommunication
- Construction/Basic Materials
- Consumer
- Capital Goods
- Oil



Interpretation

- Not driven by the index, but due to an actual intra-stock correlations.



Market correlations and the daily closing price of the Index from 2003-2013

Conclusions

- We have found differences in the structures and dynamics of the Brazilian Stock market compared to developed stock markets
- The Brazilian stock market has shown to not be driven by its index
- Could be reason for better behavior during and after crisis, we could be in presence of a possible measure as an early warning signal for the health of stock markets and distinguishing growth from bubbles

Further Research

- There are many types of markets in the world
- Much more work needs to be done to look at the structure of other emerging markets

End

- Thank You!
- Questions?