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Indonesian Stock Market Crisis Observation with Spectral and Composite Index

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Abstract

The paper discusses the employment of the index composed from the dynamical tree of correlations among stock prices both with the popularly used standard (conventional) composite one. The spectral index focus on the dynamics of the correlation coefficients among stock prices while composite index is the dynamical aggregate of the whole stocks traded in the market. Some advantages is conjectured by incorporating both indexes to the historical data of Indonesian Stock Market data. Both are shown potentially useful for detecting the crisis as well as the general stock-prices relations on fundamental issues, generally social, economic, and political situations on which the Indonesian stock market is influenced.

Keywords: composite index, spectral data, crisis, social economic and political issues.

1. Introduction

Financial crisis is an interesting terms, not only for economists but also to some other researchers outside the economics. Economic crisis is said to be related to a damaging yet contagious aspects [8] from wide ranges of domains in economy. The term economic crisis could be about the macroeconomic system [2], credit market [1], capital flows [12], stock market crashes [13], and even more. Some researchers outside the economics have even criticized economists through the inability to present a good and general explanation regarding to what the economists, journalists, and even the laypersons said about “crisis” [4]. Thus, crisis is a complex term whatsoever.

In advance, discussions about financial crisis would somehow bring us the importance seeing the dynamics of stock market [11]. Stock market crashes are probably one of the most important issues we found when we observe a financial crisis. This is the motivation of this report: observing Indonesian stock market in order to see its relations to some big events in financial (as well as economic) processes, especially those related to crisis. In order to do this, we use a methodology by modeling the spectral data mined daily in Indonesian stock market into the ultrametric space as introduced in econophysics [3, 9, 14]. Some insights from this approach are thus contrasted to the dynamics of Indonesian Composite Index. The proposal of the report is an alternative indexation of stock-market to view crisis that may contribute to our endeavors on understanding economic and financial crisis, in general.



Figure 1

The dynamics of Composite Index in Indonesian Stock Exchange.
The red dashed-circles point the events recognized as financial crisis.

The largest financial crisis Indonesia has ever experienced is in 1997. The 1997 crisis has even greater impact for it has also shaped some national-scale aspects of Indonesian politics: the fall of 32 years political regime of New Order. At that moment of economic crisis, the Indonesian Stock Market (it was named Jakarta Stock Exchange at the time) touched the lowest point following the falling Indonesian currency value. The second events of the big financial crisis recognized ever experienced in Indonesian financial market is on the second semester of 2008. The two events are reflected by the dropped composite index as shown in figure 1.

The impacts of crises were not always the same from time to time. Composite indexes are somehow evaluated to be not reliable enough to observe and foresee the financial crisis [5]. Due to observation of the dynamics of the stock market, apparently the composite index is calculated as the aggregation of all stocks that are traded per time. Thus, the dynamics of the stocks traded over time has been largely reduced into a single indicator of the whole market. The composite index is a spectral variable of which there are a lot of information should be extracted from it. In the next section, we would discuss a model that potentially can be employed in order to see the spectrum of stock prices data. The variables from this methodology could be used altogether with the standard composite index to see some events of crisis in Indonesian stock market.

2. The Evolution of the Tree of Stock Prices

In order to see the how a single stock's fluctuation correlates one another, it is usual to incorporate the cross-correlation between the price return of stock V_i and V_j written as:

$$c_{ij} = \frac{\langle V_i V_j \rangle - \langle V_i \rangle \langle V_j \rangle}{\sqrt{\langle V_i^2 - \langle V_i \rangle^2 \rangle \langle V_j^2 - \langle V_j \rangle^2 \rangle}} \quad (1)$$

For the sake of the visualizations of the correlations among the stock prices, as it has been shown in [9, 10, 14], the transformation of the correlation coefficients are delivered via,

$$d_{ij} = \sqrt{2(1 - c_{ij})} \quad (2)$$

We have a distance matrix by the equation above that could be geometrically visualized as the tree of the stock prices by the algorithm searching for the minimum spanning tree. Apparently as the data is updated daily, the tree if the stock prices is also evolved dynamically. Thus, our main concern now is to see the changes of the structural formation of the tree over time. How the "connections" among the stocks survive each time the new data is added. We use the the single step survival ratio to computationally observe each edge of any new trees in daily basis. The exemplification is depicted in figure 2. It is interesting to discover the very large change of structure in the tree only by one day interval of time. It is worth to note that the day, August 28th 1997, was the largest decline of Singaporean currency and stock market drop in the Asian Crisis 1997. At the moment, the Indonesian Stock Market Composite Index was dropped about 8% in one day, and somehow can be related to the Singaporean drop.

The single step survival ratio of the tree of stock prices can be written as,

$$\sigma_{SSSR}(t, \delta t) = \frac{|[E(t) \cap E(t + \delta t)]_T|}{N - 1} \quad (3)$$

where $E(t)$ is the interconnection set among the N stocks traded at time t .

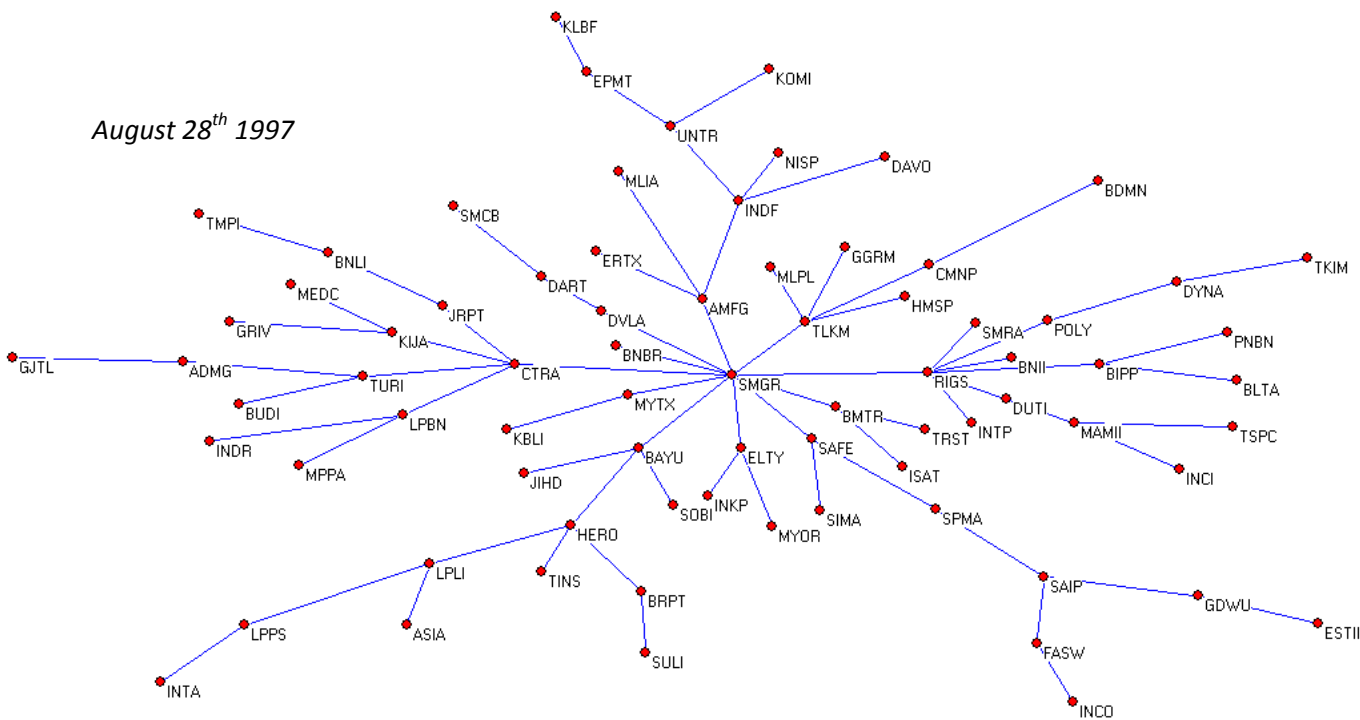
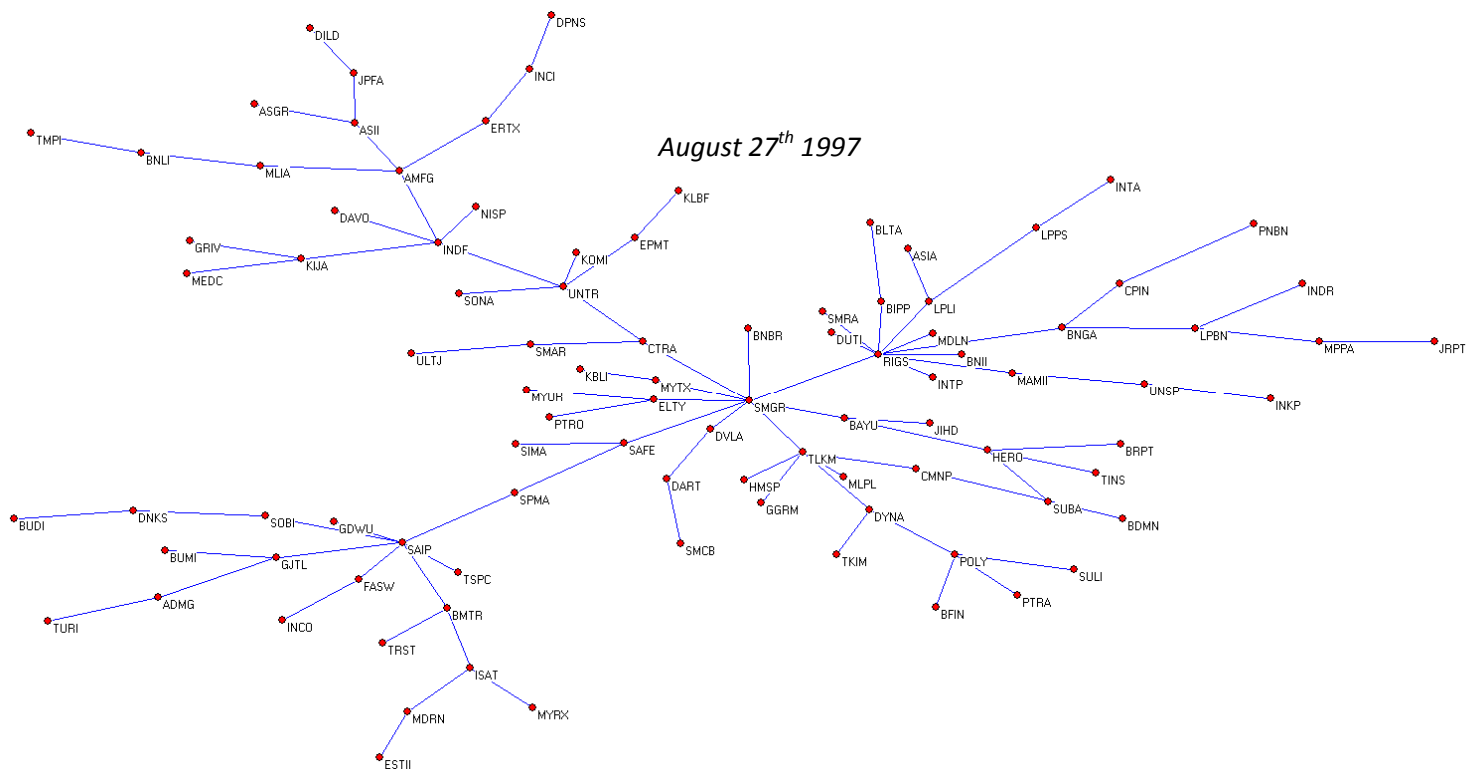


Figure 2
 The tree of stock prices August 27th and August 28th 1997: the time of the largest decline of Singaporean currency and stock market drop in the Asian Crisis 1997 induced Indonesian Stock Market Dynamics.

Some applications of this variable along with some other macroeconomic variables due to observation into 2008 crises are shown in [15]. However, in this report, we would like to propose an interesting way to see some aspects of crisis as “felt” in the stock market simultaneously with the stock market composite index.

3. A kind of “measurement of heat” in the Stock Market

To see the stock market via the spectral correlations of the stock prices and the respective stock market composite index simultaneously we would like to map the return (log-return) of the composite index into $\hat{r} = [0,1] \in R$ as well as the normalized index of single step survival ratio $\hat{s} = [0,1] \in R$,

$$s = \frac{N - \sigma_{SSSR}}{N} \quad (4)$$

where the cap denotes the normalized one. The scheme of proposed normalization would inherently shows the (subjective) empirical experience of the crisis in the sigmoid function of,

$$\hat{x} = \frac{1}{1 + Ae^{Bx}} \quad (5)$$

for both r and s with respective constant of A and B fitted from the surrogated empirical data as illustrated in figure 3.

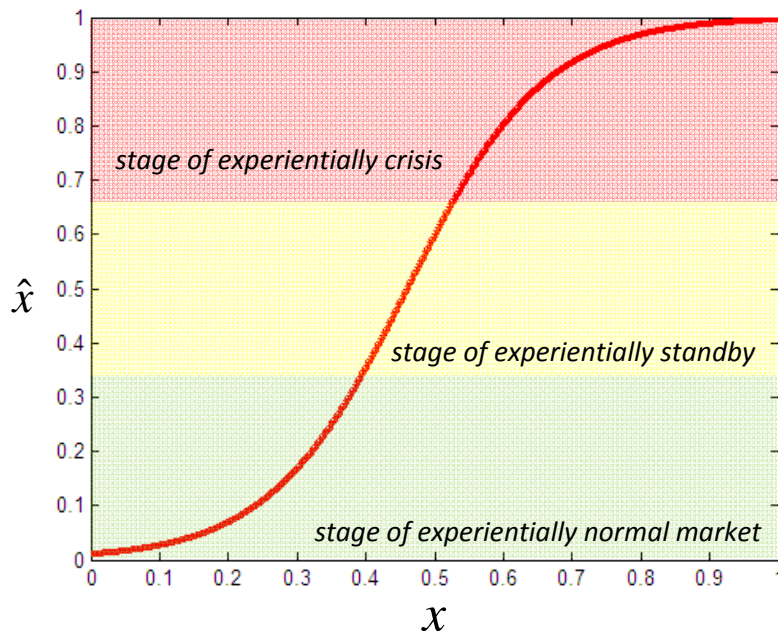


Figure 3

Illustration of the stages within the stock market indexes, be it the spectral index or the composite one.

Due to the composite index, we made some adjustment to some subjectivity as discussed with local market analyst to discover the intervals when the market to be in normal, standby, and crisis stage over the market period of daily basis between the years of 1995 to 2011. The variables within the period for the spectral and composite index are shown in table 1 and figure 4.

Table 1
Subjective experience of the stages of which prone to crises

	Normal Stage	Standby Stage	Crisis
Composite Index (log return)	$(-.02, \infty]$	$[-.04, -.02]$	$[-\infty, -.04)$
Spectral Index (s)	$[0, 0.3)$	$[0.3, .05]$	$(0.5, 1]$

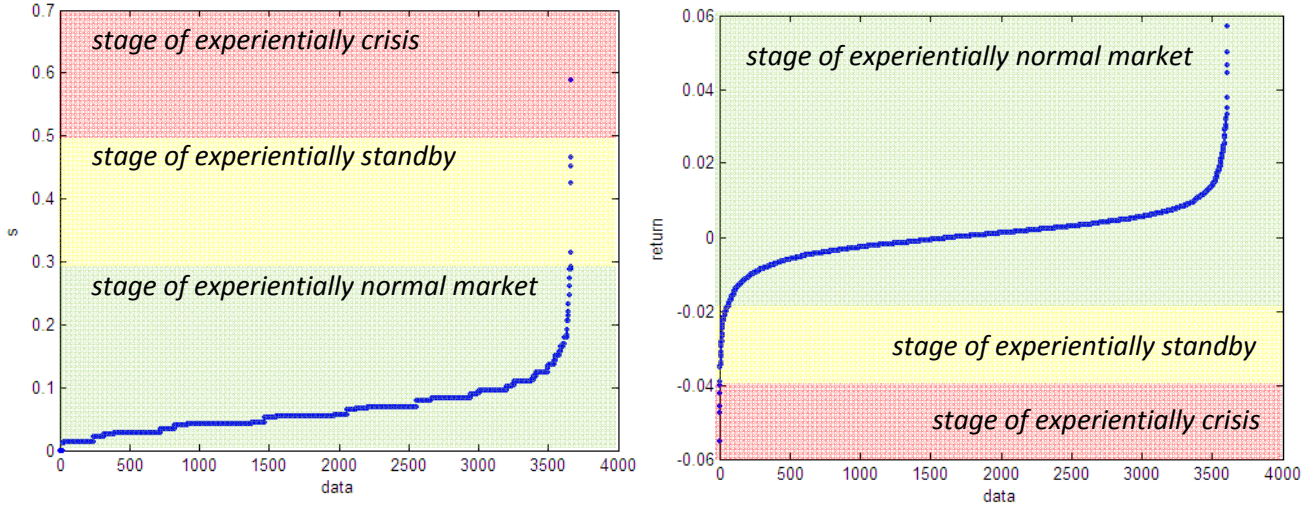


Figure 4

Stages of normal, standby, and normal market stages in Indonesian Stock Market for the spectral index (*left*) and the return of the composite index (*right*).

Having the two variables, both focusing the composite index and the dynamics of the spectral and structural stock prices, we could have a new “measurement” of the stock market in Indonesia, that metaphorically could be said as the “heat” of the market. The market is “extremely hot” while within the stage of the experientially crisis, “warm” in the phase of standby, and “colder” in the normal conditions. Since the two variables are now within the interval of $x \in [0, 1]$ then we can have the average of the two variables,

$$x = \frac{\hat{r} + \hat{s}}{2} \tag{6}$$

in order to grasp a single numbers reflecting both market parameters. Figure 5 shows the variable of \hat{r} and \hat{s} in the historical chart of Indonesian stock market data, and figure 6 depicts the average of both (x).

4. Discussions

Both index, the spectral and composite one, through historical data of Indonesian stock prices are shown in figure 5. It is interesting to discover that as we zoom in to the crisis (1997 and 2008), we could see that the changes in the spectral index seemed to show some pre-cursors pattern right before the “heat” contributed by the composite index to the stock market. It worth to note that the spectral index reflect the “micro-situation” within the stock market since it depends on the correlations among stock prices as the trading run on daily basis. The investor’s panic otherwise rush to the market is well captured within the spectral index, but unseen directly within the composite index.

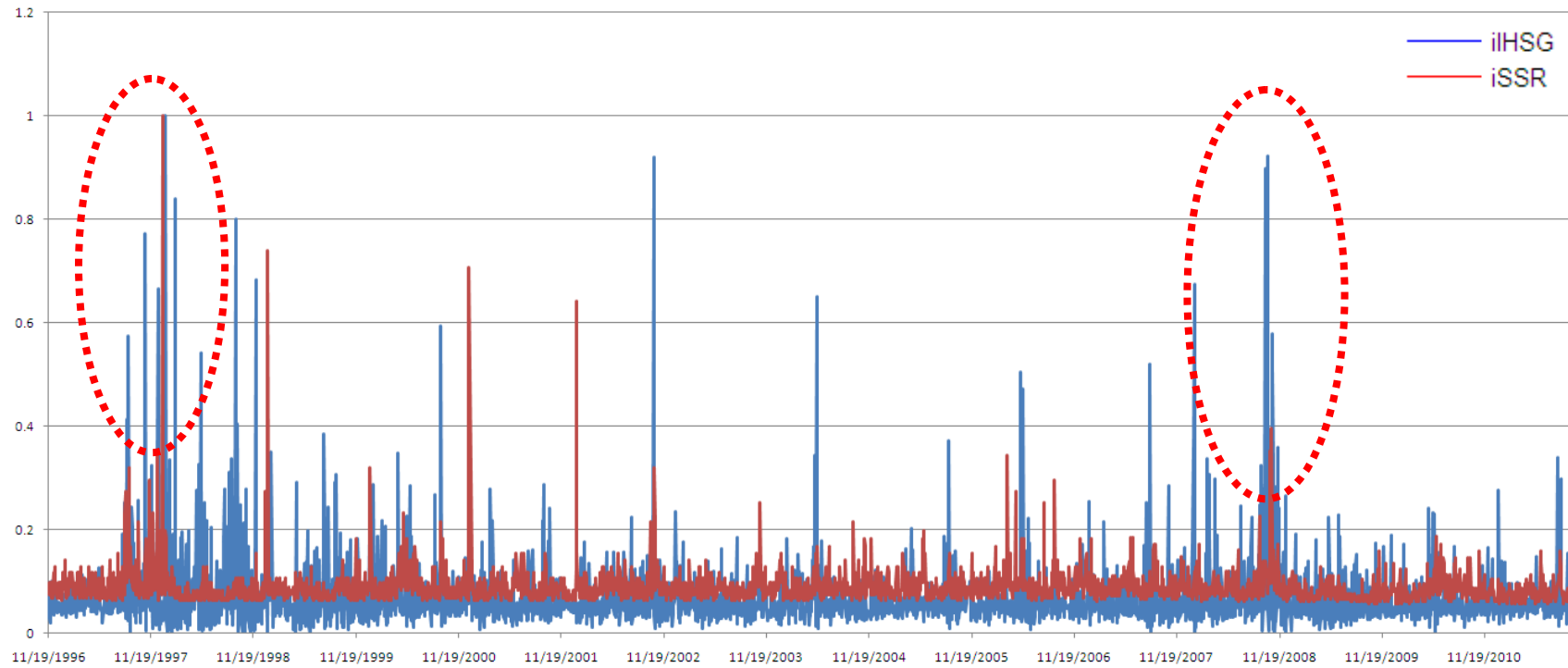


Figure 5
Two crises and the two indexes: the spectral and composite index.

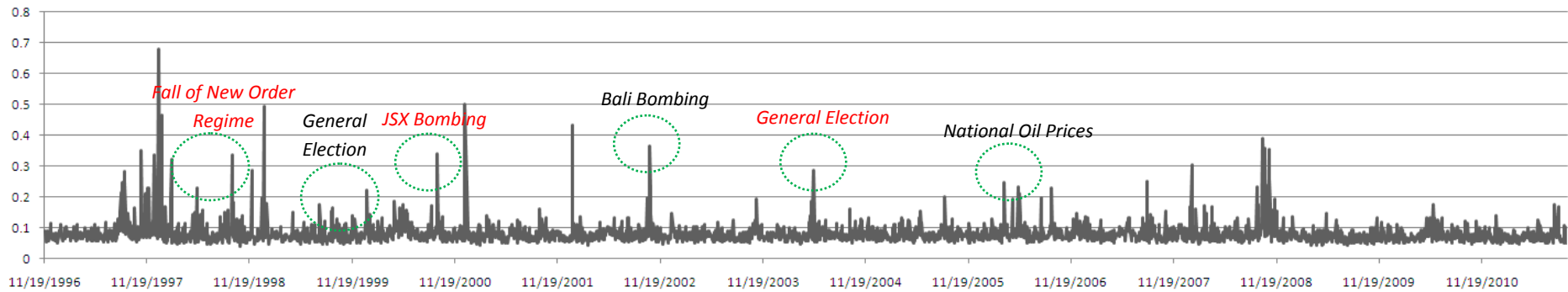


Figure 6
The Index as the heat of the stock market detected to have respond on some social national-scale issues in Indonesia.

It is not an exaggeration to conclude that the perspective by using both indexes would potentially enrich the policy decision-makers more than the view from mere composite index. In advance, it is also interesting to see some aspects as we plot the index that is made by the two indexes as shown in figure 6. This index is constructed by the eq. 6. As it has been stated in [6], even though it is not easily detected, there are some social-political and economic information inherently reflected in stock market data. However, by using both indexes as a singular parameter, it is relatively easy to detect such events as shown in the figure. The metaphor of the "heat" of the stock market as induced by social-economic- and political issues has become even more interesting.

5. Closing Remarks

We discuss some obstacles on extracting the stock market data due to comprehensive view (as well as early warning of) financial crisis in Indonesia; yet, Indonesian stock market has at least recognized to have experience facing financial crisis in, i.e.: 1997 and 2008. By distinguishing the indexation method, i.e.: the standard composite model and the spectral one some insights interestingly emerge. While the spectral index captures the dynamical correlations among stock prices for the visualization as the tree of stock prices, the composite index is simply an aggregate index in average nature.

As both indexes are implemented to the historical data of Indonesian stock prices, some interesting facts are revealed. While there should be more comprehensive and comparative analysis regarding to the usage of the spectral correlation index in some other stock markets out of Indonesia, some advantages are potentially available while we use both perspective on the stock market crisis in Indonesia. In advance, by constructing a single index composed by both spectral and composite indexes, it is fairly easy for us to relate some dynamical aspects in the stock market with some important national-scale social-economic-political issues.

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