

A comment on
“The Japanese Economy in Crises: A Time Series Segmentation Study”

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This paper is quite an interesting paper on the recent Japanese economy by the time series segmentation study on the 36 Nikkei Japanese industry indices. This paper was written before the natural and earthquake disaster occurred in March 2011. However, the result and the prediction will not be largely corrected because the disaster did not have any fatal damage to the Japanese industrial/financial structure, though it must be true that the economy was forced to be relatively digressed due to the disaster. This paper forecasts a slugged recovery until early 2012. This will not necessarily be inadmissible. It was true that the investors over the world either on the stock prices or the currency exchanges were relatively calm during the ongoing disaster. Furthermore, the reconstruction needs after destructions urgently are required in Japan. So these needs will a fortiori be conducive for the economic recovery. The future of the economy may be still much influenced by the external fluctuations outside Japan.

This paper smartly depicts some adjustment/coordination processes from the internationally external shocks. It will be stimulating in a sense that the analysis verifies the internal transitions among the empirically clustered industrial groups during the targeted recent 14 years according to the statistically derived segmentations of the whole period of this analysis. As a result of using the high frequency data, the interactive process of the concerned period of analysis can hierarchically be visible. The segmentation analysis on the time series employed in this analysis is rather classical, but the derived conclusions do intuitively not seem counterfactual. The conclusion derived here seems us considerably persuasive.

This paper used three independent parameters as the analytical benchmarks: (i) the starting time, (ii) the duration, and (iii) the Jensen-Shannon divergence value at the start

of the corresponding segment. “The starting times allow us to roughly map out the progress of volatility shocks, whereas the duration and Jensen-Shannon divergence tell us how strongly the shock impact the different industries in the Japanese economy.” The Jensen-Shannon divergence justifies the necessity of the segmentation analysis. In the Jensen-Shannon divergence calculated for the period of 1997 to 2008, it may be apparent for us that the segmented spectra is much better interpreted on the concerned periods than the single spectrum. See Figure 1. Thus the method employed in the paper could be expected a better understanding.

On the segmentation of the given time series adopted from the 36 Nikkei Japanese industry indices, the authors have employed the Gaussian parameters instead of the Levy distribution, because their interest are limited to a longer period which case is inclined to be favorable to the Gaussian process. They also justify it in view of the calculation cost. This choice may be not bad, indeed. The recursive segmentation is applied by a conservative method to impose the cutoff point $\Delta_0=10$ when the new optimized segment boundaries are not found. They then achieved the segmentations for the 36 Nikkei 500 industry indices.

In order to summarize the whole segmentations into our conventional phases: (i) growth; (ii) contraction; (iii) correction; (iv) crash, they used the hierarchical agglomerative clustering of the segments to make out the dendrogram. Hence the dendrogram can skillfully establish the four phases of the standard macroeconomic phases. The fourth cluster is verified to be statistically more robust than the five or six cluster, while the third cluster is coarser. See Figure 4. Here it is noted that the dendrogram at the level 4 (4 clusters) contains the two different choices of 6 clusters. The same story thus underlies the two different configurations. By the authors, the different configurations reflect the tinted color differences of the same photograph. So the start dates among the industries may be different in the same phase of the economy. See Tables 5 to 6.

The authors have fully inspected the configurations of temporal distributions over 36 industries during 1996 to 2010. Those inspections can be useful to confirm the five macroeconomic periods generally accepted by the public, which unfolded between 1996 and 2010: (i) the Asian Financial Crisis (1997 to 1999); (ii) the Technology Bubble

Crisis (2000 to 2002); (iii) economic growth (2003 to 2006);(iv) Subprime Crisis (2007 to 2008); and (v) Lehman Brothers Crisis (2008 to 2010). As for these periods, the authors calculated the cross correlations between the 36 Nikkei 500 Japanese industry indices. Furthermore, in order to detect the internal transitions of each period, they then compared them against cross correlations over the entire 14-year period by employing the MST diameters. See Table 7.

Following the econophysics tradition initiated by Mantegna and coworkers, the authors utilize the MST, i.e., the Minimum Spanning Trees, derived from the cross-correlation matrices. “The diameter of a MST is the largest number of links that one has to traverse to get from one node to another.” This measurement gives an important index to monitor the transition between the different phases. In this study, according to the authors, the cluster may be regarded as more open (closer), if the degree of a MST is bigger (smaller). By this definition, it follows that the financial contagion (positive sentiments) spreads faster on a closer MST (on a more open MST). This criterion may give us one of the useful judgments for the progress of the economy.

In this study, the matrices, from which the MST’s are derived, are given in three ways by employing the time series of the entire duration, but also two-year intervals, and every individual particular segments. The normalized cross-correlation matrix (the zero-lag cross-correlation between Japanese industries i and j) has a next component:

$$C_{ij} = \sqrt{\frac{\frac{1}{T-1} \sum_{t=1}^T (x_{it} - \bar{x}) \sum_{t=1}^T (x_{jt} - \bar{x})}{\frac{1}{T-1} \sum_{t=1}^T (x_{it} - \bar{x})^2 \frac{1}{T-1} \sum_{t=1}^T (x_{jt} - \bar{x})^2}}$$

In order to span a MST, firstly, we compute the distance d_{ij} for any two financial series pair (i, j) :

$$0 \leq d_{ij} = \sqrt{2(1 - C_{ij})} \leq 2$$

Then we must look for the minimum of it, then the next minimum, and so on. “We repeat this process with pairs (i_k, j_k) with increasingly larger distances (d_{i_k}, d_{j_k}) . If no

cycles are formed after drawing a link between i_k and j_k , the link is accepted. Otherwise, it is rejected. The whole process stops when all time series are incorporated into the spanning graph.”

In summary, at first, the authors calculated the cross correlations between the 36 Nikkei 500 Japanese industry indices over these five macroeconomic periods over the entire 14-year period. Next, they then calculated the MST diameters. Thus the authors discovered from the MST formations on each time period that the Chemicals and Electric Machinery industries are consistently the hubs through all the five macroeconomic periods. This is a wonderful scientific finding, which may instruct the industrial policy for the macroeconomic reconstruction. It is to be noted that such an actually acute point could never be obtained, as long as we cling to a traditionally monolithic analysis. Faced with the time series segmentation study developed here, the traditional macroeconomics will lose its significance.

More interestingly, in addition, the authors interestingly observed the phenomena on the flight to quality in the Japanese stock market. In the period of turmoil, some investors change their portfolio of the so-called growth stocks to exchange with the stocks of good performing, i.e., quality stocks. For instance, the authors divided the Subprime and Lehman Brothers Crises into 8 corresponding segments. In view of the MSTs, they identified the hubs in each stage and also the transition between these stages. In particular, it is quite interesting to learn the transition from Subprime5 to Subprime6.

In Subprime5, one part of the MST became elongated, whereas the other part become very compact and centered around Machinery (NELI), which became the only hub in the MST (see Fig. 11(e)). By comparison, we see that the cluster of industries around Electric Machinery (NELI) very quickly dissipated and reformed around Chemicals (NCHE), Machinery (NMAC), and surprisingly, Foods(NFOD), which is another industry perceived to be a quality industry. That is to say, the authors observed the both directions to growth and quality industries from Subprime5 to Subprime6. Consequently, they judged that there were two fairly distinct groups of optimistic and pessimistic investors.

Thus the authors reached their interesting conclusion on the recent Japanese economy: “Going through all eight MSTs, we see that *the growth hubs are fairly robust*

and persistent, and recovers rapidly after short disappearances. The quality hubs, on the other hand, do not survive for very long. We take this to mean that Japanese investors are actually more optimistic than most people give them credit for.”

In a new challenge like M. Aoki and H. Yoshikawa (2007): *Reconstructing Macroeconomics*, a macroeconomic state must correspond to a multiple states of microeconomic structures. This kind of microeconomic multiplicity may generate a potentially new evolution at the macro level by recombining the existing industries. This paper statistically uses this fact. It has just provided us with a fully empirical foundation for the new macroeconomic evolutionary theory. Hence the reviewer highly welcomes this study in order to reconstruct macroeconomics. Naturally, the Japanese policy makers and analysts are recommended to have an analytical thought in line with this study. Investors also are recommended to learn some analytical points shown in this paper. It must be true that the intelligence of investors can also contribute to a smooth evolution.

Finally, the study must demonstrate to be a useful analytical standard for analyzing a new macroeconomic fluctuation. But a macroeconomic fluctuation may also depend on a time series of technological innovations. Sometimes the innovation may forcefully derive the economy. The reviewer suggests the authors to consider the cross effects between the financial time series and the technological time series.