Identifying Financial States of Dhaka Stock Exchange Using Index Cohesive Force

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Abstract -- We investigated the time series data of Dhaka stock exchange from 2006-2012. The technique of correlation is applied to the return of daily closing prices of 92 stocks making one month time window for each year. The average cross-correlation increases significantly in 2011-2012 indicating the financial crisis of Dhaka stock exchange. However, just before the financial market crash in 2011, the average correlation show the lower values in comparison of our investigation period, can be used as a warning of financial market crash. The index cohesive force (ICF) is calculated and observes that ICF is higher during the periods of 2011-2012 indicating the severe periods of the market. Finally, the variations of correlation entropy with average stock index correlation also identify the financial states of the market. The change of ICF and correlation entropy can identify the financial states and can be used as an indicator of upcoming crisis.

Indexed Terms -- Dhaka Stock Exchange, Index Cohesive Force, MATLAB Programming.

I. INTRODUCTION

a) Financial Market:

A financial market is an indicator to identify financial state of a country. It is a market in which people trade financial securities, commodities and other fungible items of value at low transaction costs and at prices that reflect supply and demand. Securities include stocks and bonds and commodities include precious metals or agricultural products. Every financial market has some characteristics: it determines the level of interest rates, it allows the common stock to be traded, it allows loan to be made, it channels funds from lenders-savers to borrowers-spenders, financial market have the basic function of (a) getting people with funds to lend together with people who want to borrow funds (b) assuming that the swings in the business cycle are less pronounced (c) assuring that governments need never resort to printing money (d) providing a risk-free repository of spending power.

Financial markets improve economic welfare because they allow funds to move from those without productive investment and consumers to time their purchases better. The main sources of financing for business, in order of importance are financial intermediaries, issuing bonds and issuing stock. There are different types of financial markets and their characterization depends on the properties of the financial claims being traded and the needs of the different market participants. Capital market, which aids raising of capital on a long-term basis, generally over 1 year. It consists of a primary and secondary market and can be divided into two main Subgroups-Bond market and stock market. A primary market, or the so called "new issue market", is where securities such as shares and bonds are being created and traded for the first time without using any intermediary such as an exchange in the process. A secondary market ,or the so called "after market" is the place where investors purchase previously issued securities such as stocks, bonds, futures and options from other investors , rather from issuing companies themselves . The most well know secondary financial market is the stock exchange. The activities of the financial market are based on national bank's liabilities to control currency rates and set interest rates.

b) Dhaka Stock Exchange:

Stock market is very important financial institutions of any economy as well as Bangladesh. It opens door for companies to raise huge amount of capital from a lot of individual investors inside and outside of a country. This is a place where shares can be bought and sold. Bangladesh is one of the fastest growing emerging stock markets in South Asia and Dhaka Stock Exchange Ltd. (DSE) is very reputed and important organization in the financial sector of Bangladesh. It is located in Motijheel at the heart of the Dhaka city.

First incorporated as East Pakistan Stock Exchange Association Ltd on 28 April 1954 and started formal trading in 1956. On 23 June 1962, it was renamed as East Pakistan Stock Exchange Ltd. And on 13 May 1964 it was renamed as Dacca Stock Exchange Ltd. Now there are 250 members in Dhaka stock exchange. At present there are 559 companies of 22 sectors listed in Dhaka Stock with Bank, Policy, Mutual fund and Bond etc. Listed company of Dhaka Stock Exchange are ABB1STMF(AB Bank 1st Mutual fund), ABBANK(AB Bank Limited), ACI(ACI Limited), AL-HajTEX(Al-Haj Textile),ALARABANK(Al-Arafah Islami Bank), BATASHOE(Bata Shoe), BDCOM(BDCOM Online Ltd.), BEXIMCO(BEXIMCO) etc. Dhaka Stock Exchange (DSE) is a public limited company. The issued capital of this company is TK. 500,000 which is divided up to 250 shares each pricing TK. 2000.

II. METHODS

a) Raw Stock Correlations:

The similarity between stock price changes is commonly calculated by the Pearson's correlation coefficient [40]. The raw stock correlations [40, 43] are calculated for time series of the log of the daily return, given by:

Where is the daily adjusted closing price of stock i at day t. The raw stock correlations are calculated using the Pearson's correlation coefficient between every pair of stocks i and j,

Where, denotes average, and are the standard deviations (STD).

b) Residual Correlations:

Recently, we have made use of partial correlations to calculate the residual correlation between stocks, after removing the affect of the index [40]. Partial correlation is a powerful tool to investigate how the correlation between two stocks depends on the correlation of each of the stocks with a third mediating stock or with the index as is considered here. The residual, or partial, correlation between stocks i and j, using the Index (m) as the mediating variable is defined by [39, 40, 44]

Note that according to this definition,, can be viewed as the residual correlation between stocks i and j, after subtraction of the contribution of the correlation between each of the stocks with the Index.

c) The Index Cohesive Force:

Recently, we have shown that the market index has a cohesive effect on the dynamics of the stock correlations [20]. This refers to the observed affect the index has on stock correlations, where we have found that larger changes of the index result in higher stock correlations, and as such more cohesive [20]. Here we expand this analysis and introduce a quantitative measure of the index cohesive force. We define - the index cohesive force calculated over a time window t, as a measure of the balance between the raw and residual correlations given by,

Where, the time window, during which the average correlation and average residual correlation are calculated, denoted by is the average of average correlation (partial correlation). The size of the time window is selected following the consideration presented further below.

d) Eigenvalue Entropy:

To further asses the market stiffness, we computed the eigenvalue (spectral) entropy of the raw correlation matrices. Qualitatively, the entropy of a system refers to the changes in the status quo of the system, and is used as a measure for the order and information content of the system. The spectral entropy [39, 41, 42, 45, 46], SE, is defined as

Where, the normalized eigenvalues of the diagonalized matrix (correlation matrix) - are defined as

Note that the 1/log (N) normalization was incorporated to ensure that SE = 1 for the maximum entropy limit of flat spectra (equal eigenvalues). We associate the market stiffness with one minus the SE [19, 21, 22, 25, 26].

III.   RESULTS

a) Time Dynamics of the Average Cross Correlation and Partial correlation:

We begin our investigation by studying the dynamics of the average cross correlation between stocks, with the focus being on large time windows, to reduce the statistical variations of Dhaka Stock Exchange. Here we selected a shorter, 21 trading days (in one month), time window. The configurations of the change in cross correlation are shown in Figure 3.1(a). This figure gives a complete overview of the change in cross correlation of Dhaka Stock Exchange over the 7 year periods. It helps us to compare the state of the market at different times. From figure we see that average cross correlation among the companies not significant change from 2006 to 2010. In 2011 average cross correlation sharply increases. The higher average cross correlation indicates that the companies are interacted to each other strongly. Time Dynamics of Average Correlation and partial Correlation are shown in Figure 3.1(b).
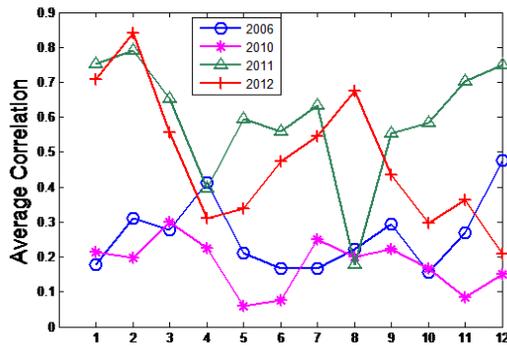
Fig. 3.1(a): - Monthly Average Correlation
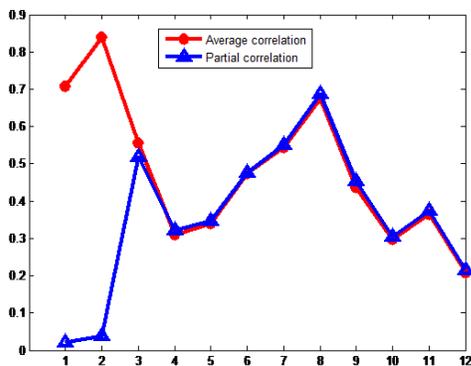
Fig. 3.1(b): - Time Dynamics of Average Correlation and Partial Correlation

b) Dynamics of the Index Cohesive Force (ICF versus Stock Index Correlation):

Index Cohesive Force (ICF) is the balance between the raw stock correlations that include the index effect and the residual stock correlations (or partial correlation) after subtraction of the index effect. The ICF provides a means to identify structural changes in the market, which significantly alter the stability of these markets. The market index has a cohesive effect on the dynamics of the stock correlations. Strong ICF (high ratio between correlations and residual correlations), in which the index predominantly affects the market dynamics while it shades the effect of other degrees of freedom that can contribute to the market flexibility. Thus high values of the ICF correspond to a state in which the market index dominates the behavior of the market. Also the ICF is a new quantitative measure to assess the stability and wellbeing of financial markets. When the ICF is less than 10 financial market healthy or good. On the other hand when ICF more than 10 it indicates that financial market is stiff or unstable. ICF increases with the increase of stocks-index correlation, which imply the strong effect of index on stocks. In 2006, we observe that ICF is less than 10. Thus the financial market is stable. In 2010 we observe that ICF is less than 10 and the financial market is healthy. In Figure 3.2 we see that in 2011 the ICF is greater than 10 and financial market is unstable, which implies that the financial market is going to crisis. In 2012 the ICF is high.
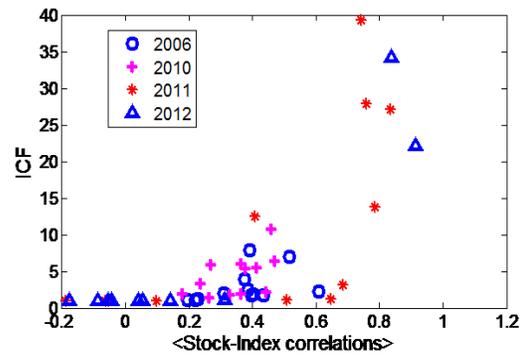
Fig. 3.2: - Time evolvement of ICF for year 2006 to 2012 (ICF versus Stock Index Correlations)

c) Dynamics of the Index Cohesive Force (ICF versus Time Window):

After observing the figures we find there is an up and down of the dynamics of ICF. In Figure 3.3 when we observe the variation of ICF 2006, we found that the value of ICF is below 10. It implies that the financial market is good. 2010, just before the financial crush. In this time we observe that around September the ICF is bigger than 10. It identifies that in this time market is unstable. However after September, the values of ICF again come back below 10, shown in Figure 3.3. In 2011 up to June the ICF is less than 10. However, after June the ICF increases sharply, which implies that the market is totally unstable. In December the ICF come back in normal states. In the beginning of 2012 ICF again sharply increases which identify the unstable market. After February of 2012 the ICF come back again below 10 and which sustain the rest periods of 2012
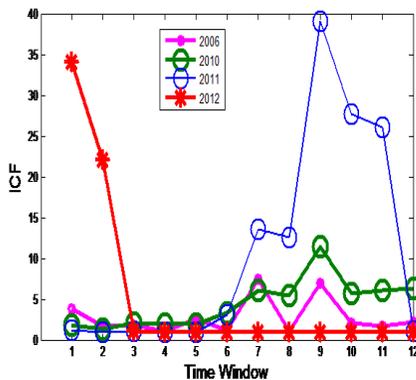
Fig. 3.3: - Time evolvement of ICF for year 2006 to 2012 (ICF versus Time Window)

d) Dynamics of Eigenvalue Entropy:

Eigenvalue Entropy indicates the modularity of stocks. It also implies the latent information embedded in the stock index correlations. Assessment of the index influence using this measure reveals that the index has a significantly stronger effect during financial crisis. In Figure 3.4, in April and December of 2006 companies make strong cluster. It also indicates that in this period index has strong effect in the stocks. In 2010, Eigenvalue Entropy is higher than other periods which identify the less effect of index on stocks and the companies make quick cluster. We can observe in 2011 most of the periods Eigenvalue Entropy is lower which identify the strong effect of index on stocks and the companies make strong correlations. In 2012 we

also observe almost similar pattern of Eigenvalue Entropy as like 2011.
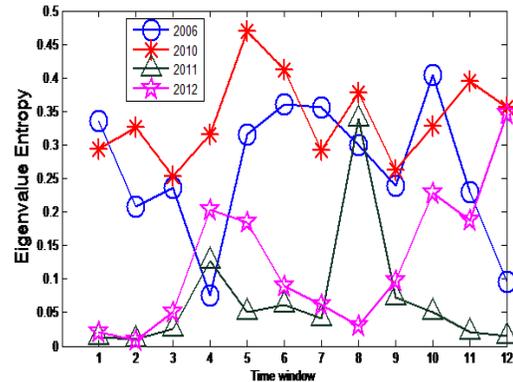
Fig. 3.4: - Eigenvalue Entropy versus Time Window (Yearly)

IV.   CONCLUSION

We propose the ICF as a new system-level parameter, which provides an efficient measure to describe and quantify the market dynamical state, and which can be used as a tool to monitor the stability of stock markets. We found during 2011 and 2012 Dhaka stock market was completely unstable. The stability of the markets is crucial for the Bangladesh economics, thus this tool can be very important to governments.

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