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The fluctuation in Carbon emission trading Market

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Abstract: As an emerging financial market, the trading value of Carbon emission trading Market are definitely increased in recent years. The carbon emission is not only trading in Carbon emitters but also become an important investment target. For reveal the mechanism of this growing market, we analyzed the EU allowances (EUA) price series in European Climate Exchange (ECX), that is the leading European emissions futures market. As other financial market, the absolute value of price change (volatility) in Carbon emission trading Market also shows long-term power-law correlations. Our analysis shows that definite cross correlations exist between EUA and many other markets. These cross correlation exist in wild-range fields, stock market index, futures of crude, sugar, cocoa, etc. it suggest that in this new carbon emission trading market the speculation behavior had already become a main factor that can affect the price change.

Keywords: carbon emission, emerging financial market, Minimal-spanning trees,long-term power-law correlations

1 INTRODUCTION

Many social systems are characterized by complex int eractions between a large numbers of individual compo nents, which manifest in power-law Correlations. For e xample, in financial field, several stylized facts have b een found for the equity price data in temporal field, s uch as 1, the distribution of the stock price changes (r eturn) has a power-law tail. 2, the absolute value of st ock price change (volatility) is long-term power-law co rrelated. 3. The spectral density of stock price is well described by power-law function. Such as 1, the distrib ution of the stock price changes (return) has a power-l aw tail. 2, the absolute value of stock price change (v olatility) is long-term power-law correlated. 3. The spe ctral density of stock price is well described by power -law function [3-5].

In the field of physics and economy, not only the c haracter of a single asset (time series) is important, bu t also the cross-correlations between pairs of assets pla y a key role in the financial analysis. The taxonomy a nalysis for a stock portfolio is considered as a useful method. The investigation of correlation distance of dif ferent stocks can extract economic information stored i n the stock-price time series, and define the metric of the relative distance between the stocks included in po rtfolio. In this study we investigate the relative distanc es based on daily price time series of EU allowances (EUA) and with other stock and futures markets. The Minimal-spanning trees (MST) are determined by the r elative distances.

2 TAXONOMY OF EUA AND SOME OTHER MARKET

A method of determining a distance between time seri es (usually stock price time series) i and j evolving in time in a synchronous fashion is the following.

$$\tilde{S} \equiv \frac{S_i - \langle S_i \rangle}{\sqrt{\langle S_i^2 \rangle - \langle S_i \rangle^2}} \qquad (1)$$

Where S_i the logarithmic price difference of time seri es i, is given by equation (2).

$$S_i \equiv \ln Y_i(t) - \ln Y_i(t-1) \qquad (2)$$

Here is the daily closure price of time series i at tim e t, and S_i is the daily change of the logarithm of t he price of stock i.

The Euclidean distance d_{ij} between vectors $\tilde{S}_i$ and $\tilde{S}_j$ is obtainable from the Pythagorean relation. If th ere have n time series of $\tilde{S}_i$ present in the same tim e interval. The distance of time series i and j can b e described as equation (3)

$$d_{ij} = \| \tilde{S}_i - \tilde{S}_j \|^2 = \sum_{k=1}^{n} (\tilde{S}_{ik} - \tilde{S}_{jk})^2 \qquad (3)$$

The d_{ij} can also be described by correlation coefficie nt ρ_{ij}, as following function, the correlation coefficien t assume values ranging from -1 to 1.[1]

$$d_{ij} = \sqrt{2(1-\rho_{ij})} \qquad (4)$$

Because Equation (3) defines a Euclidean distance the following three properties must hold:

$$d_{ij} = 0 \Leftrightarrow i = j$$

$$d_{ij} = d_{ji}$$

$$d_{ij} \le d_{ik} + d_{kj}$$

Thus the quantity d_{ij} fulfills all three properties that must be satisfied by a metric distance. In the presence of a metric space in which n objects are linked together, the subdominant ultrametric can be obtained by determining the minimal spanning tree (MST) connecting n objects. The MST is a concept in graph theory [2]. In a connected weighted graph of n objects, the MST is a tree having n-1 edges that minimize the sum of the edge distances.

In our study, we select 22 worldwide financial price time series from 2007 to 2010, which include 6 stocks indicates and 16 future options that include EU allowances (EUA). The data are download from finance yahoo and European Climate Exchange ECX market. All financial daily price time series that used in our study are list in Table 1.

Table 1. The list of financial products used in our study

Name	***Description***
NYdow	indicator of NYDOW stock exchange
FTSE100	Financial Times Stock Exchange 100 Index
BSE30	Bombay Stock Exchange Sensitive Index
BVSP	indicator of Sao Paulo Stock Exchange
Nikkei	indicator of Tokyo stock Exchange
SSEindex	indicator of Shanghai stock Exchange
Treasury30	U.S. 30-year bonds
UKgilt_all	Average UK gilt
EUA	EU allowances future price
WTI	West Texas Intermediate
RIchard_bay_Coal	Future price of coal loading at Richards Bay in South Africa
EUR_Index	Index of Euro
UK_Nature_Gas	Future price of UK nature gas
UK_Base_Electricity	Future price of UK base Electricity
Coffee_C	Future price of Coffee in ECX
Sugar_No_11	Future price of Sugar No. 11
FCOJ-A	Future price of FCOJ A
Cotton_No_2	Future price of Cotton No.2
US_Dollar_Index	Index of US Dollar
Western_Barley	Future price of Western Barley
Canola_Futures	Future price of Canola of Canada
RJ/CRB_Index	Reuters Jefferies/CRB Index, benchmark indicator of overall commodity price

We calculate the relative distance of each two price time series from 2007 to 2010 by using equation (3). Next the MST can be produced by these relative distances. It is shown in Figure 1.

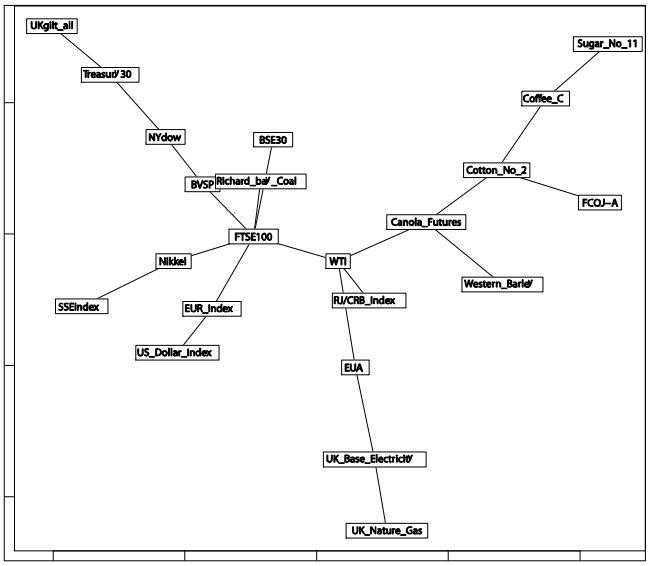

Fig. 1. The structure of minimal spanning tree (MST) for the time period 2007 to 2010.

From Figure 1, we can find that all stocks indicate become a group, and EUA are strong correlated with gas and electricity futures. In this graph we also find that WTI and FTSE100 are two key financial products, the two connect the stocks and futures. Moreover, we find that the same type financial productions are closer than different type. For example debt future Treasury30 and UKgilt are connected, EUR and Dollar futures are also connected.

3 STABILITY OF MST

In chapter 2, we investigate the relative distance of our selected worldwide financial products. Next we want to know how stable a minimal spanning tree structure can be. So we showed the minimal spanning tree obtained in the calendar years from 2007 to 2010 for the 22 financial products.

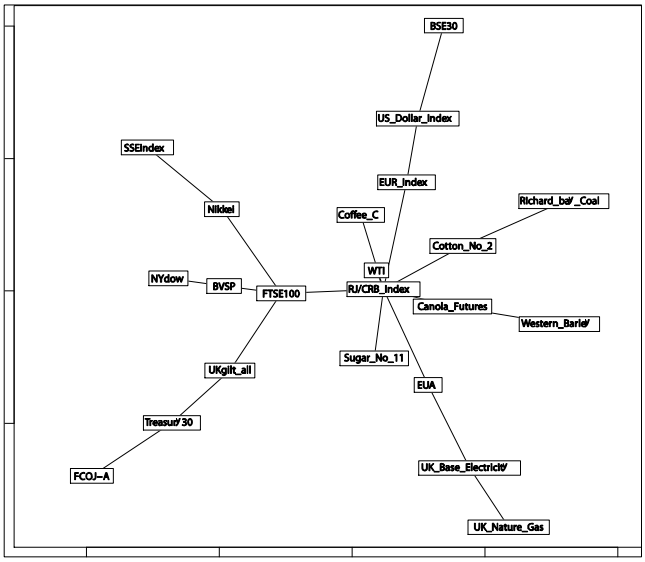

Fig. 2. The minimal spanning tree of 2007

In Figure 2, we show the MST during the calendar y ear 2007. From this graph we also find that the stock indicates and futures are grouped into two sides. The WTI and FTSE100 also show important characters. Dif ferent with figure 1, RJ/CRB index become Central no de instead of WTI. Next, the FCOJ-A is moved to sto ck and debt side, BSE30 is connected with US dollar index. EUA are also correlated with nature gas and ele ctricity futures.

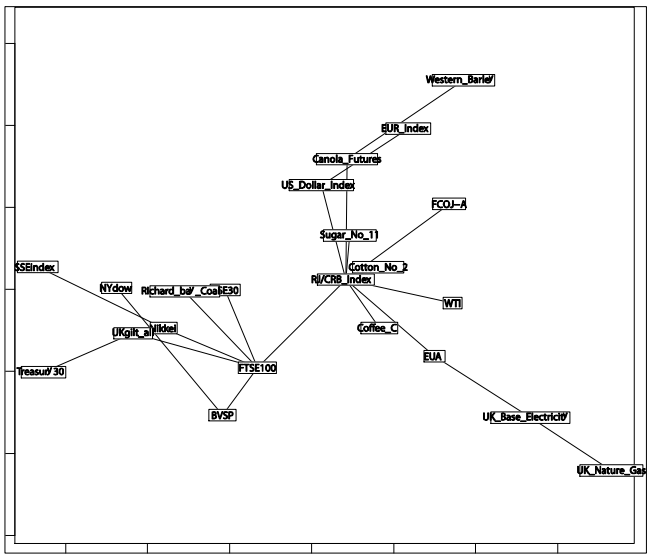

Fig. 3. The MST minimal spanning tree of 2008

Figure 3, shows the MST during the calendar year 200 8. Compare with Figure 2 that is from 2007, the struc ture of MST is more similar with figure 1. The EUA connections with gas and electricity futures are still exi sted.

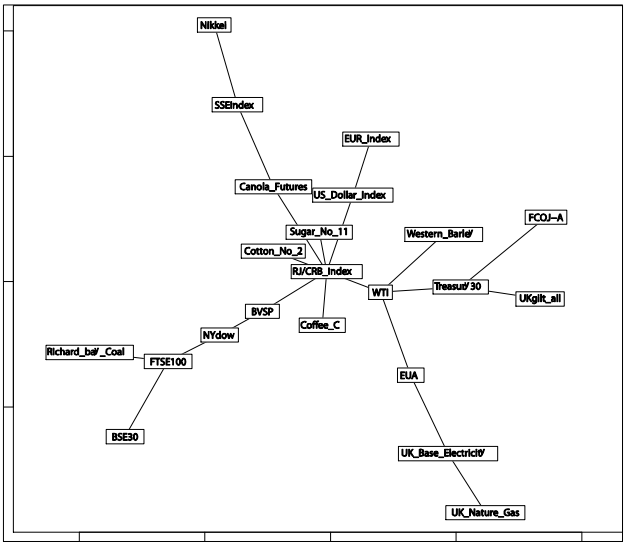

Fig. 4. The MST minimal spanning tree of 2009.

Figure 4, shows the MST during the calendar year 200 9. The structure of MST is changed a lot, it look like s a one center tree, the center is RJ/CRB index. But t he basic links are not changed, the stocks are connecte d as one group, debt future and currency index are co nnected too.

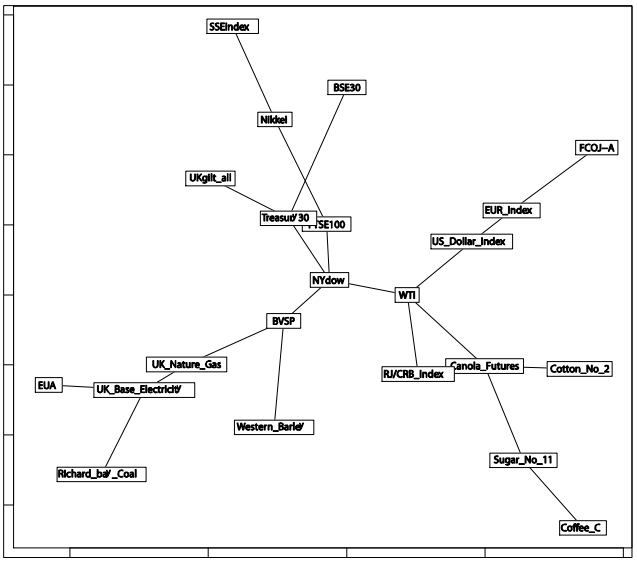

Fig. 5. The MST minimal spanning tree of 2010

Figure 5, shows the MST during the calendar year 2010. EUA are correlated with nature gas and electricity futures, and the base electricity future is connected with Coal. WTI and NYdow are two key financial products which connect the stocks and futures.

In these figures, the correlations of EUA and gas and electricity futures are observed in all years. It indicates that the stable correlation of EUA, nature gas and electricity futures. In all financial produces we may find that the center nodes of the structures are always included in next four products, WTI, RJ/CRB index, NYdow and FTSE100.

In summary, the Figure 2 to Figure 5 show that the MST is time dependent, but maintains on a time scale of years a basic structure that exhibits some meaningful economic correlations.

4 SUMMARY

In our study we have seen that is possible to devise strategies that allow us to obtain meaningful structure of taxonomies if we start from the synchronous analysis of more than one price time series. We find that compare with other links the links of EUA and Nature gas and base electricity price. It indicates d that the Carbon emission are more depended on nature gas and base electricity than other elements. Our study also show that the MST is time dependent, and it maintains on a long time scale a basic structure. The structure may exhibits some meaningful economic correlations.

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