Renewable Energy 102 (2017) 107–117

Contents lists available at ScienceDirect

Renewable Energy

journal homepage: www.elsevier.com/locate/renene

An overview of renewable energy companies in stock exchange: Evidence from minimal spanning tree approach

Mansooreh Kazemilari [a], Abbas Mardani [b], Dalia Streimikiene [c, *], Edmundas Kazimieras Zavadskas [d]

[a] Department of Mathematical Sciences, Faculty of Science, Universiti Teknologi Malaysia (UTM), Skudai Johor, 81300, Malaysia
[b] Faculty of Management, Universiti Teknologi Malaysia (UTM), Skudai Johor, 81300, Malaysia
[c] Lithuanian Energy Institute, Breslaujos3, LT-44403, Kaunas, Lithuania
[d] Department of Construction Technology and Management, Vilnius Gediminas Technical University, Sauletekio al. 11, LT-10223, Vilnius, Lithuania

ARTICLE INFO

Article history:
Received 19 February 2016
Received in revised form
20 September 2016
Accepted 16 October 2016
Available online 20 October 2016

Keywords:
Renewable energy
Stock exchange
Minimum spanning trees (MSTs)
Financial market

ABSTRACT

The renewable energy industry has the important role in overall growth in the worldwide economy in the last two decades. This paper constitutes a first analysis on renewable energy companies in stock exchange by used the minimum spanning trees (MSTs) approach. In this study, the daily closure prices data of 70 stocks of renewable energy companies during the time period from 13th October 2010 to 4th March 2015 are investigated. In stock market analysis, the interrelations among stocks are represented in terms of Pearson correlation coefficient (PCC). This is the standard practice to construct the stock network. With the precondition of time series are synchronous, the similarity among the stocks is quantified by the PCC between the logarithmic exchange rate returns of i and j stocks. In order to analyze the topological properties of MST, three major centrality measures are used, namely; degree, closeness and betweenness centralities. Result of this paper indicated that; First Solar Inc., General Cable Corporation and Trina Solar are more important within the network, moreover; we found that; these stocks play a significant role in renewable energy development in terms of market capitals.

1. Introduction

The worldwide financial system has several kinds of markets which are located in different industries such as renewable energy and in that a broad several financial goods and products are traded. Despite the variety of marketplaces, index activities frequently respond to the similar financial statements or marketplace news [1–3] which suggests that monetary time sequence may show related features and be associated. Renewable energy is important in terms of strengthening the local improvements. That is why there is a growing interest in renewable energy both in the developed and developing countries. Though, there are several problems facing [4,5] the activities to increase use of renewable energy, that should be understood and correctly interpreted into an inclusive controlling framework. The initial and notable problem for greater renewable penetration into energy organizations refers to the high-up front charges and associated inadequate cost usefulness. There are several market barriers and failures preventing penetration of renewables, such as commercialization barriers faced by new technologies competing with mature technologies; price distortions from existing subsidies and unequal tax burdens between renewables and other energy sources; failure of the market to value the public benefits of renewables and other, such market barriers such as inadequate information, lack of access to capital, “split incentives” between building owners and tenants, and high transaction costs for making small purchases etc. Consequently, it is significant to present financial support mechanism and satisfactory advancement arrangements, particularly ones which will interest isolated funding into energy segment and in such way decrease the monetary load on the public budget [6,7].

Numerous of previous studies have attempted to use the networks theories for analysis of exchange market in the international level. Mizuno, Takayasu and Takayasu [8], used minimum spanning tree (MST) and hierarchical taxonomy for analysis of foreign exchange market data. McDonald, Suleman, Williams, Howison and Johnson [9], applied MST for examine of the currency correlations among foreign exchange markets, finding of this analysis indicated that; dependent and dominant currency

* Corresponding author.
E-mail address: dalia@mail.lei.lt (D. Streimikiene).

http://dx.doi.org/10.1016/j.renene.2016.10.029
0960-1481/

structures can be as some global foreign exchange dynamics in the MST network. Therefore; there are very useful correlation based networks among financial markets for investing and building the optimal strategy in renewable energy markets. Additionally, knowing about how evolving of stock markets is useful and important over the time. Consequently, in the past years explaining the patterns among stock markets networks have been popular study agenda. Development of stock market network theory allowed to introduce these patterns in an elucidative and simple way [10–14]. Using of statistical physics to financial exchange market data has been very interesting issue in last decade. Network analysis is assumed as the most important technique among other techniques, because, the introducing of financial exchange market as network topology represents optimal ways for understanding of the financial market structural properties [15–17]. While; some evaluations performed on various stock exchange markets in the social science, in several industries, due to the important of renewable energy stock market in the financial world, unfortunately; no previous study paid attention on this issue. First of all, few of previous scholars have conducted research on understanding of behaviour of network properties of renewable energy stocks of the market and interpretation of the network topology in financial terms of those stocks. Second, previous research focuses solely on econometric techniques, and does not try to explain their findings upon financial theory. Therefore, this paper attempted to use the network theory to the analysis of the renewable energy exchange market. Moreover; this study utilized MST to finding and filtering significant information related to those complex networks. As a real example, 72 renewable energy companies' data from 13th October 2010 to 4th March 2015 were used.

The rest of the paper is organized as follows; in Section 2, the researchers present literature review on stock market networks, renewable industry in stock exchange market, MST and graph theory. Section 3 describes the research methodology of this paper; in following section presents the results based on MST approach, market network correlation and graph theory. Finally, Section 5 provides concluding remarks on this paper.

2. Literature review

2.1. Stock market networks

In the stock market, all corporations are related to each other and therefore their stock charges are correlated. This correlation, recognized as the possible of deep internal influence, forms the stock market network. Network theory was extended into an extensive variety of themes [18–21]. Barabási, Albert and Jeong [22], presented the scale-free network that is made by the development rule and the preferential attachment rule. In monetary marketplaces, the topology network analysis is an extensively applied practical instrument and delivers well-organized approaches for describing their market and structural possessions [23]. In the stock markets, Mantegna [10] first offered topology network analysis technical instrument of minimal spanning tree (MST) for analyzing the similarities among stock prices and found important results for portfolio optimization. After that, the network-based approach was applied extensively for exploring market belongings in monetary marketplaces, like equity marketplaces [16], the Korean stock marketplace [13], the Athens stock marketplace [24], European equity marketplaces [25], the NYSE stock marketplace [26], the Brazil stock marketplace [27], and commodity marketplaces [28]. Additionally, the topology network model was has been presented for assessing the FX market properties [28,29]. Ortega and Matesanz [30], evaluated some actual FX rates of 28 currencies during 1990–2002 for building the FX and MST networks in that the worldwide FX markets are segmented into subdivisions including nations from the similar geographical areas. Then, a related assumption was presented by Ref. [8] investigated the network of FX market of 26 currencies based on three kinds of metals duration of 1999 and 2003 for classification of currencies based on correlation coefficient and MST network. Results of this study indicated that; USD has played as an important role in the FX markets. Subsequently, Naylor, Rose and Moyle [31] used USD and NZD as two currencies for examine of two different currency networks based on topology evolution of 44 currencies from 1995 to 2001. This study constructed two MST networks and demonstrated that the structure of network has changes. Also, Kwapien, Gworek and Drozdz [29] assessed a set of FX market rates in 46 currencies based on metals between 1998 and 2008, finding of this study found that; in the different FX markets currencies had the different MST networks. They examined the temporal and topology evolution of FX markets and determined that the USD node gradually loses its centrality, but the EUR node has developed slightly more dominant than before in all the network activities. More lately, Keskin, Deviren and Kocakaplan [32] investigated the correlation topology of networks in 34 currencies by applying the hierarchical tree and MST tools from 2007 to 2008. They applied USD and TRY as numeraires to create the networks and presented that the groups coordinated well with corresponding countries from the similar geographical areas of Asia and Europe. Jang, Lee and Chang [23], examined the time series properties of FX market since 1990 to 2008 about the history of the currency crises according to the MST technique. Their consequences showed that EUR as well as USD had a strong negative correlation afterward the Southeast.

Numerous renewable corporations were listed on stock relations in the retro after 2000. The early 21st century was considered as a high dynamic period for the renewable energy manufacturing, as several administrations set long term renewable energy development aims. Some selected to directly fund the renewables by feed-in tariffs as well as related short-term procedures for bridging the gap for fulling cost accounting which would correctly reward these tools for their short releases and absence of interference with ecosystem amenities, and likewise for ensuring some volume and incentive for installing conservation-focused smart grid machineries. Monetary markets around the globe might be viewed as a compound scheme. This forces us for focusing on a global-level explanation for analyzing the communication assembly among marketplaces that might be obtained over signifying the scheme as a network. Association among stock markets has a significant character in asset theory and risk management, and likewise is important basics for the optimization problem in the Markowitz [33] portfolio theory. For the optimization of portfolio in the stock exchange market, there are some trading activities which show the similarity among stocks [14,34]. Compound networks deliver a high general framework, according to the notions of statistical physics, for examining the systems with large amounts of interrelating properties. These networks could positively define the topological possessions and features of several real-life schemes like multi-locus arrangement typing to analyze the clonality [35], scientific association in the European outline programmes [24], global hotel business in Spain [36], classification of correlations of wind speed [37], Brazilian term structure awareness rates [38] and legislative election consequences [39]. MST method is not merely applied inside only one stock market but likewise for networks made from interest rates [38], currencies [40], economic segments [41] and product charges [42]. Though, possibly the most promising method according to network modeling was applied to examine the associations among stock marketplaces as the consequences confirm a growth in the interdependence amongst markets over the past two decades [25,43,44].