



Hierarchical structure of Turkey's foreign trade

Ersin Kantar^{a,c}, Bayram Deviren^b, Mustafa Keskin^{c,*}

^a Institute of Science, Erciyes University, 38039 Kayseri, Turkey

^b Department of Physics, Nevşehir University, 50300 Nevşehir, Turkey

^c Department of Physics, Erciyes University, 38039 Kayseri, Turkey

ARTICLE INFO

Article history:

Received 21 January 2011

Received in revised form 5 April 2011

Available online 13 May 2011

Keywords:

Correlation networks
Minimal spanning tree
Bootstrap technique
Foreign trade

ABSTRACT

We examine the hierarchical structures of Turkey's foreign trade by using real prices of their commodity export and import move together over time. We obtain the topological properties among the countries based on Turkey's foreign trade during the 1996–2010 period by using the concept of hierarchical structure methods (minimal spanning tree, (MST) and hierarchical tree, (HT)). These periods are divided into two subperiods, such as 1996–2002 and 2003–2010, in order to test various time-window and observe the temporal evolution. We perform the bootstrap techniques to investigate a value of the statistical reliability to the links of the MSTs and HTs. We also use a clustering linkage procedure in order to observe the cluster structure much better. From the structural topologies of these trees, we identify different clusters of countries according to their geographical location and economic ties. Our results show that the DE (Germany), UK (United Kingdom), FR (France), IT (Italy) and RU (Russia) are more important within the network, due to a tighter connection with other countries. We have also found that these countries play a significant role for Turkey's foreign trade and have important implications for the design of portfolio and investment strategies.

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1. Introduction

Complex networks provide a very general framework, based on the concepts of statistical physics, for studying systems with large numbers of interacting assets. These networks have been able to successfully describe the topological properties and characteristics of many real-life systems such as multilocus sequence typing for analyses of clonality [1], scientific collaboration in the European framework programmes [2], international hotel industry in Spain [3], taxonomy of correlations of wind velocity [4], Brazilian term structure interest rates [5] and legislative election results [6]. We present, within the best of our knowledge, the first study using the MST on the basis of foreign trade data. Moreover, the most recent literature has studied networks generated by correlations of stock prices [7–16]. In this paper, we focus on foreign trade and the main objective is to characterize the topology and taxonomy of the country's network.

Foreign trade is recognized as one of the most significant determinants of economic development of country, all over the world. The foreign trade of a country consists of the inward and the outward movement of goods and services, which results into outflow and inflow of foreign exchange. The primary objective of foreign trade is to increase production and raise the standard of living of its people. If a country is deficient in some of the resources, it has also to import consumer goods to satisfy the rising expectations of the people with the improvement in their economic conditions. These imports have to

* Corresponding author. Tel.: +90 352 4374938x33105; fax: +90 352 4374931.

E-mail address: keskin@erciyes.edu.tr (M. Keskin).

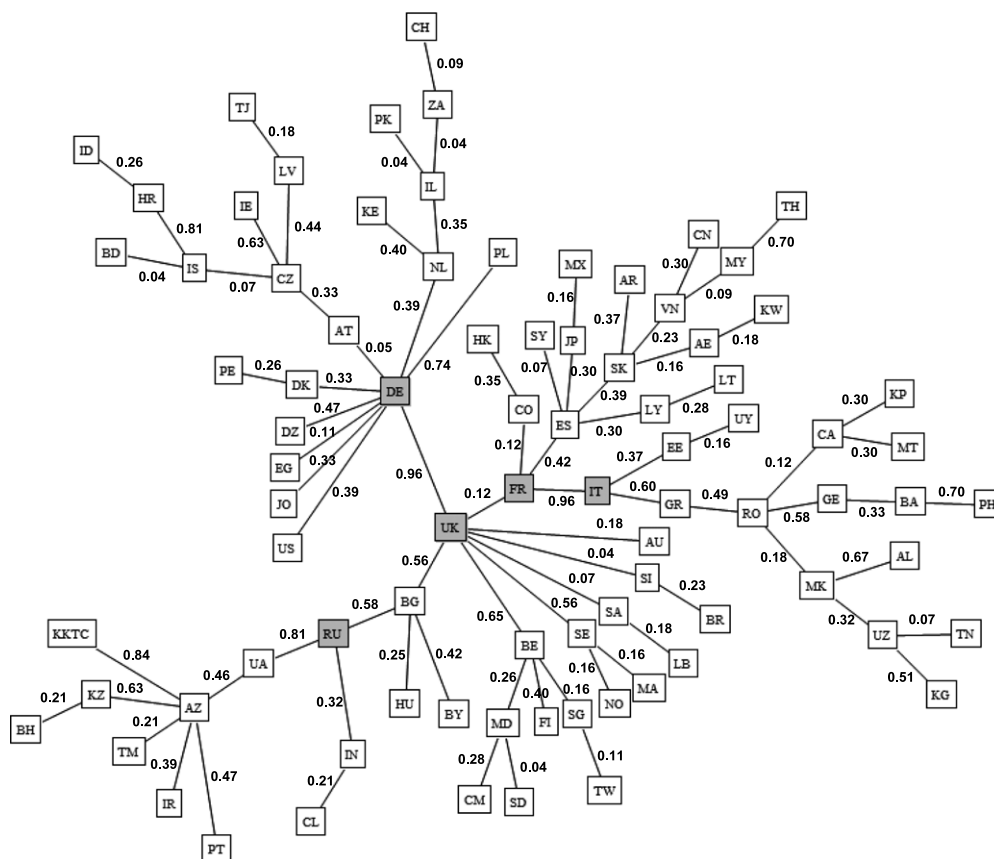


Fig. 1a. Minimum spanning tree associated with monthly data returns of the 86 countries in Turkey's export during the 1996–2010 period.

be paid for foreign exchange. Besides foreign trade, many papers have reported a negative association between country wealth and corruption level, where on average richer countries are less corrupt [17,18]. In addition to these, some papers reported that financial and economics time series of developed markets exhibit different scaling behavior than the series of undeveloped and developing markets [19]. Moreover, similar differences between developed markets and developing markets are reported also in financial series during large market crashes [20].

Turkey's foreign trade has been rising since 1980s and maintaining the same development in 2000s. Turkey's export was 23 224 million dollars in 1996, increased to 27 775 Million Dollars in 2000, amounted to 73 476 Million Dollars in 2005, and 102 143 Million Dollars in 2009, respectively. Between 1990 and 2009, the yearly average increase in exports was over 12.2%. In the same period, there has also been a higher rate increasing in imports. In 1996, imports was 43 627, increased to 54 503 Million Dollars in 2000, amounted to 116 774 Million Dollars in 2005 and 140 928 Million Dollars in 2009. The yearly average increase in imports was 14.1% during the 1990–2009 periods. Moreover, Turkey became a member of World Trade Organization in 1995 and Customs Union with the European Union (EU) was established. Increasing of Turkey's export and import were very small during the 1980–1995 period, but after 1996 the export and import have been risen much more up to 2009 [21]. We should also mention that Podobnik et al., studied annual logarithmic growth rates, R , of various economic variables such as exports and imports, and find that the distributions of R can be approximated by double exponential Laplace distributions in the central parts and power-law distributions in the tails [22]. Moreover, the foreign trades ultimately diminished the differences between developed and developing countries; hence we suggested to state that some experts believe that convergence across all countries exists because of globalization [23–25].

Therefore, the aim of the present paper is to examine relationships among countries based on Turkey's foreign trade by using the concept of minimal spanning tree (MST) and hierarchical tree (HT) over the period of 1996–2010. From these trees, both geometrical (through the MST) and taxonomic (through the HT) information about the correlation between the elements of the set can be obtained. Note that the MST and then the HT are constructed using the Pearson correlation coefficient as a measure of the distance between the time series. Moreover, we performed bootstrap technique to associate a value of reliability to the links of MSTs and HTs. We also used the average linkage cluster analysis for obtaining the HT. These methods give a useful guide to determining the underlying economic or regional causal connections for individual countries.

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