African Journal of Basic & Applied Sciences 10 (3): 64-74, 2018
ISSN 2079-2034

DOI: 10.5829/idosi.ajbas.2018.64.74

Dynamic of Trade of Bangladesh in World Trade Network

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Abstract: We analyze the role of Bangladesh on world trade network with evolution of time and a comparison is done with rest of the world. For this purpose we've used the world trade data of 9 products named all commodities, animal, beverage, chemical, crude oil, food, mineral fuels, machinery and manufactured goods from 1995 to 2013 by making a network from adjacency matrix for import and export values between two countries. We investigate the degree annually. We make a comparison between degree of Bangladesh & average degree of the world. The investigation is done by using graph theory, power law, network techniques and hierarchical approach. Our observation is that, the dynamic increase of degree except sharp fall in 1999 and 2013. This implies that the interactions of Bangladesh with other countries is growing. The degree of Bangladesh almost in all products of world trade network is higher than the mean degree of the networks. We then construct minimum spanning tree from trade matrix and found that the exponents of degree distribution are not equal for all products which imply the unequal trade among the countries for some products.

Key words: Degree · Minimum spanning tree · Power law · Graph theory · Network technique

INTRODUCTION

The trade [1-4] can be thought as the driving force of economic growth of a country. It is very essential for small countries like Bangladesh [5-7] and in the era of global integration [8]. The ambition of this research work is to investigate the state of Bangladesh in world trade [9-17] over the year period 1995-2013 through financial crises, natural disaster, political crisis etc. The investigation is done by using network techniques [18-20]. A network [22-27] is constructed from Adjacency matrix. Where each node correspond to countries and the link between them refers to a trade relationship among those countries. There are many recent studies concerning world trade as a complex network. The first empirical characterization of the world trade web was studied by Serrano and Boguñá [21]. The next study was by Garlaschelli and Loffredo [14] and till now the research is going on International trade [28, 29]. In order to perform our analysis our sample contains 170 countries that are related with trade for the products named all commodities, animal, beverage, chemical, crude oil, food, mineral fuels, manufactured goods, machinery by being import & export with ours. We extracted data from COMTRADE database of the United Nations statistics division [30]. We investigate the degree (total number of links that the node established) & make comparison with rest of the world. We analyze the Degree distribution. The results are represented graphically & the work is done by using MATLAB programming.

After investigation our remark is that the role of Bangladesh in World Trade Network is enhancing day by day.

This paper is structured as follows: Section II illustrates Network Techniques [18-20] e.g. Degree, Average Degree, Degree distribution & Adjacency matrix. Section III describes the view of the model [31-33]. Data analysis & economic crises are mentioned in Section IV. Section V analyzes the result & the rest of the paper contains the conclusion & discusses future extensions.

Methods (Network Techniques):
Adjacency Matrix:

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A Square matrix, A is said to be adjacent if its elements a_{ij} is represented as:

$$a_{ij} = \begin{cases} 1, & when\ i = j \\ 0, & otherwise \end{cases}$$

The adjacency matrix is symmetric i.e. ($a_{ij} = a_{ji}$) if the graph is undirected. And is asymmetric ($a_{ij} \neq a_{ji}$) if the graph is directed.

Degree:

The degree of a node is the total number of links that the node established. It can be defined from the adjacency matrix as:

$$k_i = \sum_{i \neq j} a_{ij}$$

Mean Degree:

The mean degree $< K >$ is the average of degree (k_i). Where, $i = 1,2,....,N$ is the nodes in the network.

In case of undirected network,

$$< K > = \frac{2E}{N}$$

where; E is the total number of edges & N is the total number of nodes.

Degree Distribution:

The degree distribution $P(k)$ of a network is defined as the fraction of nodes in the network with degree K. If there are n nodes in a network and n_k of them having degree K. Then we have,

$$P(k) = \frac{n_k}{n}$$

In case of real networks, the degree distribution follows the power law [34-36].

Model Review: To build an international trade network [31-33] we followed the flow of goods. Here we've mentioned a table that means an 5 × 5 order matrix. The property of adjacency matrix is applied to it. e.g. If Bangladesh imports something from India or India exports something from Bangladesh then we've set 1. This means that; if there is a trade relationship between any two countries (e.g. BD, India, Pakistan, China, USA) then we've set 1 & if not then 0. It has been noticed that, the diagonal elements are 0 as there not be any trade relationship of a country with itself.

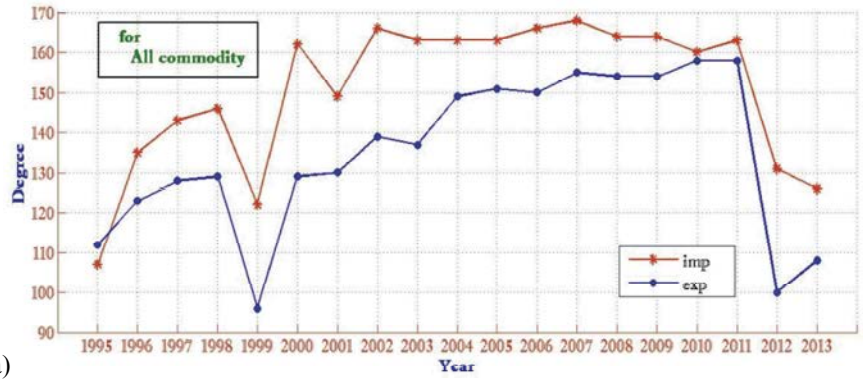
	BD	India	PAK	China	USA
BD	0	1	0	1	1
India	1	0	1	1	1
PAK	0	1	0	1	0
China	1	1	1	0	1
USA	1	1	0	1	0

Data Analysis and Economic Crises: We build the World Trade Network [9-17] on UN COMTRADE data [30]. The original dataset we work with is annual and the time duration is 1995-2013. After this data processing 170 countries are in our consideration as they are related with trade for the products named all commodities, animal, beverage, chemical, crude oil, food, mineral fuels, manufactured goods, machinery by the medium of import & export with Bangladesh. During this time interval some crisis occurred that hampered the progress of our country economically. The crisis are as like as flood of 1998, Global financial crisis of 2008, financial market crash of 2010-2011 & political unrest & violence of 2012-2013.The results are represented graphically. This work is done by using MATLAB programming.

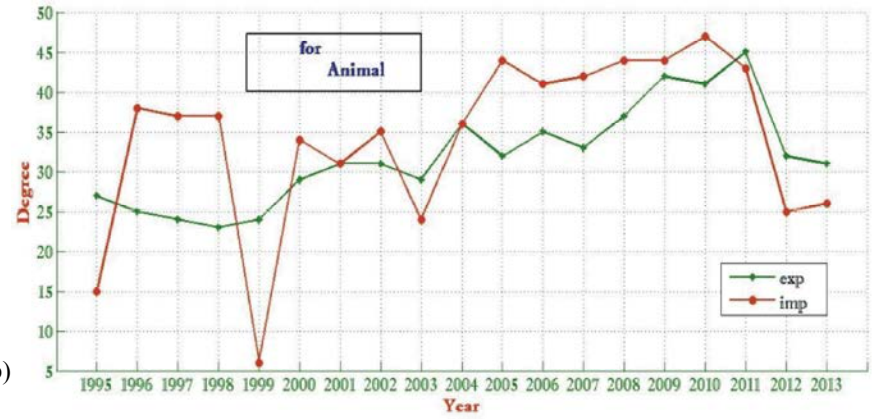
RESULTS

Estimation of Degree: We start our investigation by estimating Degree. This will help us to explore total number of trade links of Bangladesh. After analyzing the International trade network (shown in Fig. 1) for all types of products of our discussion we can say that; the products of all commodity were more up to the links than others. It was noticed that, the number of links in case of all commodity was increasing from year to year & similarity (i.e., enhancement) was noticed in case of the products chemical, crude oil, food, manufactured goods. On the other hand this picture was completely different for the products of animal, beverage & mineral fuels. Though in this time interval (1995-2013) they promoted slightly but the rate was not as high as like as others. They were mostly effected by natural disaster like flood of 1998 & 2004, global financial crisis of 2008, market crash of 2010-2011 & political crisis of 2012. After all, interconnectivity of other countries with Bangladesh is increasing in the trade sector.

Comparison Between Degree of Bangladesh & Average (Mean) Degrees of World: By observing the international trade network (Fig. 2) we can say that, at the beginning of 1995 the least no. of degree of Bangladesh was around 28 (for animal) while the average degree of the world was


for
All commodity
Degree
Year
imp
exp

(a)


for
Animal
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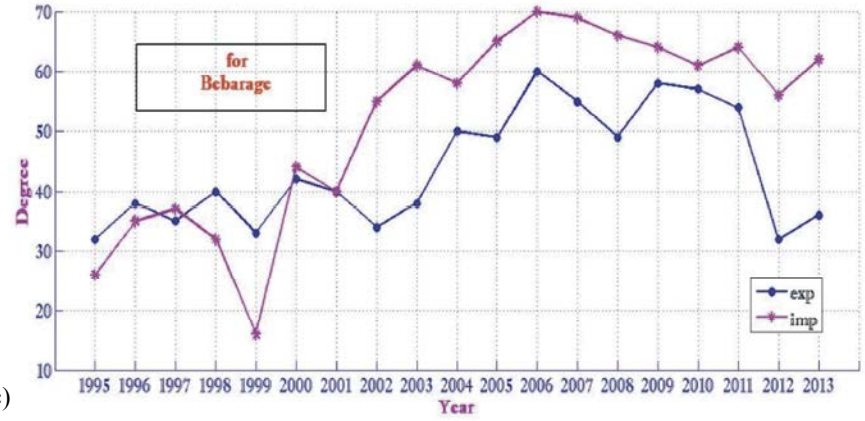
(b)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Degree
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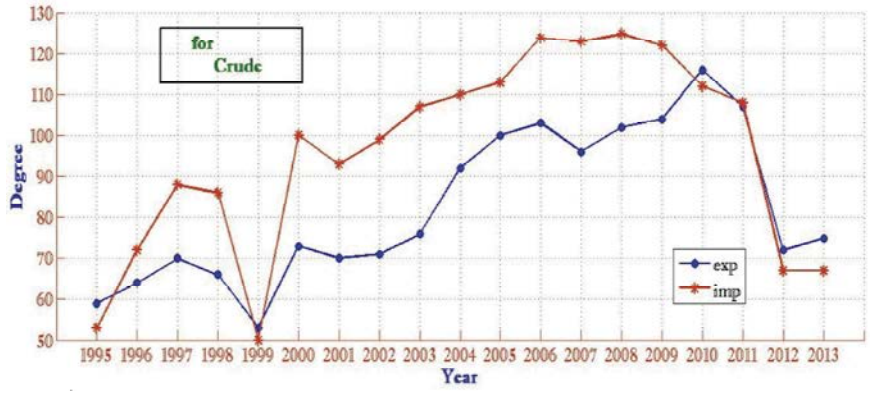
(c)


for
Crude
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exp
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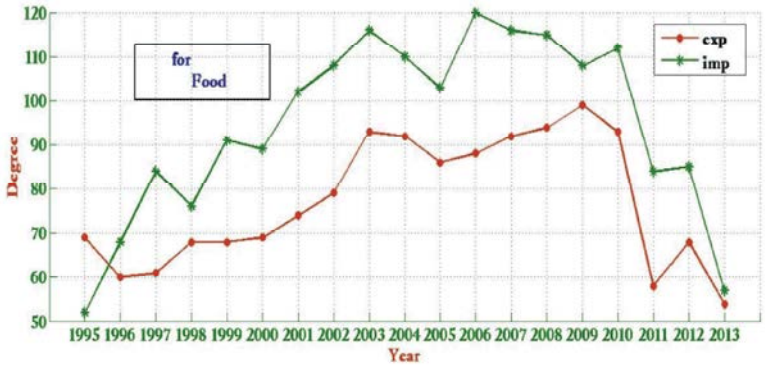
(d)


for
Food
exp
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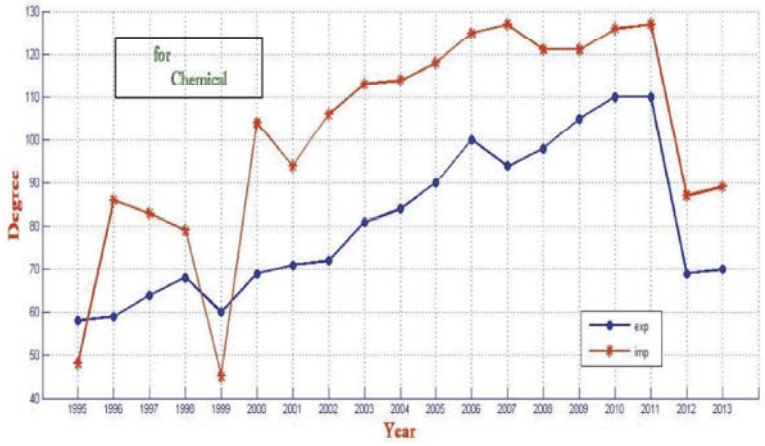
Degree
Year

(e)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Chemical
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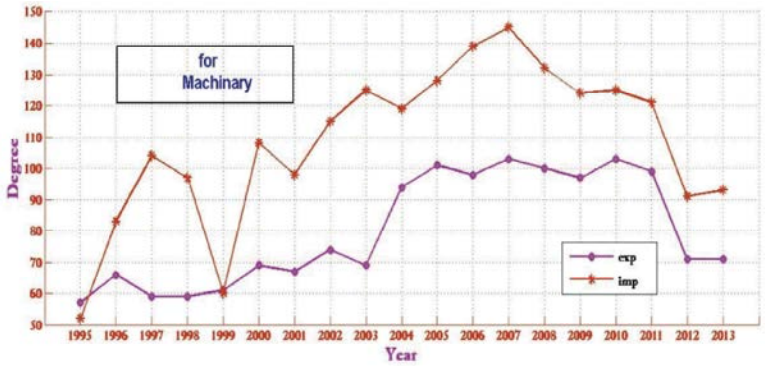
(f)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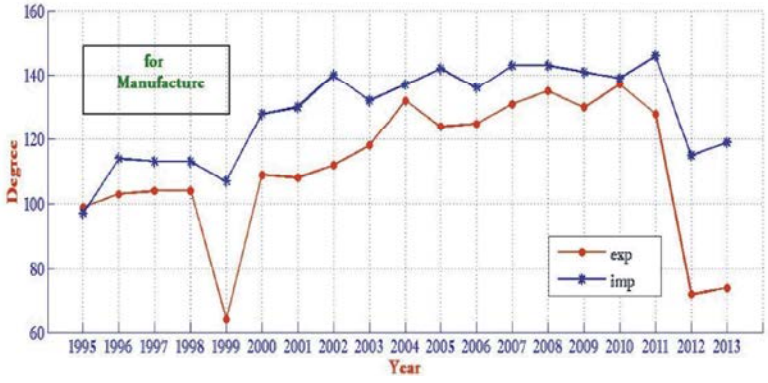
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Degree
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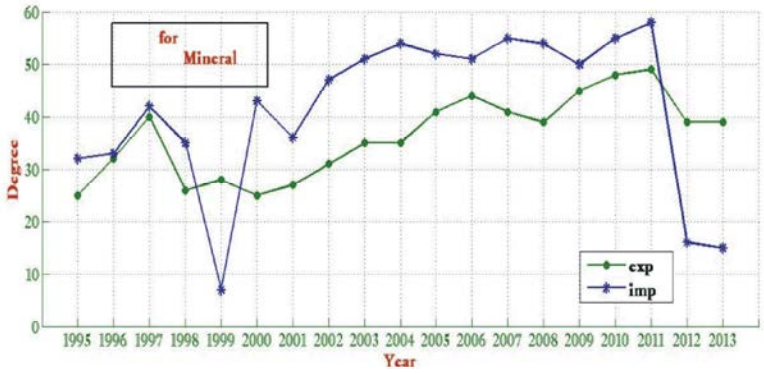
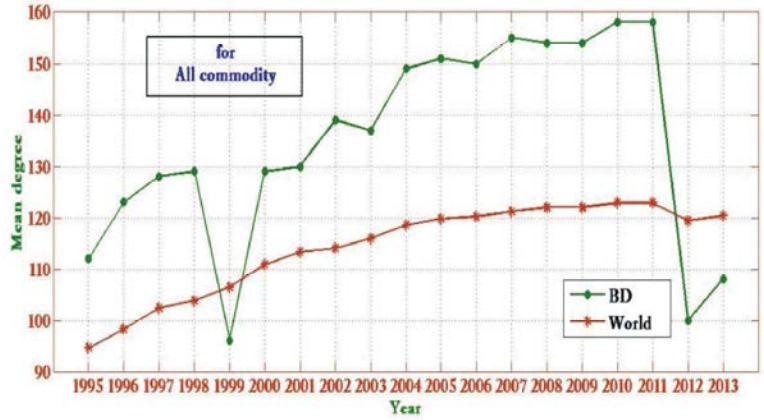
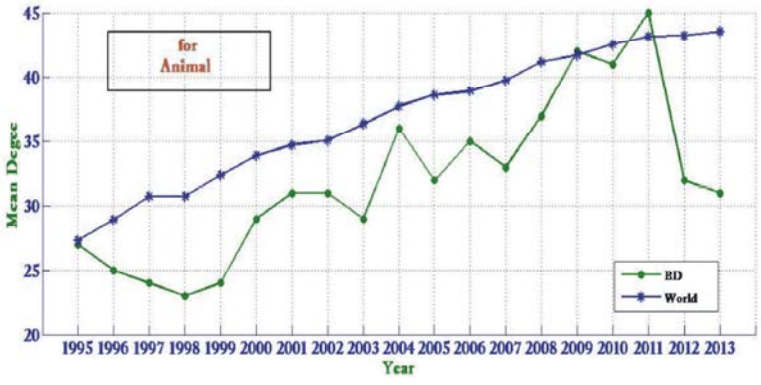


(i)

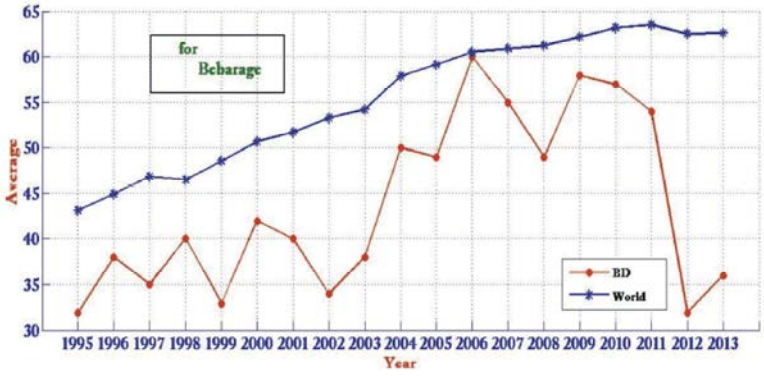
Fig. 1: Degree of (a) all commodities (b) animal (c) beverage (d) crude oil (e) food (f) chemical (g) machinery (h) manufactured goods (i) mineral fuels



(a)

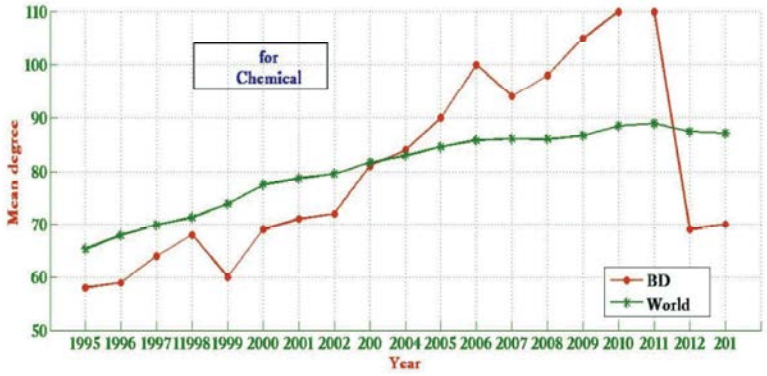


(b)

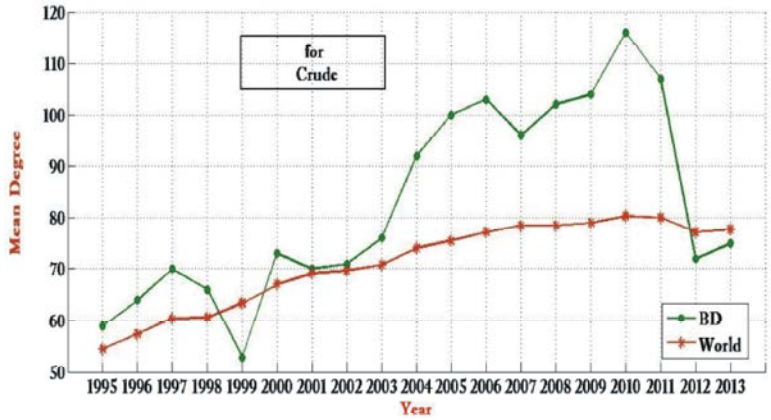


(c)

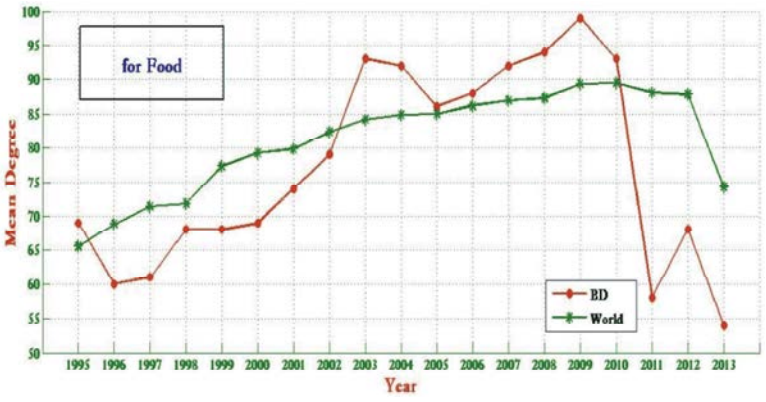
(d)


for
Chemical
Mean degree
Year
BD
World

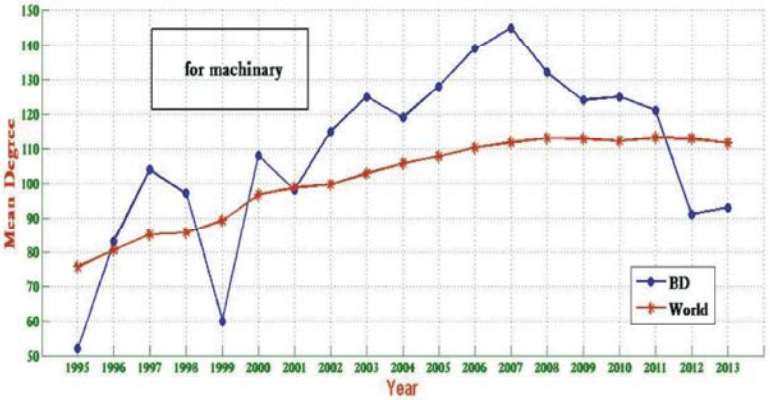
(e)


for
Crude
Mean Degree
Year
BD
World

(f)


for Food
Mean Degree
Year
BD
World

(g)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Mean Degree
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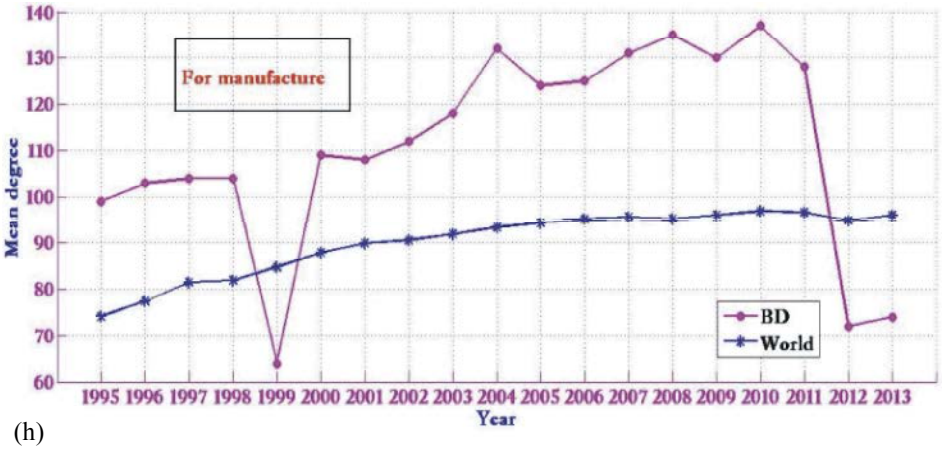

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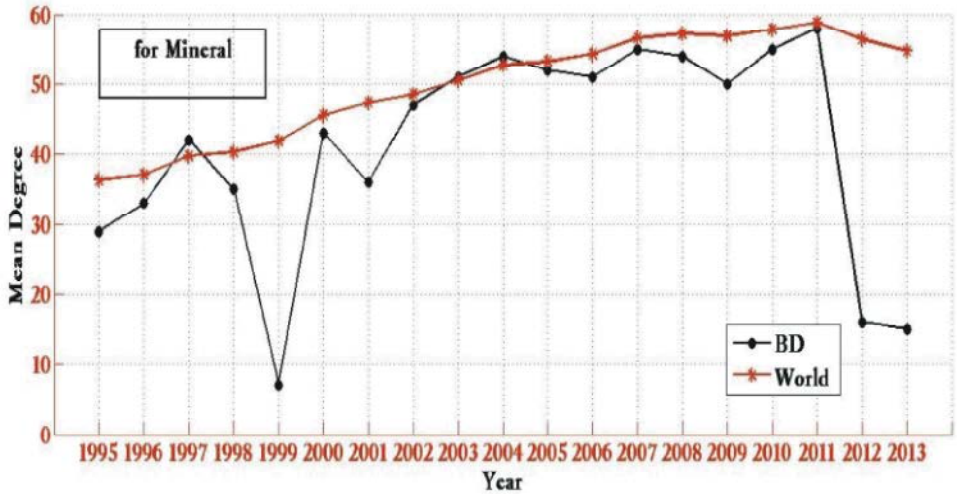
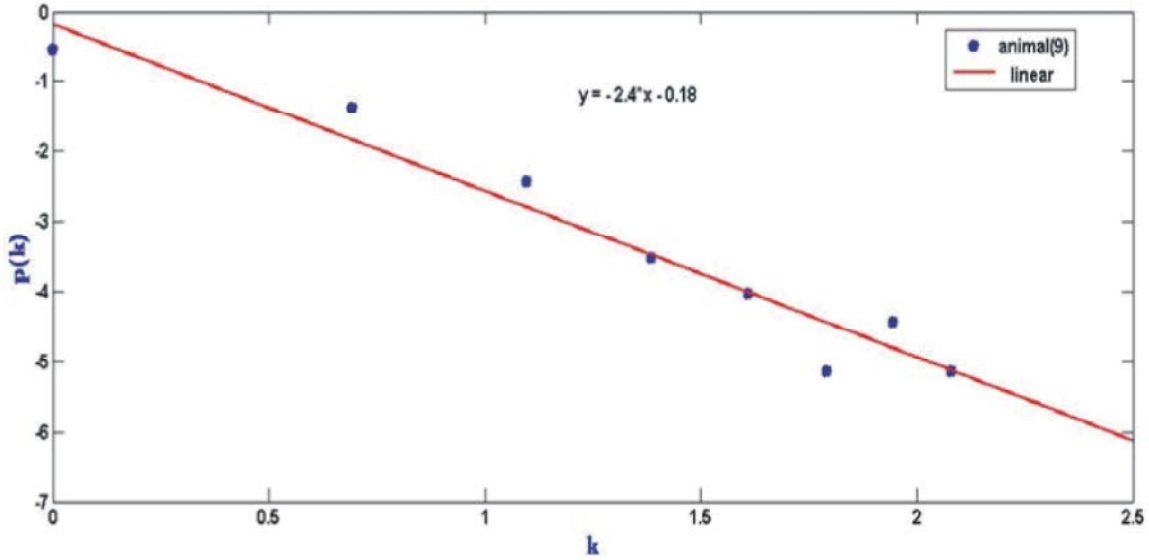


(i)

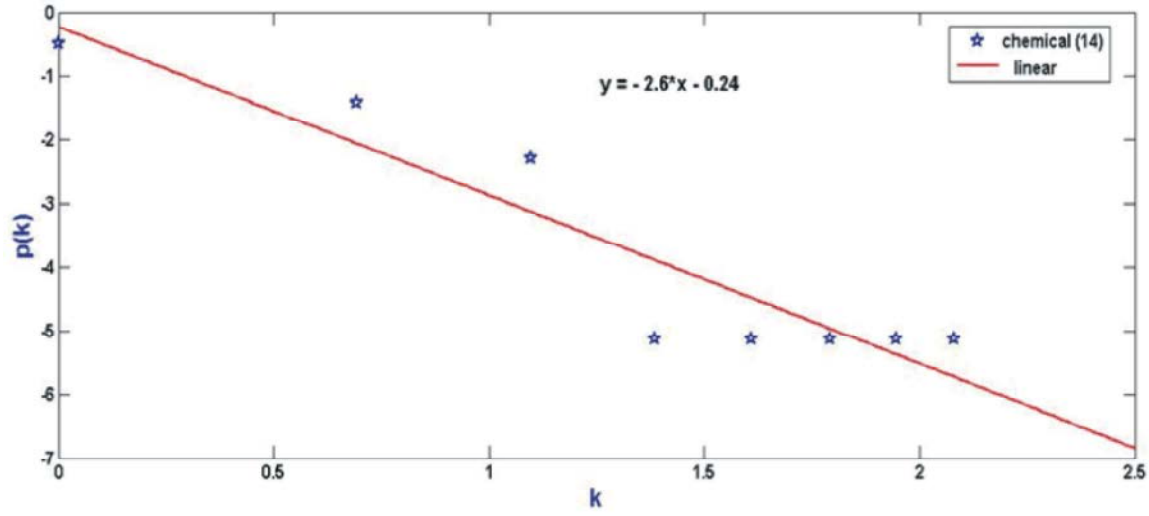
Fig. 2: Comparison between degree of Bangladesh & the degree of world for the products (a) all commodities (b) animal (c) beverage (d) chemical (e) crude oil (f) food (g) machinery (h) manufactured goods (i) mineral fuels

around 110 (for all commodity). This implies that the total no. of links of Bangladesh was comparatively lower than the world. A sharp transition was noticed in 1999 due to the effect of flood & it raised sharply in the next year. Fluctuations were to be continued from 2000-2006. Almost all types of products were in slight increment in 2006 but it started to fall slightly from 2007-2011 due to the global financial crisis of 2008 & market crash of 2010- 2011. A remarkable increment was noticed in 2011 but a sharp transition occurred in the next year due to the financial & political crisis.

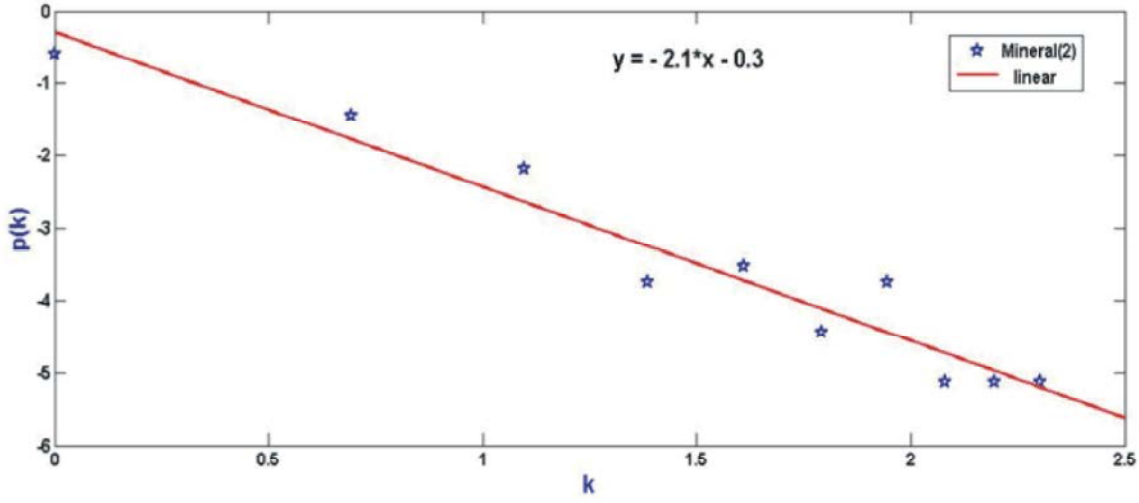
Estimation of Degree Distribution: In case of degree distribution the more connected a node (countries) is, the more likely it is to receive new links. Nodes with higher degrees have powerful capabilities to capture links connected to the network. Higher degree exponent means the no. of nodes (countries) of lower degree is comparatively more than higher degree, whereas, lower degree exponent means high edge density of many vertices and consequently too large clusters. The degree distribution follows power law behavior and so the graphs are linear (Fig. 3). The exponents depend on the state of the market. This process is sometimes referred as the rich getting richer phenomenon. Figure 5 shows that, the degree exponent of mineral & crude oil are $v \approx 2.1 + 0.1$ & $v \approx 2.3 + 0.28$ i.e. having low degree, whereas, animal, chemical & food have high degree i.e, $y \approx 2.4 \pm 0.18$, $v \approx 2.6 + 0.24$ & $y \approx 2.6 \pm 0.29$ respectively. High degree node maintains exclusive trade when low degree node is managed by a certain number of nodes.


animal(9)
linear
y = -2.4*x -0.18
p(k)
k

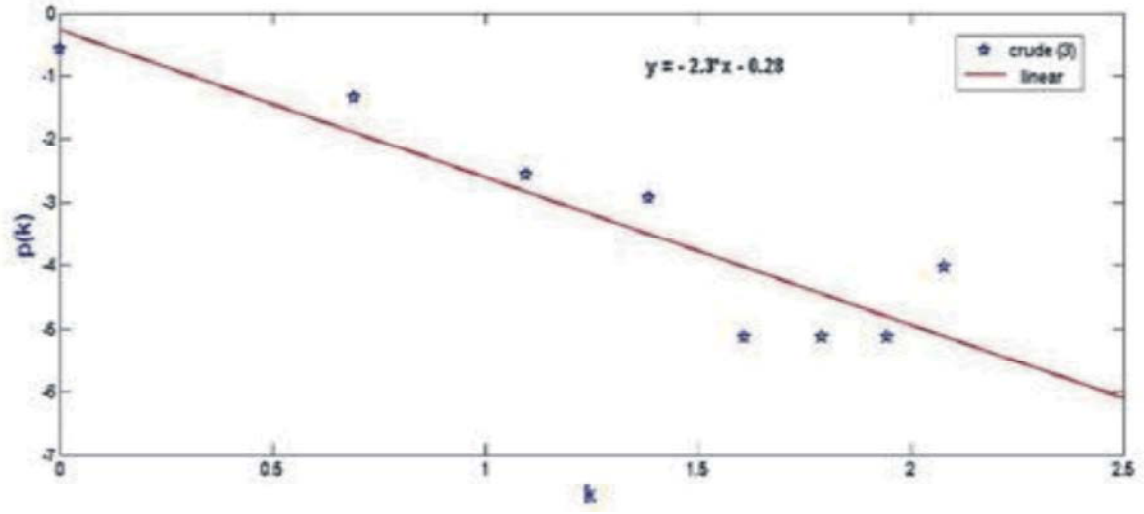
(a)


chemical (14)
linear
y = -2.6*x - 0.24
p(k)
k

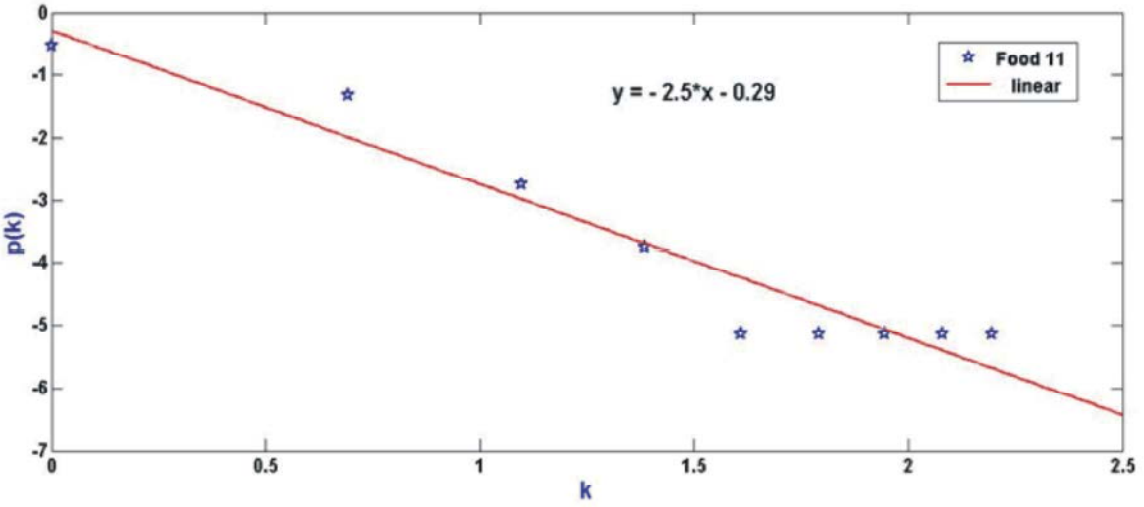
(b)


Mineral(2)
linear
y = -2.1*x - 0.3
p(k)
k

(c)



(d)



(e)

Fig. 3: Log-log plots of the degree distribution for the world trade network of (a) animal (b) mineral fuels (c) chemical (d) crude oil & (e) food

CONCLUSION

In this paper we've used a model that has already been used in research on world trade network [31-33]. But there was no application of this model in international trade of Bangladesh. This kind of analysis helped us to know the position of Bangladesh in world trade. In world trade, the total products are more than 800 [30].We only analyze the 9 major products. In future, we will analyze all products. One nation can develop by improving the quality of product. e.g. S. Korea, Columbia. We will identify the products which quality should be increased to develop our nation.

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