Evolution of Emerging Economies and International Trade

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1 INTRODUCTION

The World-Trade Web (WTW) is defined as the network of import-export relationships between world countries. WTW can be seen as the backbone of the global economy system. Understanding global economic development requires identifying significant countries and areas in such a network and charting their influence through time. The modern world is characterized by globalization and economic interdependence. The growing division of labor and fragmentation of supply chains, in particular, has resulted in the globalization of production and shipping of numerous commodities and services, enhancing international economic cooperation [4].

The objective of this paper is to analyze networks between developing countries to better understand their trade relations and how it affects their growth as a country. We will look at emerging economies, which are the markets of developing countries that are rapidly growing and industrializing, as our main focus, and examine how they have been performed over the years.

2 PROBLEM DEFINITION

In our project, we aim to analyze the global trade network and its properties. Our research spans the years 2008 to 2017, and the rationale for this is that we want to look at the most recent links and trends, particularly in the aftermath of the financial crisis of 2008.

- Using the GDP of each country, spanning over our given timeline, we are able to analyze how these countries have progressed over the years.
- Given annual export data for each country, analyze the strength of the network with respect to the WTW

3 RELATED WORK

Our project is related to the global trade network modelling. Here we present some existing studies on this topic.

In the study of Iapadre, et. al.[8], they discuss the role of emerging countries in the international trade network. It's important to note that the increase in the number of trading partners and the leadership role taken up by these countries, in the last few decades, has had a huge impact on the growth of the international trade network. Here, on the one hand, network analysis takes into account how local trade structures affect the overall international trade system, and on the other, it allows to examine the structure within local networks, to highlight asymmetries, and to determine whether they are built around a single country acting as a system hub, or if they represent a system of countries with similar roles and importance.

They introduce the concept of centrality in the international trade network [8]. The centrality of a node is directly related to its connectedness with the rest of the system, and it is used to determine its significance in the network structure. Essentially, if a central node is separated from the network for whatever reason, the entire network structure is affected, and if a shock hits a central node, the shock will be transmitted quickly and widely. In the global trade network here, the centrality measures based on the number of trade links of a given country and their strength indicate how well connected a country is to the rest of the system, and to what extent the position of the country shapes the network.

Giorgio Fagiolo is a researcher who has done extensive analyses of the world trade web, and has dedicated much of his career to the research of economic networks and in particular the world trade web[3, 7, 9].

4 METHODOLOGY

In order to address the problems, as discussed in Section 2, and carry out our analysis, we take the following steps:

(1) Secure the dataset(s), which is discussed briefly in Section 4.1.
(2) Leveraging this data, the network will then be constructed. This process will be thoroughly covered in Section 4.2.
(3) After the network has been constructed, we can finally perform some simulations and run some tests. Section 5 should be able to report the detailed analyses and results of the performed experiments.

4.1 Data Set

We are going to use the database from the World Integrated Trade Solution(WITS) website[10], a rich database with trade statistics for each country. This database will provide us the flexibility to analyze emerging countries' effects on the global economy in terms of industry, region, income group, etc. From this database, we were able to obtain the total exports, exports partner share, and GDP, for each country during the years 2008 - 2017.

Another database we use is from Our World in Data website[5], which gives us the weighted average of the world trade, measured as a share of GDP. This database can help us make a more involved analysis of developing economies on socioeconomic metrics like income inequality, household income, and unemployment. Another reason we investigate another dataset is so that we may compare the two and see what similarities and differences exist.

4.2 Network Construction

Global trade can simply be summarized as the import and export network between countries. In this network, countries are represented as nodes. The nodes will be color-coded depending on the metric or context we are looking at. An edge exists between two countries if they trade with one another, as revealed by the data we collect (see section 4.1). Countries A and B are trade partners if node A has an edge linking to node B. The graph will be directed in the ideal case, with edge weights added to each edge. If nation A has exported a dollar quantity of products equivalent to W in dollars to country B in that year, node A has a directed edge E to node B with weight W.

In this part, we will try to find the characteristics of global trade. The main idea for this part is to understand the main actors and components of world trade. Finally, we will narrow our focus to developing countries. We look at how developing countries are connected to each other and the global network. We try to answer questions like, Which countries and regions are on the rise? How important are developing countries to the global economy and to their regions? What are the common characteristics that define developing countries? We also try to predict the underdeveloped countries that will potentially become developing countries.

5 EVALUATION

5.1 Attributes

The table below gives us a brief insight into the entire World Trade Web. In graph theory, a clustering coefficient is a measure of the degree to which nodes in a graph tend to cluster together. In our network, it shows the strength of the connections between the countries. The overall level of clustering in the network is measured as the average of the local clustering coefficients of all the nodes. We created a dataframe from our dataset[10], with the results displayed in the table below.

year	node	edge	average clustering	average shortest path
2008	149	1602	0.5882244563075004	1.3650462543079993
2009	138	1394	0.5880602489295544	1.3995556966042526
2010	145	1564	0.5827068056595	1.5001436781609196
2011	156	1739	0.5966224418964257	1.403225806451613
2012	153	1767	0.6282820472768784	1.383857929136567
2013	149	1770	0.6364652126301222	1.4429076727734447
2014	154	1768	0.6398612889743857	1.3822680587386469
2015	149	1615	0.6235211628800981	1.4895701070197715
2016	152	1569	0.6009886805129084	1.452204600906239
2017	150	1664	0.6317030439053943	1.4653691275167786

Our first observation is the decrease of average clustering in the year 2008, and then again in the year 2014 - 2016. Lets first consider 2008, the year of the financial crisis which took the world by shock and had a huge impact of the entire world.

The subprime mortgage crisis in the United States was a global financial crisis that occurred between 2007 and 2010 and contributed to the global financial crisis of 2007–2008[6]. It was sparked by a sharp drop in home values in the United States following the bursting of a housing bubble, which resulted in mortgage defaults,

foreclosures, and the devaluation of housing-related securities. Following these events, World trade experienced a sudden, severe, and synchronised collapse in late 2008 – the sharpest in recorded history and deepest since WWII[2].
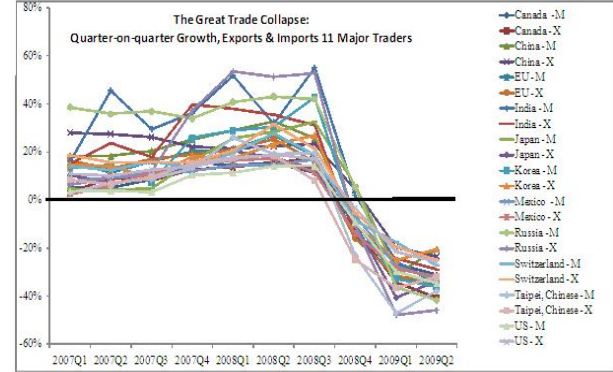

Figure 1: Trade collapse following 2008 crisis

The figure above[2] shows how imports and exports collapsed for the EU27 and 10 other nations that together account for three-quarters of world trade; each of these trade flows dropped by more than 20% from 2008Q2 to 2009Q2; many fell 30% or more.

Here we have evidence of how the trade network is so interconnected. The fall of the United States of America, one of the biggest importers, has such a huge impact of the whole world. In conclusion, the decrease in the average clustering during the years 2008 - 2009 is expected, as the connectivity of the network decreased substantially during that time.

Additionally, the decrease in the connectivity of the network during the years 2015 - 2016 can also be explained. In 2016, world merchandise trade recorded its lowest growth rate in volume terms since the financial crisis of 2008, with an increase of just 1.3%, as measured by the average of exports and imports[1]. Part of the reason for the slowdown in trade growth was the global economy's continued downturn, with economic activity slowing in both developed and emerging economies. However, it also represented deeper structural shifts in the trade-economic growth link. In 2016, the most trade-intensive components of global demand were especially weak, as US investment spending fell and China continued to re-balance its economy away from investment and toward consumption, lowering global import demand[1].

To simplify, the 2008 crisis had not only global effects, but long lasting impacts as well. As the world continued to recover, the WTW saw drawbacks in the following years, which can be observed in the findings of our table above.

5.2 PageRank

This next section is inspired from the study of Iapadre, et. al.[8], specifically using the centrality of a node to analyze the trade network. In simple terms, the centrality of a node will give us the importance of that node with respect to the entire network(section 3). We use the PageRanks algorithm, a link analysis algorithm that assigns a numerical weighting to each element of a hyperlinked set

of documents, such as the World Trade Network, with the purpose of "measuring" its relative importance within the set. From the data[10], we were able to create simple graph representations of the leading countries and the emerging economies, in terms of their influence in the network, spanning over our timeline.
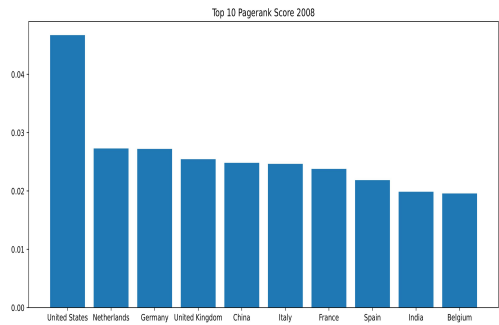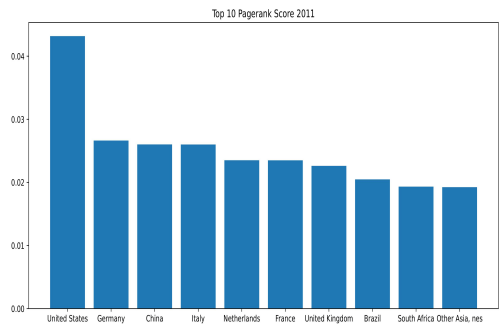

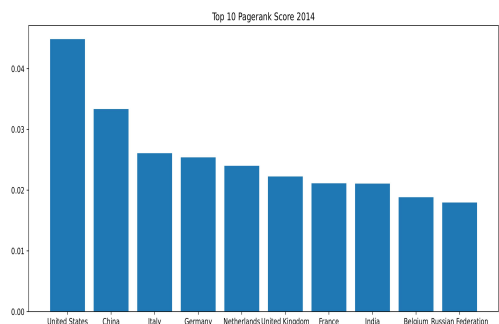Figure 2: Leading Countries : 2008

Figure 3: Leading Countries : 2011

Figure 4: Leading Countries : 2014
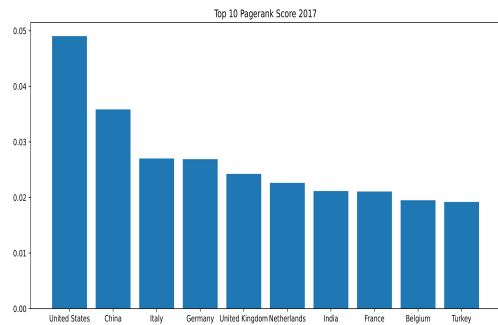
Figure 5: Leading Countries : 2017

Figures 2, 3, 4, & 5 show the top 10 countries obtained from using the PageRank algorithm, in the years 2008, 2011, 2014 & 2017 respectively. The centrality of a country, or its importance in the network, is represented by PageRank.

Next, we created a list of emerging economies by selecting the countries that have GPD per capita between $14.000 - $4.000. Using this list of emerging economies we created **Figures 6, 7, 8, & 9** to show the top emerging countries for the years 2008, 2011, 2014, &2017 respectively. This gives us an idea of where these countries rank on the global scale.
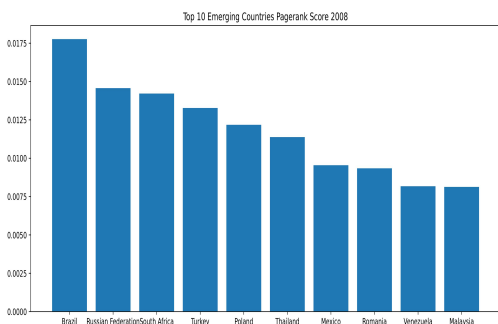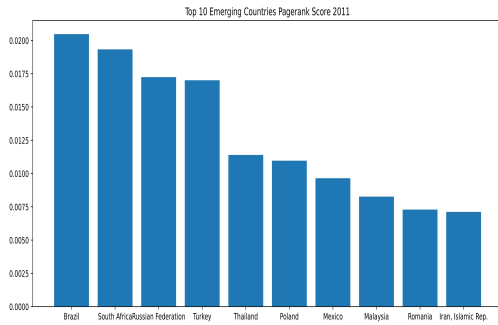

Figure 6: Top Emerging Countries : 2008
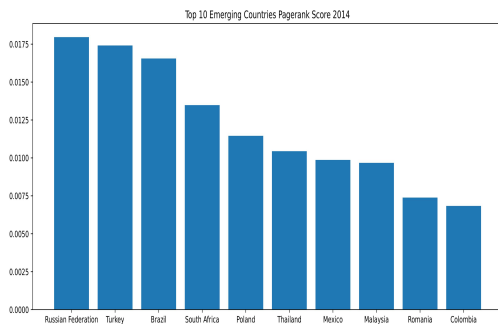
Figure 7: Top Emerging Countries : 2011

Figure 10: Trade (% of GDP)

Figure 8: Top Emerging Countries : 2014

Figure 11: Yearly Avg. Clustering Coefficient
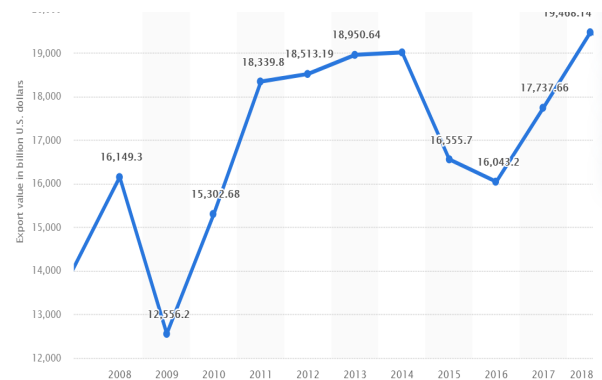

Figure 9: Top Emerging Countries : 2017

Figure 12: Global Export Value of Trade in Goods

5.3 Visualization

The global economy is not a simple subject to cover. It might be difficult to interpret the data just by looking at the numbers. Here we provide comprehensive visual representations of function graphs derived from the results of our experiments with network methods and algorithms applied on yearly trade networks.

In **Figures 10, 11, & 12**, we see a relationship between the World GDP, Connectivity of network, and the total global exports. These figures clearly indicate the proportionality of these 3 measures and how they follow similar trends. When world trade is doing well, .i.e increasing in exports, we see the connectivity increase simultaneously, and vice versa.

6 CONCLUSION

The World Trade web has a plethora of features and attributes that allow it to be examined and investigated from various angles and for various purposes. When merely looking at total annual export by country, this analysis discovered several of the world trade web's well-known traits as well as other lesser-known aspects connected to community structure. We see how influential countries can sometimes be a deciding factor for the direction of entire global Trade network. In our final report we will tackle problems like Community and regional Analysis, and Link prediction in the network.

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