"Global Uncertainty Fueling Indian Economy" Systematic Study of India Trade and economy with various factors

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Abstract - This research paper summarizes Indian trade and economy with top 5 economies of the world and formulating their mathematical equation and correlation. The data has been taken from official government websites. For this we have used mathematical techniques of correlation and regression and analyzed it graphically and structured in the form of research paper. This research paper is systematic study of applying correlation and regression techniques to the import and export data available. We also added theoretical effects of G20 summit 2023, Ukraine-Russia War, Covid-19, International Reforms by WTO etc. to India Trade. We concluded what will be the monetary value of trade in the coming years using quadratic and Bi-quadratic equations. In the end, India are in top 5 race for top economies and trade being one of the most crucial part of it. India geographic location and agricultural sector makes it one of the most important exporter in world along with industrial reforms.

***Key Words*: Import, Export, Trade, Economy, G20, Covid, Ukraine-Russia**

1. Introduction

1.1 What is economy of a Country?

The economy of a country is a multifaceted and dynamic system that encompasses all the economic activities within its borders. It serves as the lifeblood of a nation, influencing the standard of living, employment opportunities, and overall well-being of its citizens. Understanding a country's economy involves examining various factors and indicators that collectively paint a picture of its financial health and performance on the global stage.

At its core, an economy represents the intricate web of production, distribution, and consumption of goods and services. It encapsulates the following key elements:

1. Production: This includes all the processes by which raw materials, resources, and labor are transformed into finished products and services. These activities can range from farming and manufacturing to high-tech industries and service-based sectors.

2. Consumption: Consumption refers to the utilization of goods and services by individuals, households, businesses, and the government. It reflects the spending patterns and preferences of various economic actors within the country.

3. Distribution: The distribution of wealth and income is a critical aspect of an economy. It encompasses how the earnings and resources generated within the economy are distributed among its citizens and entities. Disparities in income distribution can have significant social and political implications.

4. Trade: International trade plays a crucial role in most economies. It involves the exchange of goods and services across borders, impacting a nation's balance of trade and its integration into the global marketplace.

5. Government Intervention: Governments often play a pivotal role in regulating and influencing the economy through fiscal policies (e.g., taxation, spending) and monetary policies (e.g., interest rates, money supply). These policies aim to stabilize the economy, manage inflation, and promote economic growth.

6. Economic Sectors: Economies are typically categorized into primary, secondary, and tertiary sectors, each representing different types of economic activities. The mix of these sectors can vary significantly from one country to another.

7. Macroeconomic Indicators: Various indicators such as Gross Domestic Product (GDP), unemployment rates, inflation rates, and balance of payments provide insights into the overall health and performance of an economy. These indicators help policymakers and analysts assess economic trends and formulate strategies.

8. Global Factors: Economic conditions in one country can be influenced by global factors, including international trade agreements, exchange rates, commodity prices, and economic crises. These external forces can have significant implications for a country's economy.

9. Social and Environmental Considerations: An economy's sustainability and impact on society and the environment are increasingly important aspects of economic analysis. Issues such as environmental sustainability, income inequality, and social welfare programs are integral to understanding a country's economy in the modern era.

The economy of a country is a complex and evolving system that reflects the interplay of various economic, social, and political factors. Its performance has profound effects on the well-being of its citizens and its position in the global community. As such, it is a subject of continuous analysis, policy development, and debate among economists, policymakers, and the public.

1.2 Trading:

International trade is the lifeblood of countries in the modern global economy. It involves the exchange of goods and services between nations, transcending geographical boundaries and fostering economic interdependence. Trade is not merely a transaction; it represents a complex network of economic relationships that shape the fortunes of nations. Countries engage in trade to access resources, technologies, and products they may not produce domestically while exporting goods and services where they possess a comparative advantage. This exchange not only spurs economic growth but also enhances cultural exchange and diplomatic ties among nations. However, trade is not without its challenges, including trade deficits, protectionism, and the need for regulatory frameworks. In an increasingly interconnected world, the trading of countries is a pivotal force that drives economic prosperity, innovation, and cooperation on a global scale.

1.3 Trading and GDP of a Country:

Trading, in the context of a country's Gross Domestic Product (GDP), generally refers to the contribution of international trade to a nation's economic output. Specifically, it can be broken down into two components:

1. Exports: The value of goods and services produced within a country and sold to foreign markets. When a country exports its products, it generates income from external sources, which adds to its GDP. Exports are considered a positive contributor to GDP.

2. Imports: The value of goods and services purchased from foreign markets and consumed within a country. Imports represent spending on foreign products and services and are subtracted from GDP. Therefore, imports have a negative impact on GDP.

The net effect of these two components on GDP is referred to as the "net exports" or "trade balance." It is calculated by subtracting the value of imports from the value of exports:

Net Exports = Exports - Imports

- If a country's exports exceed its imports (a trade surplus), then net exports are positive, and this contributes positively to GDP.

- If a country imports more than it exports (a trade deficit), then net exports are negative, and this detracts from GDP.

In essence, the net exports component of GDP reflects how much a country contributes to global trade and whether it is a net exporter or importer of goods and services. A positive net exports figure indicates that the country is exporting more than it is importing, which adds to its GDP. Conversely, a negative net exports figure indicates that the country is importing more than it is exporting, which subtracts from its GDP.

It's important to note that the impact of trade on GDP can vary significantly from one country to another, depending on the size of their economy, the composition of their trade, and the prevailing global economic conditions. For some countries, trade can be a major driver of economic growth, while for others, it may play a smaller role in their overall GDP.

2. International Trade Policy:

International trade policy is the set of rules, agreements, and strategies that govern a country's engagement with the global economy. It's a complex web of decisions and regulations that determine how nations trade with each other. These policies can have profound impacts on a country's economic prosperity, the competitiveness of its industries, and the well-being of its citizens. From free trade agreements that aim to eliminate barriers to trade, to tariffs and non-tariff barriers designed to protect domestic industries, trade policy is a tool that governments wield to navigate the complex terrain of the global marketplace. It also includes provisions for intellectual property protection, dispute resolution mechanisms, and efforts to promote economic development and inclusion. In an interconnected world, international trade policy is not only about economics but also about diplomacy, geopolitics, and the pursuit of a nation's interests in a rapidly changing global landscape.

3. World Trade Organization:

The World Trade Organization (WTO) is a global institution that serves as the primary forum for regulating international trade and resolving trade disputes among its member countries. Established in 1995, the WTO operates on principles of transparency, non-discrimination, and open trade. Its primary goal is to facilitate the smooth flow of goods and services across borders while promoting fair and equitable trade practices. The WTO provides a framework for trade negotiations, helping countries establish trade agreements and reduce trade barriers. Additionally, it offers a platform for settling trade-related disputes through a well-defined dispute resolution mechanism, ensuring that trade conflicts are addressed in a fair and impartial manner. The WTO plays a crucial role in shaping the rules of the global trading system and fostering economic cooperation among nations, contributing to increased global prosperity and stability.

4. Positon of India in International Trading:

India is a significant player in international trade, and its position in global trade has been steadily growing. India is one of the world's largest economies and is known for its diverse range of exports and imports.

Here are some key points about India's position in international trading:

1. Export and Import Volumes: India is a major exporter and importer of goods and services. It exports a wide range of products, including textiles, pharmaceuticals, software services, chemicals, machinery, and agricultural goods. It also imports various items, such as crude oil, electronics, machinery, and precious metals.

2. Trade Partners: India conducts trade with numerous countries around the world. Some of its key trading partners include the United States, China, the United Arab Emirates, Saudi Arabia, and the European Union.

3. Services Trade: India is known for its services sector, particularly information technology (IT) and business process outsourcing (BPO). It provides IT services, software development, and customer support to clients globally, contributing significantly to its export earnings.

4. Trade Agreements: India is party to various trade agreements and partnerships. It is a member of the World Trade Organization (WTO) and has signed multiple regional trade agreements, including the South Asian Free Trade Area (SAFTA) and bilateral agreements with countries like Japan and South Korea.

5. Challenges: India faces challenges in trade, such as trade deficits (importing more than exporting), issues related to trade barriers, and the need to enhance infrastructure and ease of doing business to boost exports.

6. Government Initiatives: The Indian government has launched initiatives such as "Make in India" to promote domestic manufacturing and exports. It has also been working on improving the ease of doing business, simplifying customs procedures, and implementing reforms to boost international trade.

5. Ukraine-Russia War impact on Indian economy:

The war in Ukraine has had a significant impact on the Indian economy, both directly and indirectly.

Direct impact:

- Increased energy prices: The war has led to a sharp increase in global energy prices, which has had a knock-on effect on India, which imports over 80% of its oil and gas needs. This has led to higher inflation and a widening trade deficit.
- Disrupted supply chains: The war has also disrupted global supply chains, making it more difficult and expensive for Indian businesses to import goods and services. This has particularly affected sectors such as manufacturing and pharmaceuticals.
- Reduced investment: The war has created uncertainty and volatility in the global economy, which has led to a decline in foreign investment in India. This is a major concern, as India needs foreign investment to finance its growth and development.

Indirect impact:

- Weaker global economic growth: The war is expected to slow global economic growth, which will have a negative impact on India's exports.
- Higher interest rates: The US Federal Reserve has raised interest rates in an effort to combat inflation. This is likely to lead to higher interest rates in India, which will make it more expensive for businesses to borrow money and invest.
- Reduced consumer spending: The war has led to a rise in the cost of living, which is likely to reduce consumer spending in India. This will have a negative impact on the retail and tourism sectors.

Overall, the war in Ukraine is having a negative impact on the Indian economy. The government is taking steps to mitigate the impact of the war, but it is likely to be a major challenge for the Indian economy in the coming months and years.

Here are some of the measures that the Indian government is taking to mitigate the impact of the war:

- Providing subsidies on fuel and other essential items: The government is providing subsidies on fuel and other essential items to help consumers cope with the rising cost of living.
- Cutting taxes: The government has cut taxes on certain goods and services to help businesses and consumers.
- Increasing public investment: The government has increased public investment in infrastructure and other sectors to boost economic growth.
- Promoting exports: The government is promoting exports to help reduce the trade deficit.

It is important to note that the war in Ukraine is a fluid situation and the impact on the Indian economy is likely to evolve over time.

6. Effect of G20 Summit on World Trade:

The G20 summit 2023 was held in New Delhi, India, from September 8-10, 2023. The summit's theme was "Vasudhaiva Kutumbakam: One Earth, One Family, One Future."

One of the key issues discussed at the summit was trade. The G20 leaders reaffirmed their commitment to a free, fair, open, inclusive, and non-discriminatory multilateral trading system under the World Trade Organization (WTO). They also pledged to work together to address trade challenges, such as the COVID-19 pandemic and the war in Ukraine.

In the context of import and export policies, the G20 leaders committed to the following:

- Reduce trade costs and barriers: The leaders agreed to work to reduce trade costs and barriers, including tariffs and non-tariff barriers. They also pledged to support the WTO's efforts to reform the global trading system.
- Facilitate trade: The leaders agreed to facilitate trade by simplifying customs procedures and improving digital trade infrastructure. They also pledged to promote the use of trade finance to support small and medium-sized enterprises (SMEs).
- Support sustainable trade: The leaders agreed to support sustainable trade practices, such as green trade and fair trade. They also pledged to work to reduce the environmental impact of trade.

In addition to these general commitments, the G20 leaders also made specific commitments on import and export policies in certain sectors. For example, they agreed to work to reduce barriers to trade in agricultural products and to promote trade in renewable energy technologies.

The G20's commitments on import and export policies are significant because the G20 economies account for over 80% of global trade. If the G20 leaders are able to implement their commitments, it could have a positive impact on global trade and economic growth.

Here are some specific examples of import and export policies that G20 countries have implemented in recent years:

- India: India has introduced a number of measures to promote exports, including tax breaks and subsidies. The government has also made it easier for businesses to import goods and services.
- China: China has reduced tariffs on a number of imported goods and has simplified customs procedures. The government has also invested heavily in infrastructure to support trade.
- United States: The United States has negotiated a number of trade agreements with other countries, including the United States-Mexico-Canada Agreement (USMCA). The government has also taken steps to reduce trade barriers, such as by eliminating tariffs on certain goods.

7. Covid-19 impact on Indian Trade:

The COVID-19 pandemic has had a significant impact on India's trade. In 2020, India's merchandise exports fell by 17.5% and imports fell by 14.2%. The pandemic has disrupted supply chains, reduced demand for Indian goods and services, and led to increased trade costs.

The following are some of the specific effects of COVID-19 on India's trade:

- Disruption of supply chains: The pandemic has caused disruptions to supply chains around the world, including India. This has made it difficult for Indian businesses to get the inputs they need and to produce and export their goods.
- Reduced demand: The pandemic has led to a decline in global demand for goods and services. This has reduced the demand for Indian exports, such as textiles, apparel, and engineering goods.
- Increased trade costs: The pandemic has led to increased trade costs, such as the cost of shipping and insurance. This has made it more expensive for Indian businesses to export their goods.
- Impact on sectors: The pandemic has had a particularly severe impact on certain sectors of the Indian economy, such as tourism and hospitality. This has led to a decline in exports of services from these sectors.

The Indian government has taken a number of steps to support trade during the pandemic. These include providing financial assistance to exporters, simplifying customs procedures, and negotiating trade agreements with other countries. The Indian government has also taken steps to support businesses that have been affected by the pandemic. These include providing tax breaks, subsidies, and loan guarantees. The COVID-19 pandemic has had a significant impact on India's trade, but the Indian government has taken steps to support trade and businesses during this difficult time. The impact of the pandemic on India's trade is expected to continue in the short term, but the Indian economy is expected to recover in the long term.

8. Make In India and Indian Trade:

The Make in India initiative is a key driver of Indian trade. The initiative is focused on promoting India as a global manufacturing hub, and it has had a significant impact on India's exports.

Since the launch of the Make in India initiative in 2014, India's exports of manufactured goods have increased by over 50%. This growth has been driven by a number of factors, including:

- Increased foreign investment in the manufacturing sector
- Improved ease of doing business in India
- Development of manufacturing infrastructure
- Focus on specific sectors, such as automobiles, aerospace, electronics, and pharmaceuticals

The Make in India initiative has also helped to diversify India's export basket. In the past, India's exports were heavily concentrated in a few sectors, such as textiles and apparel.

However, the Make in India initiative has helped to boost exports of other manufactured goods, such as engineering goods and chemicals.

The Make in India initiative is also expected to help India reduce its imports. As India's manufacturing sector grows, it will be able to produce more of the goods that India currently imports. This will reduce India's trade deficit and improve its balance of payments. Overall, the Make in India initiative has had a positive impact on Indian trade. The initiative has boosted India's exports, diversified India's export basket, and helped to reduce India's imports. The initiative is expected to continue to drive Indian trade growth in the future.

Here are some specific examples of how the Make in India initiative has impacted Indian trade:

- India's exports of automobiles have increased by over 100% since the launch of the Make in India initiative.
- India's exports of electronics have increased by over 50% since the launch of the Make in India initiative.
- India's exports of pharmaceuticals have increased by over 30% since the launch of the Make in India initiative.

The Make in India initiative is still ongoing, and the government is working to achieve its goal of making India a global manufacturing hub. The initiative has the potential to transform the Indian economy and boost Indian trade.

9. Why I chose this topic?

I chose this topic for my paper due to my deep interest in understanding the dynamics of demand and supply and the tools which became a catalyst for economic growth. Apart from the internal factors which focus on the manufacturing industry and the allied support business like IT, Retail, Tourism etc., the force drivers are the external factors like competition from other countries which in a state of slowdown become the active factors of the growth of one's own country. Seeing how these external factors are aligned and how Indian becomes the epicenter of growth, the reasons had to be documented.

10. India Trade with various countries:

1. India and USA:

Year	Import(in million dollars)	Export(in million dollars)
2014	204	426
2015	204	403
2016	203	419
2017	240	460

2018	389	516
2019	349	548
2020	266	493
2021	413	715

2. India and China:

Year	Import (in million dollars)	Export (in million dollars)
2014	582	134
2015	616	94
2016	604	89
2017	719	124
2018	903	163
2019	684	172
2020	587	190
2021	875	230

3. India and Russia:

Year	Import (in million dollars)	Export (in million dollars)
2014	42	22
2015	45	16
2016	47	18
2017	79	21
2018	85	23
2019	62	28
2020	59	25
2021	86	33

4. India and Japan:

Year	Import (in million dollars)	Export (in million dollars)
2014	99	57
2015	96	45
2016	98	38
2017	104	44
2018	151	47
2019	127	48
2020	102	40
2021	144	60

5. India and United Kingdom:

Year	Import (in million dollars)	Export (in million dollars)
2014	47	96
2015	53	88
2016	38	85
2017	43	89
2018	85	97
2019	68	87
2020	47	77
2021	67	103

11. Correlation and Regression in Statistics :

Correlation in statistics is a fundamental concept used to quantify and describe the relationships between variables. It allows us to understand how two or more variables are related and to what extent changes in one variable correspond to changes in another. At its core, correlation provides valuable insights into patterns and associations within data.

The most commonly used measure of correlation is the Pearson correlation coefficient, denoted as "r." This coefficient assesses the strength and direction of the linear relationship between two continuous variables.

A positive value of "r" suggests a positive linear correlation, meaning that as one variable increases, the other tends to increase as well.

Conversely, a negative value of "r" indicates a negative linear correlation, where one variable tends to decrease as the other increases.

A correlation coefficient of zero signifies no linear relationship between the variables.

The formula for the Pearson correlation coefficient (commonly denoted as "r") in statistics is as follows:

$$r = \frac{n(\sum xy) - (\sum x) - (\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2]} * \sqrt{[n\sum y^2 - (\sum y)^2]}}$$

In this formula:

- ‘r’ represents the Pearson correlation coefficient, which measures the strength and direction of the linear relationship between two variables.
- ‘n’ is the number of data points (observations).
- ‘x’ and ‘y’ are the two variables for which you want to calculate the correlation.
- $\sum xy$ represents the sum of the products of the corresponding values of x and y.
- $\sum x$ and $\sum y$ represent the sums of all the values of x and y respectively.
- $\sum x^2$ and $\sum y^2$ represent the sums of the squares of all the values of x and y respectively.

Regression analysis is a vital statistical tool that plays a central role in understanding and quantifying relationships between variables. At its core, regression seeks to model and predict the behaviour of a dependent variable based on the values of one or more independent variables. It provides a systematic way to explore and measure the impact of these independent variables on the outcome of interest. The most common form of regression is linear regression, which assumes a linear relationship between the variables.

12. Calculations and Graphs:

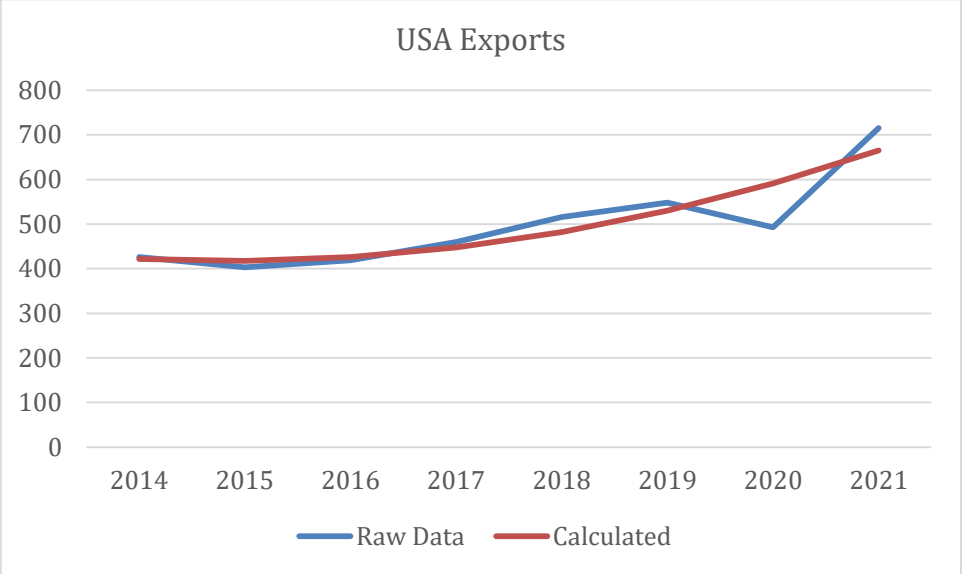
a. Monetary value of Export to USA:

In graph, x-axis as years from 2014 to 2021 and Y-axis will show monetary value of exports to USA (in million dollars).

Let's consider 2014 as 1, 2015 as 2……..2021 as 8.

After manually drawing graph and on excel.

We concluded cubic equation covers maximum number of plots considering $y=Ax^2+Bx+C$.



Formula: $y= 6.56*x^2-24.3*x+439.68$

Where "y" represents monetary value of exports to USA (in million dollars), and "x" represents 1, 2,3……(1 represents 2014, 2 represents 2015 and so on).

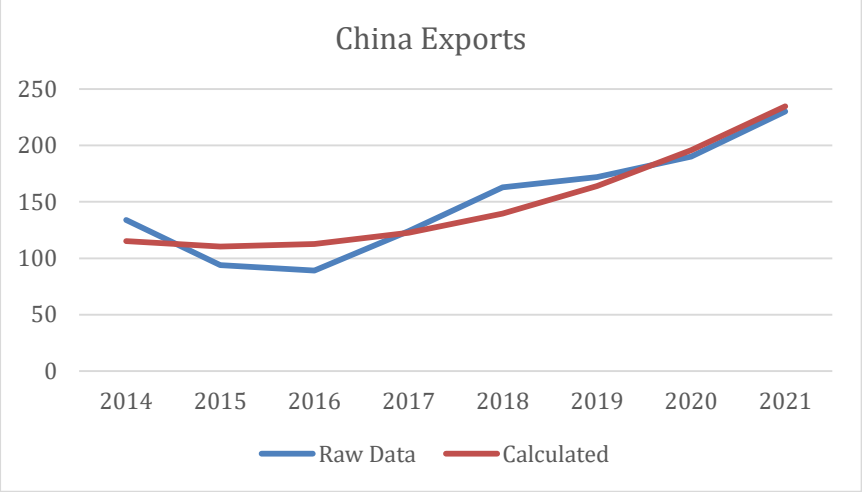
b. Monetary value of Export to China:

In graph, x-axis as years from 2014 to 2021 and Y-axis will show monetary value of exports to China (in million dollars).

Let's consider 2014 as 1, 2015 as 2……..2021 as 8.

After manually drawing graph and on excel.

We concluded cubic equation covers maximum number of plots considering $y=Ax^2+Bx+C$.



Formula: $y= 3.65*x^2-15.75*x+127.18$

Where "y" represents monetary value of exports to China (in million dollars), and "x" represents 1, 2,3……(1 represents 2014, 2 represents 2015 and so on).

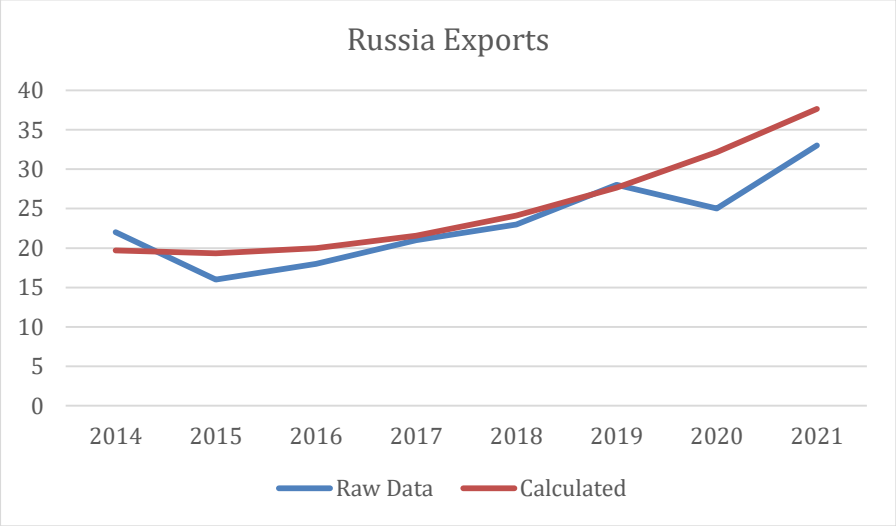
c. Monetary value of Export to Russia:

In graph, x-axis as years from 2014 to 2021 and Y-axis will show monetary value of exports to Russia (in million dollars).

Let's consider 2014 as 1, 2015 as 2……..2021 as 8.

After manually drawing graph and on excel.

We concluded cubic equation covers maximum number of plots considering $y=Ax^2+Bx+C$.



Formula: $y= 0.485*x^2-1.8*x+21$

Where "y" represents monetary value of exports to China (in million dollars), and "x" represents 1, 2,3……(1 represents 2014, 2 represents 2015 and so on).

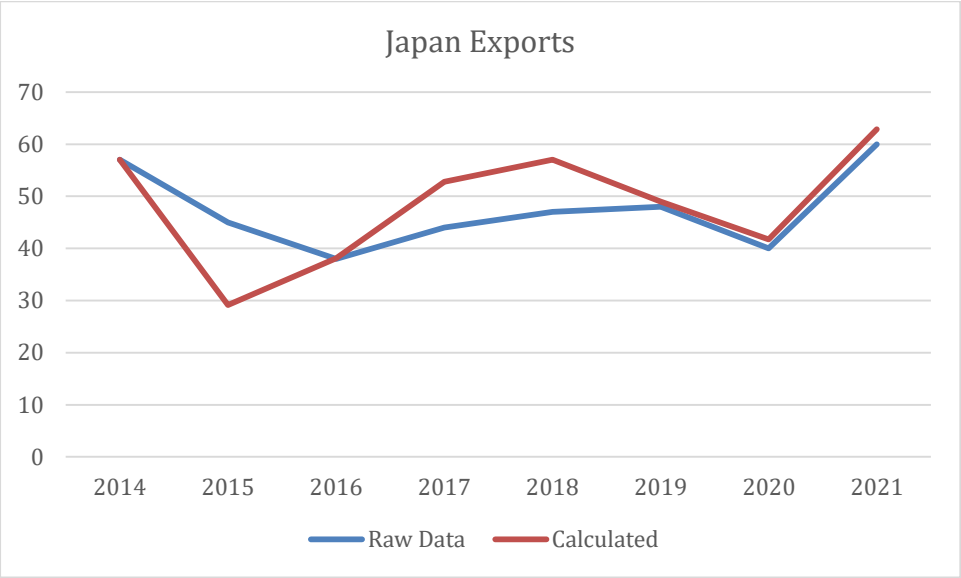
d. Monetary value of Export to Japan:

In graph, x-axis as years from 2014 to 2021 and Y-axis will show monetary value of exports to Japan (in million dollars).

Let's consider 2014 as 1, 2015 as 2……..2021 as 8.

After manually drawing graph and on excel.

We concluded cubic equation covers maximum number of plots considering $y=Ax^4+Bx^3+Cx^2+Dx+E$.



Formula: $y= 0.61*x^4-11.26*x^3+70.69*x^2-170.24*x+167.2$

Where "y" represents monetary value of exports to Japan (in million dollars), and "x" represents 1, 2,3……(1 represents 2014, 2 represents 2015 and so on).

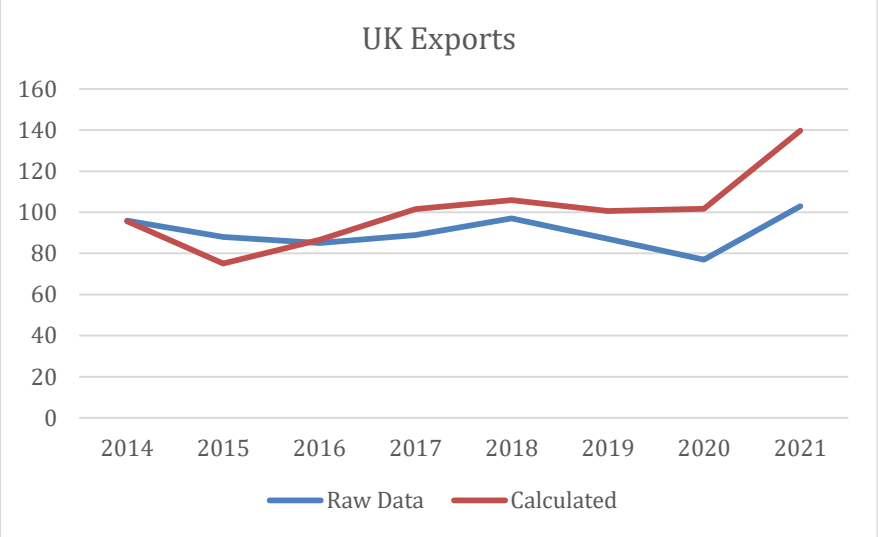
e. Monetary value of Export to Japan:

In graph, x-axis as years from 2014 to 2021 and Y-axis will show monetary value of exports to United Kingdom (in million dollars).

Let's consider 2014 as 1, 2015 as 2……..2021 as 8.

After manually drawing graph and on excel.

We concluded cubic equation covers maximum number of plots considering $y=Ax^4+Bx^3+Cx^2+Dx+E$.



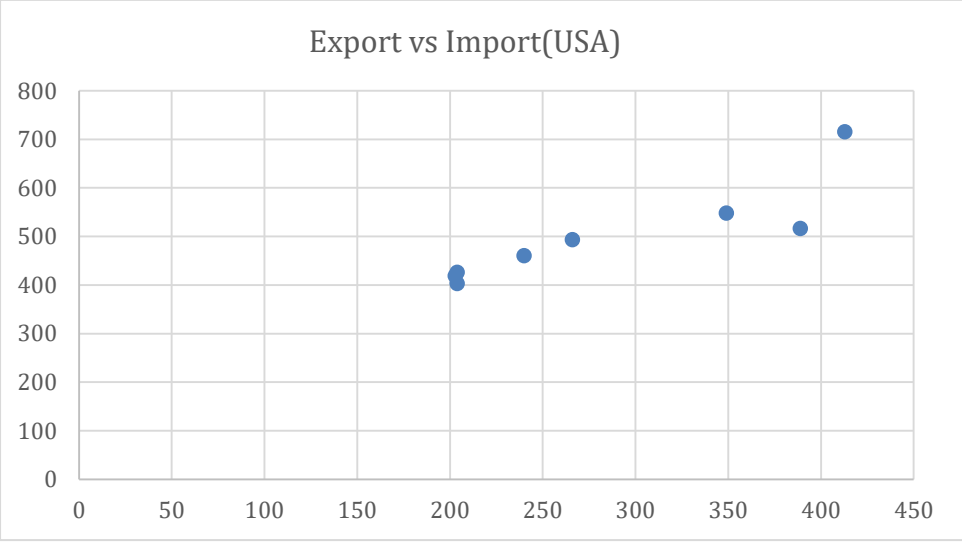
Formula: $y = 0.62*x^4 - 11*x^3 + 66.58*x^2 - 152.62*x + 192$

Where "y" represents monetary value of exports to UK (in million dollars), and "x" represents 1, 2,3……(1 represents 2014, 2 represents 2015 and so on).

f. Monetary Value of Export Vs monetary value of Import in USA:

Graph between monetary value of export at x-Axis and monetary value of import at y-axis is plotted.

Both in million USD dollars.



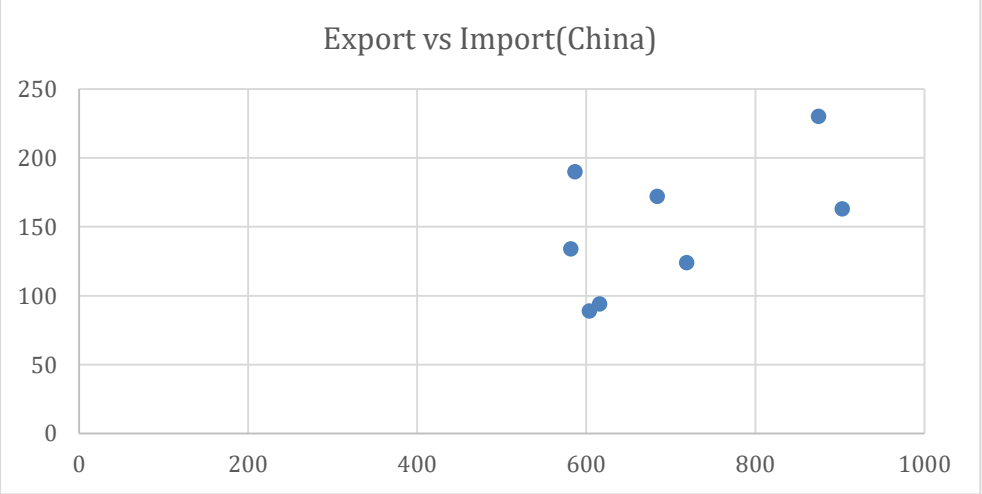
Correlation Value is calculated by using above equation in 10th point.

Correlation Factor comes out to be 0.879.

g. Monetary Value of Export Vs monetary value of Import in China:

Graph between monetary value of export at x-Axis and monetary value of import at y-axis is plotted.

Both in million USD dollars.



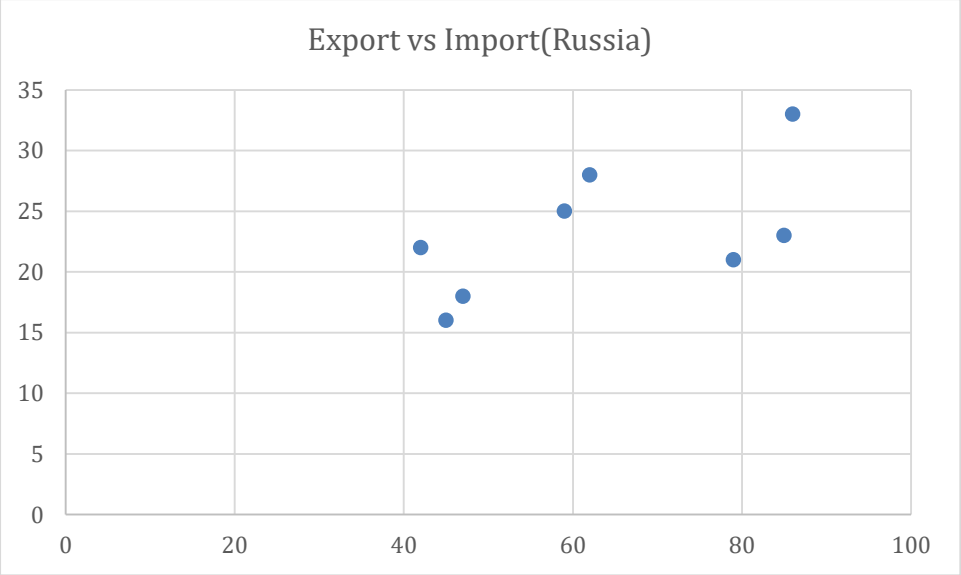
Correlation Value is calculated by using above equation in 10th point.

Correlation Factor comes out to be 0.554.

h. Monetary Value of Export Vs monetary value of Import in Russia:

Graph between monetary value of export at x-Axis and monetary value of import at y-axis is plotted.

Both in million USD dollars.



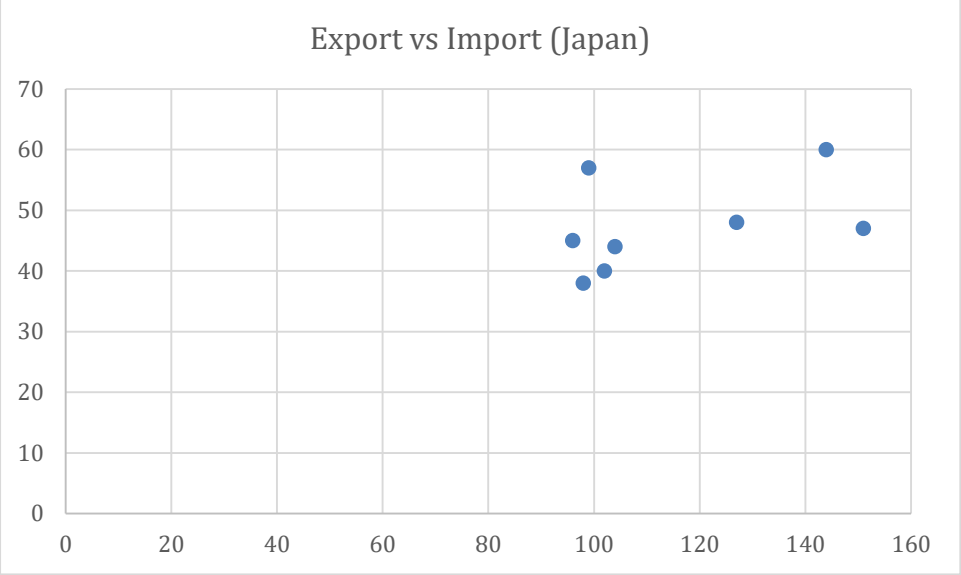
Correlation Value is calculated by using above equation in 10th point.

Correlation Factor comes out to be 0.6.

i. Monetary Value of Export Vs monetary value of Import in Japan:

Graph between monetary value of export at x-Axis and monetary value of import at y-axis is plotted.

Both in million USD dollars.



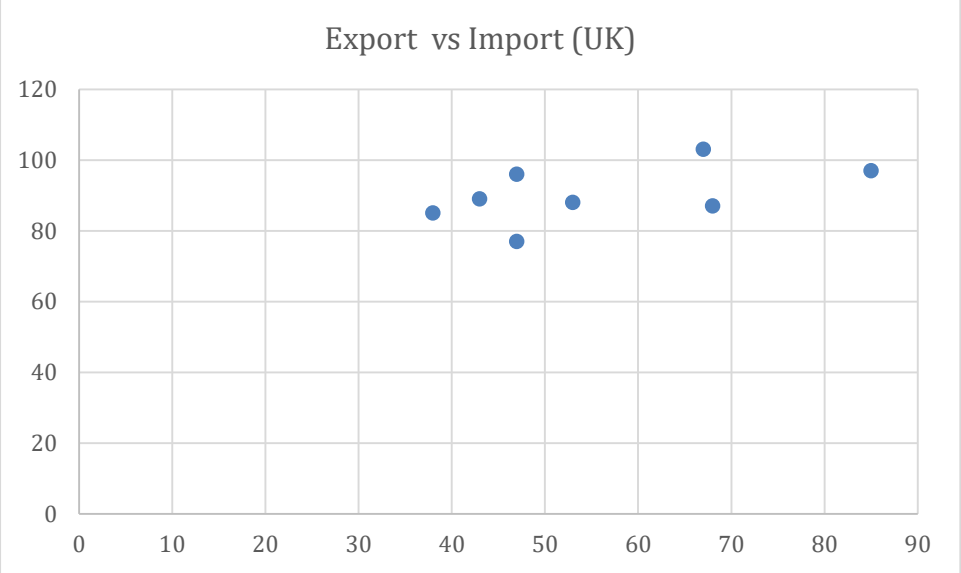
Correlation Value is calculated by using above equation in 10th point.

Correlation Factor comes out to be 0.533.

j. Monetary Value of Export Vs monetary value of Import in Japan:

Graph between monetary value of export at x-Axis and monetary value of import at y-axis is plotted.

Both in million USD dollars.



Correlation Value is calculated by using above equation in 10th point.

Correlation Factor comes out to be 0.454.

13. Conclusion:

As analyzed in the above section, India trade is rising at a high rate. Import as well as Export of India with countries with highest GDPs in the world are increasing. We can proudly as that in near future India can become global power due to its economic reforms and natural diversity. In the end, mathematically we concluded various Biquadratic and quadratic equations of monetary value of exports with India.

We also found out correlation between import and export of partner countries with India to find the relationship between them. All the values of correlation are positive so export is also increasing by increasing import.

As quoted by our Honorable Prime Minister Narendra Modi "'Brand Bharat' is built of 5 Ts-Talent, Tradition, Tourism, Trade and Technology."

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- Creative Editor of the School Computer Science magazine
- Counseling Head MCGS
- Won the 'Raghu Rai' National Award for Photography at the IPSC Visual Arts competition
- Won the School Art competition
- Headed the 'Bifrost' organization's various Community Service Projects.
- Scored 96.0% in ICSE Board Examinations
- Won the Honours Certificate for Class XI Examinations..

Under the guidance of:

Dr. Mamta Jain

- M.Sc (Mathematics) (Double gold medalist)
- M.Phil (Computer Applications) with honors From University of Roorkee (now IIT Roorkee)
- PhD (Mathematics) -Various papers published in international journals
- Former Lead Auditor ISO 9001,ISO -22000 School Accreditation Examiner by QCI
- 26 years of teaching experience
- Various Research Paper Published

Er. Raunaq Jain

- B.E Mechanical Engineering From Thapar Institute of Engineering and Technology
- District Physics Topper
- Content Writer and graphic designer
- Mechanical Mentor from session 2019-2020
- Upcoming Data Analyst at Deloitte