

Comparative Analysis of Top 4 Currencies In the world using Mathematical Techniques and Graphs with respect to Rupee

Ansh Rajput

Student, Commerce, Sat Paul Mittal School

Abstract- This research paper summarizes the "Comparative Analysis of top 4 Currencies in the world with Rupee using Mathematical Techniques and Graphs". The data has been taken from 1980-2022. We have compared US Dollar, Euro, Pound Sterling, and Japanese Yen concerning Indian Rupee using mathematical graphs and techniques.

Keywords- USD, INR, Pound Sterling, Euro, and Japanese Yen

1. INTRODUCTION

Exchange rates are one of the most crucial factors in business since they serve as the basis for the exchange process. Exchange rates, which are defined as the rate at which one currency is also changed into another, are used by nations to purchase goods or services from one another. When evaluating these exchange rates, it's crucial to realize that there are two different types of rates—nominal and real trade—that are applied to international commerce. The number of nominal units needed to exchange one unit of one currency for another. The US dollar, Japanese yen, euro, and pound sterling are the four most widely used currencies in the world. My research compares and examines the most widely used currencies in the world concerning Indian Rupee.

1.1 United States Dollar (USD)

The National Currency of United States of America is USD (United States dollar). To distinguish it from other dollar-based currencies, it is represented by the symbol \$ or US\$. Several regions outside of the United States use it as their official currency, while other territories utilize it as their sole form of unofficial money. The U.S. dollar is the most listed currency in the world. . The monetary unit was a remote second with thirty seconds of all transactions. The reach of the U.S. dollar has resulted in its index, the USDX, which may be a weighted price index against a basket of six different currencies; the monetary unit, Japanese yen, British monetary unit, franc, Swedish krona, and also the Canadian dollar. Furthermore, the U.S. dollar is a legal tender in many U.S. territories, as well as the Puerto RICO Act, Guam, and the U.S. Virgin Islands, as well as the Puerto RICO Act, Guam, and the U.S. Virgin Islands.

1.2 Indian Rupee (INR)

The currency unit of India is Rupee (INR) and the currency symbol is ₹. The rupiya, a silver coin first introduced by the great Turkish Sher Shah Suri in the 16th century, is the origin of the word rupee.

Coins with a value of 50 paise or less are called small coins, while coins with a value of one rupee or more are called rupee coins. Paper rupees have denominations written on the back in fifteen different languages, as opposed to the front which contains Hindi and English.

Banknotes are changed frequently with new designs and notable differences between the most recent series of Spirit leader series banknotes and the new banknotes of the same name. The notes include many designs from India's manufacturing heritage. India is a cash-based economy, which has led to the circulation of counterfeit money by people engaging in unethical activities. Over the years, the Reserve Bank of India (RBI) has been forced to revise and update the rupee banknotes with new security features. Terrorists and money launderers produce counterfeit money that can look like legitimate money. High denomination notes are perhaps the most frequently counterfeited. In 2016, the Indian government announced the de-

monetization of all Spiritual Leaders 500 and 1000 rupee notes, arguing that this would cripple the black market and make the use of illegal and fake profits to help criminals and terrorists become more difficult. A new Spiritual Leaders banknote with more security measures has been introduced to replace the 500 and 1000 rupee notes. Various capital constraints and fungibility restrictions have been imposed on the rupee over the past few years. It is illegal for foreign nationals to import or export rupees and only a certain amount of rupees can be imported or exported by Indian nationals. To maintain a healthy and balanced capital account, the Indian government alternately loosens and tightens limits on foreign investment, limits gold swings or eliminates them altogether. The government recently relaxed limits on foreign investment inflows to stabilize the falling exchange rate and boost business investment in the country.

1.3 British Pound Sterling (GBP)

The British pound sterling, the official currency of the United Kingdom, is called GBP. South Georgia, South Sandwich Islands, British Antarctic Territory, Isle of Man and Channel Islands are all British Overseas Territories. Falkland Islands Pound, Promontory Pound, St Capital of Montana Pound, Jersey Pound (JEP), Dairy Pound (GGP), Manx Pound and European National Note pegged to British Pound just a fraction of the currency. A penny is one-hundredth of a pound. The official name of the GBP is British Pound. However, "Sterling" or STG is also commonly used in accounting or exchange situations. Some symbols are displayed in pence instead of pounds. In this situation, the exchange may use the GBX or GBP to distinguish between pence and pounds (GBP). The US Dollar, Euro and Japanese Yen are the only currencies with a higher level of commercial activity than the British Pound. Approximately 13% of daily trading volume on the interchange market is settled in British pounds. The image of the euro is €. The pound image is £. The Euro and US Dollar are the two most popular currency pairs for the British Pound (EUR/GBP and GBP/USD respectively). Interchange traders refer to the GBP/USD exchange rate as the "cable". The oldest existing currency still in use today is the GBP or British Pound. British pounds are represented by the pound sign (£). However, it is also sometimes called a "sterling" or "pound".

1.4 EURO

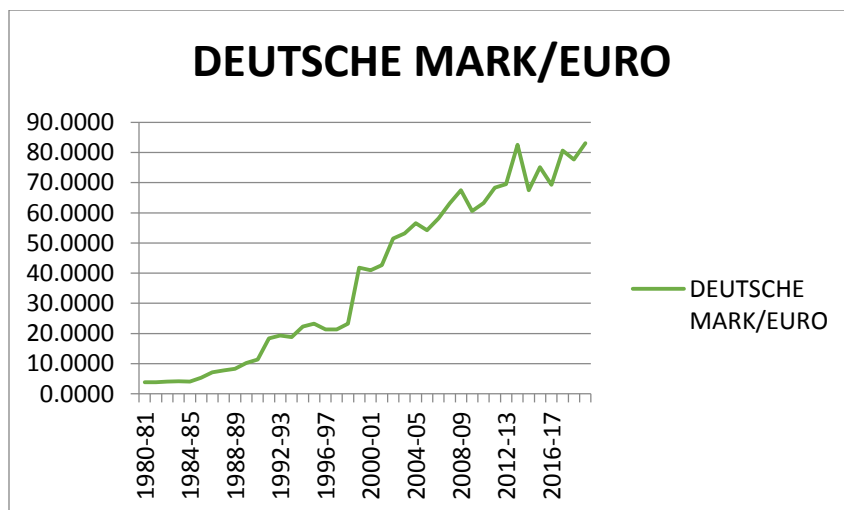
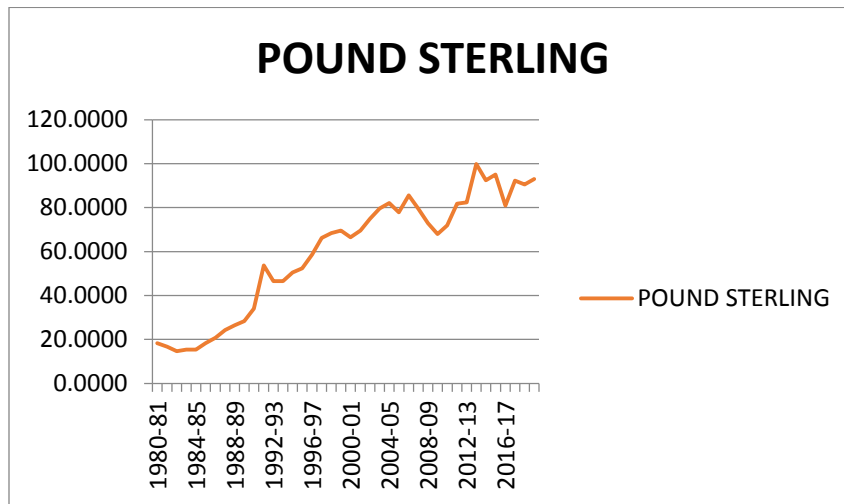
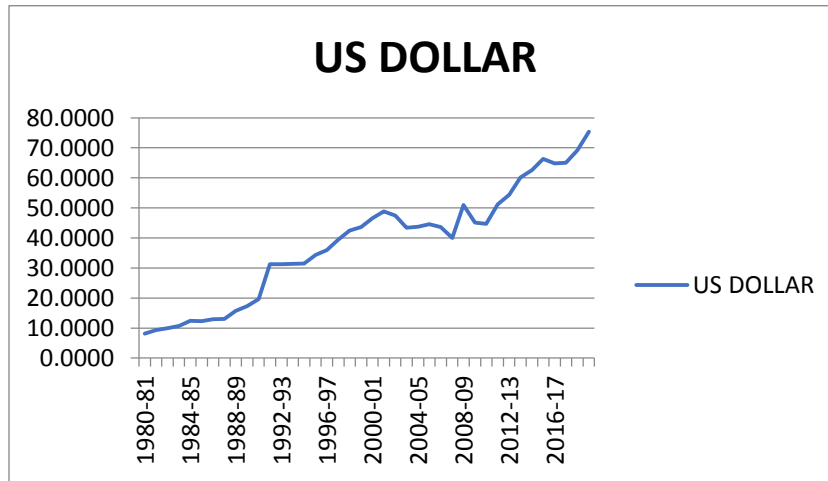
The official currency of the European Union is the Euro. It is the second most popular reserve currency in the world and is also the second most traded currency in the world. The old euro was issued in 1999 and was an electronic currency until the introduction of banknotes and coins in 2002. The currency unit is usually abbreviated as "EUR". Monetary units are the only means of exchange introduced together in EU member states. These countries are called the Eurozone, a section whose monetary unit is a common currency. Four non-EU countries use the euro as their official currency: Andorra, City, San Marino and Monaco. The European Financial Institutions (ECB) have the EU's mandate to maintain value stability by protecting the value of monetary units. Those who do not adopt monetary units. The introduction of the currency unit has eliminated currency risk for European companies and financial institutions doing cross-border business within the increasingly integrated EU economy. Commercial and financial requirements for the introduction of monetary units also led to deeper political integration of member states. Financially lagging farmers' lenders not only cut interest rates but also value the euro against major European trading partners to boost exports. Furthermore, while monetary units cannot be demoted to facilitate economic change within the EU, the common currency will provide an additional trusted repository. Monetary units are still overwhelmingly widespread among residents of the country.

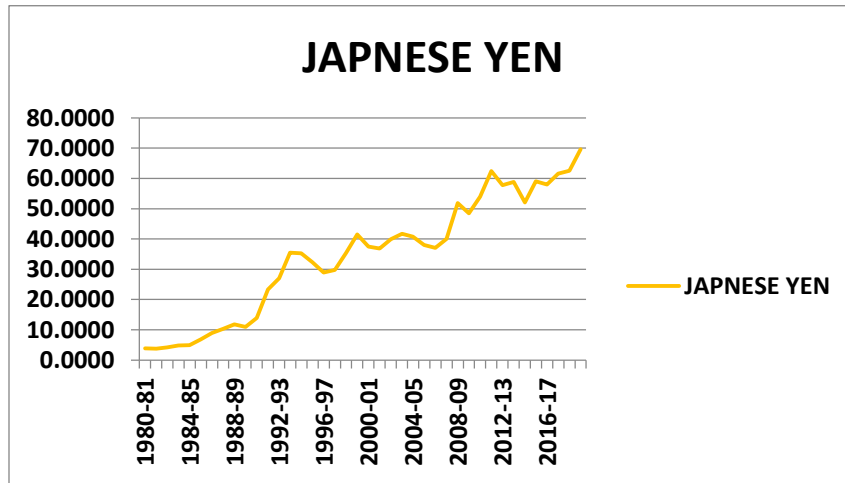
1.5 Japanese Yen

JPY stands for Japanese Yen, the country's official currency. The Yen symbol is typical. The Japanese Yen is the third most traded currency in the Forex market. The Japanese Yen is in its third position behind the US Dollar and the Euro as the dollar-denominated foreign exchange reserves are starting to overrun due to official reserve denominations. Yen's name comes from the Japanese word 'en', which means circle. The Meiji government replaced Tokugawa gold coins with yen. The Bank of Japan (BoJ) was established in 1882 as a financial institution. In 1884, it was given the monopoly of issuing coins and issued the first yen banknotes the following year. The value of the yen was shaken by World War II and the American occupation. After the war, the yen's value against the dollar fell rapidly due to high inflation when authorities introduced a regulated exchange rate. The Plaza Accord of 1985 was the main cause of the devaluation of the US dollar which increased the value of the yen against the US dollar.

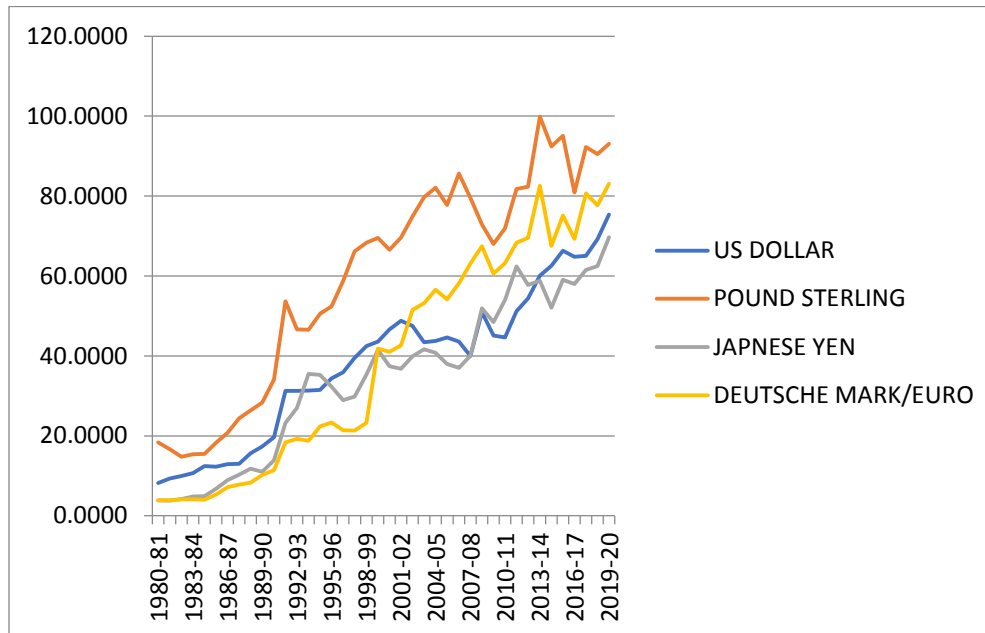
Table of 4 currencies with respect to Rupee from 1980-2020

Year	US DOLLAR	POUND STERLING	JAPANESE YEN	DEUTSCHE MARK/EURO
1980-81	8.1900	18.3800	3.9000	3.9000
1981-82	9.3460	16.6520	3.8000	3.8710
1982-83	9.9700	14.7460	4.2000	4.1090
1983-84	10.7070	15.4460	4.8000	4.1340
1984-85	12.4300	15.4500	4.9000	4.0190
1985-86	12.3061	18.2500	6.8000	5.3020
1986-87	12.8882	20.7490	8.9000	7.1620
1987-88	13.0318	24.3510	10.3000	7.8070
1988-89	15.6630	26.3990	11.8000	8.2590
1989-90	17.3248	28.3010	11.0000	10.1670
1990-91	19.6429	34.0500	13.9000	11.4270
1991-92	31.2256	53.6913	23.2800	18.3501
1992-93	31.2354	46.6200	26.9900	19.2864
1993-94	31.3725	46.5200	35.5200	18.7575
1994-95	31.4950	50.5650	35.2888	22.3600
1995-96	34.3500	52.4300	32.2975	23.3038
1996-97	35.9150	58.6938	28.9463	21.3863
1997-98	39.4950	66.1638	29.7813	21.3350
1998-99	42.4350	68.3588	35.3263	23.2863
1999-00	43.6050	69.5100	41.4825	41.7975
2000-01	46.6400	66.5788	37.4338	41.0113
2001-02	48.8000	69.5863	36.8063	42.6438
2002-03	47.5050	74.9225	39.8925	51.4925
2003-04	43.4450	79.6813	41.6725	53.1725
2004-05	43.7550	82.1125	40.8075	56.5863
2005-06	44.6050	77.7963	38.0188	54.1875
2006-07	43.5950	85.5938	37.0338	58.1513
2007-08	39.9850	79.5138	40.0650	63.0963
2008-09	50.9450	72.8575	51.8900	67.4713
2009-10	45.1350	68.0188	48.4338	60.5913
2010-11	44.6450	71.9163	54.0175	63.2350
2011-12	51.1600	81.7975	62.4250	68.3550
2012-13	54.3893	82.3209	57.7600	69.5438
2013-14	60.0998	99.8498	58.8300	82.5765
2014-15	62.5908	92.4591	52.1100	67.5104
2015-16	66.3329	95.0882	59.0600	75.0955
2016-17	64.8386	80.8797	57.9600	69.2476
2017-18	65.0441	92.2846	61.5400	80.6222
2018-19	69.1713	90.4756	62.5200	77.7024
2019-20	75.3859	93.0760	69.6500	83.0496

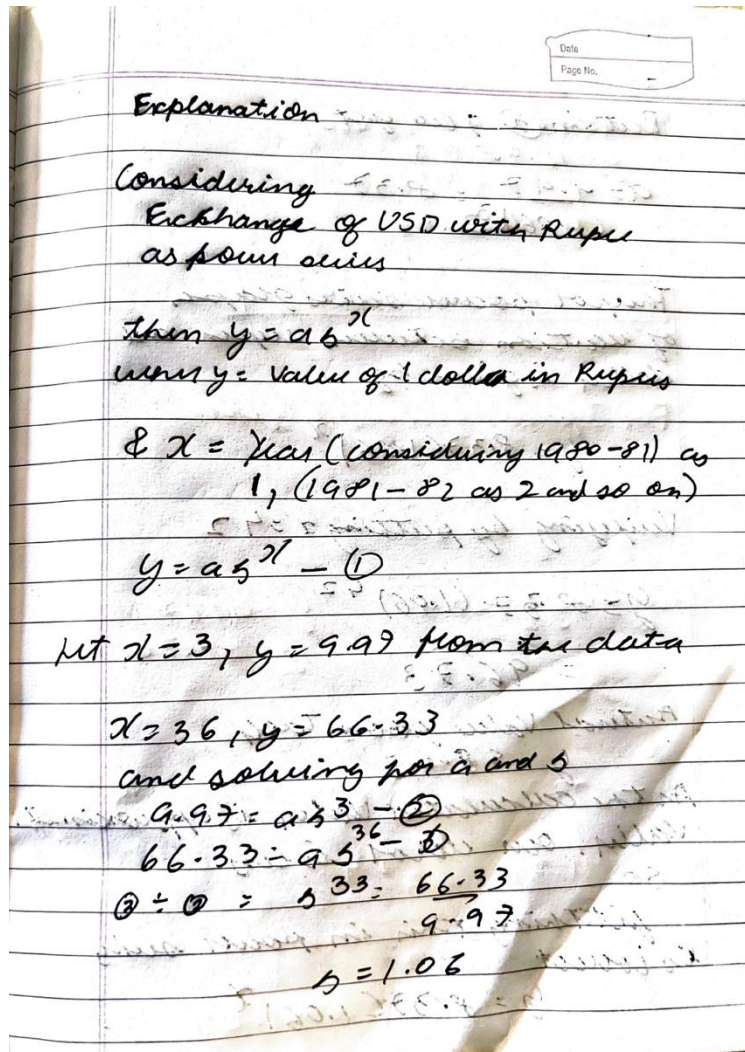




Relation between US Dollar , GBP , Euro , Japanese Yen with respect to Rupee



3. Explanation and Calculations



Date _____
 Page No. _____

Put in (2) we get

$$a = \frac{9.97}{(1.06)^3} = 8.37$$

Therefore power series graph of variation between rupee and dollar is given by

$$y = 8.37(1.06)^x$$

Verifying by putting $x = 42$

$$y = 8.37(1.06)^{42} = 96.73$$

Actual Value from Table $y = 98.03$

As the calculated value is approximate value, our model is less fitting. This in power series is correct

$$y = 8.37(1.06)^x$$

Date _____
 Page No. _____

Considering relation between pound and rupee as continuous type of power series.

$$y = ax^b$$

y = exchange value of 1 pound in rupees

x = Year, starting from 1980-81 as 1, 1981-82 as 2 and so on

$x=1, y=18.38$

$x=25, y=2.11$

$$y = ax^b$$

$$18.38 = a(1)^b$$

$a = 18.38$

Putting $= 2.11 = 18.38(25)^b$

$$2.11 = \frac{18.38}{100.38} = 0.469$$

Date _____
 Page No. _____

$x=41$
 $y=18.30 (x^{0.469})$
 $y=102.96$
 $y = 18.30 (0.414)^x$

For Japanese Yen and Rupee

We consider

$y = a b^x$

Ranking $x=24$ $y=41.67$
 $x=33$ $y=57.76$

Simplify for a, b

$57.76 = a b^{33}$

$41.67 = a b^{24}$

$b = \frac{57.76}{41.67} = 1.386$

$b = 1.0369 = 1.04$

Now put $x=41$

We get $y = 102.96$

$y = 16.26 (1.04)^x$

Date _____
 Page No. _____

For Euro And Rupee

Consider

$$y = ax^b$$

$x = 3, y = 4.11 \Rightarrow a3^b = 4.11$

$x = 39, y = 61.54 \Rightarrow a39^b = 61.54$

Simplify for a to weight

$$\frac{a39^b}{a3^b} = \frac{61.54}{4.11}$$

$$13 \approx 14.97$$

$$b \approx 1.055 \text{ (approximately)}$$

$$a = 1.29$$

Verify for $x = 41$

$$y = 1.29(41)^{1.055}$$

$$\approx 64.87 \text{ (approximately)}$$

$y = 1.29x^{1.055}$

4. Conclusion

From graphically as well as mathematical analysis of exchange rates of 4. Currencies w.r.t Rupee it is evident that British Pound Sterling has the maximum growth rate succeeded by Euro, Japanese Yen and US Dollar almost at the same growth rate.

References

<https://www.investopedia.com/>

<https://www.sbi.co.in/>

<https://www.rbi.org.in>

<https://www.japan.go.jp>

<https://www.gov.uk>

<https://www.european-union.europa.eu>

<https://www.usa.gov>

Biographies

Ansh Rajput

Currently studying in Sat Paul Mittal School in class XII

Lead Designer School Newspaper

Best Delegate in more than 5 MUN

Freelancer in Video and graphic designing

Logo Designer for Horizon School of Excellence

Scored 92.2% in ICSE Board Exam

Letter of Evaluation from Boston University, Boston, Massachusetts, United States of America

Under the guidance of:

Dr. Mamta Jain

M.Sc (Mathematics) (Double gold medallist)

M.Phil (Computer Applications) with honours

From University of Roorkee (now IIT Roorkee)

PhD (Mathematics)

5 papers published in international journals

Former Lead Auditor ISO 9001,ISO 22000

School Accreditation Examiner by QCI

26 years of teaching experience