# A Collative Study of The Out-Turn of Circulation of Coins And Notes On Gross Domestic Product In The Context of India

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## Abstract:

Circulation of coins and notes has become intrinsic to economic interaction. Circulation promotes trade, drives monetary policy and ensures global financial stability. In fast-evolving India, circulation of money is important for permanent growth and sustainability. We will take an in-thorough look at the heritage of money in India, including the transition from cowrie shells, to introduction of metal currency, to initiation of modern banking. We will cover examples of important events that have led to changes to currency management in India such as demonetization and the introduction of the Digital Rupee, specifically around how those and others events have played a large role in currency management. We will draw on historical trends and present operational practices, as well as their impacts on key economic indicators, such as GDP, etc., to provide insights to policymakers and other interested parties.

## Introduction:

The consistent provision and distribution of coins and notes at varied denominations is important endeavour for any economy. They facilitate trade and commerce, they create opportunities for a government to manipulate its economic policy, and they represent to some extent the economic wellbeing of the economy as a whole. Physical currency allows consumers and businesses to undertake transactions that drive an economy. If coins and notes are not circulating appropriately this circulation could have implications on important factors of the economy including market liquidity, consumer spending and business.

India's economy is a mixture of spices. It is dynamic and diverse. There is very fast-paced economic growth, kind of like a dance, one quick dance step after another. Currency is included in this ever-evolving dynamic, and is the spice which wades into trades between the sub-economies. With a population of 1.3 billion, India is large and colorful. Its currency will have to be regulated if growth is to advance towards development. Importantly for policymakers, economists, and business leaders, at the very least you will want to understand how a flow of currency affects critical indicators like Gross Domestic Product (GDP).

This document will look into the economic effects on GDP of coin and note circulation. It will analyze historical trends, existing challenges, and implications for the future, demonstrating the effects of money circulation in India's economic history. By analyzing historical trends, money circulation can inform policy makers when considering realistic and sustainable legislation and policy in pursuit of sustainable economic growth and development.

**Historical Background of Currency Circulation in India:**

- Since historic times, people have used various forms of money such as cowrie shells and metal coins. Coin usage originated in India during the Mauryan Empire (322-185 BCE).
- Currency and currency systems were modified under the Mughal Empire and then under British rule who sets forth standardized coins and paper money.
- The Reserve Bank of India (RBI) was established in 1935 who now manages the circulation of currency and is a part of maintaining financial stability.

**Current Scenario of Currency Circulation**

- India has seen circulation of variety of coins and banknotes, ranging from ₹1 to ₹2000. In November 2016, the Reserve Bank of India (RBI) undertook demonetization and removed ₹500 and ₹1000 notes from circulation and replaced them with new ₹2000 notes. However, in May 2023, the RBI announced the withdrawal of ₹2000 notes from circulation.
- The aim of 2016 demonetization was to fight black money and counterfeit currency. This resulted in a short term decline in circulation and had noticeable economic effects.
- Recent initiatives promoting digital payments focus on reducing reliance on cash and pushing the shift toward a cashless economy.

**E- Rupee (e₹):**

- The Reserve Bank of India (RBI) issues the e-Rupee, also called the Digital Rupee or e₹. It serves as a central bank digital currency (CBDC). A high-level interministerial committee under the Department of Economic Affairs, Ministry of Finance, first proposed this idea in January 2017.
- Pilot programs for the retail (e₹-R) and wholesale (e₹-W) versions of the e-Rupee took place before its official launch on December 1, 2022. The retail version aims to handle everyday transactions for consumers and businesses. In contrast, the wholesale version deals with interbank settlements among financial institutions. The growing interest in digital currency like the e-Rupee comes from the desire to avoid the hassle of using physical cash.

**Subject selection:**

The circulation of coins and currency is vital to all economies. It enhances the potential for trade, guides monetary policy, and provides economic stability. Given the differentiated, diverse, and rapid growth of the economy in India, understanding the linkage between currency circulation and GDP becomes paramount. This research aims to study that linkage. It will study

the trends in currency circulation over time, events surrounding significant events such as demonetization, and the role of the Reserve Bank of India in regulation. Ultimately, the hope of the research is to provide knowledge gained from its findings for the understanding of how effectively managing currency can affect sustainable growth and stability.

**Importance of the subject:**

To better appreciate the structural economic system operating within India we must recognize and understand about the circulation of coins and currency that effect India's GDP . This includes; explores the circulation of currency which is a part of trade which directly has an impact on; monetary policy, economic stability. Because of India's long-standing history with currency circulation and events like demonetization has a very significant influence GDP. The very recent increase in the use of cashless payment systems, the shift towards financial inclusion of 'cash' linked to the cashless physical and non-physical elements is very timely. When economists, institutions and policymakers understand better the circulation of currency and its significance in terms of GDP will give them a pathway to develop evidence-based policies to help promote financial stability that can benefit sustainable economic growth.

## Review of literature:

Roy (2020) offers a thorough examination of India's economic history, tracing the country's evolution from barter in antiquity to modern paper money. The author examines the early Mauryan Empire standardized coinage as well as the later, more intricate systems created by the Mughal emperors and later British colonial periods. This has historical significance for understanding the origins of the current monetary system.

According to Balachandran (1998), the RBI has played a crucial role in guiding currency circulation and preserving monetary stability. He goes over the RBI's background and its role in coordinating to establish some of the present objectives of financial stability, currency supply management, and inflation control. The book offers insightful information about RBI policies and associated economic matters.

(Azeez et al., 2022) examines how digital payments affect GDP and finds that they have increased financial inclusion, reduced transaction costs, and increased efficiency. The study emphasizes how digital payments can reduce dependency on physical currency and boost economic growth.

According to the World Bank (2020), South Korea and Sweden are two prosperous cashless economies. In addition to providing data pertinent to India's circumstances, the report emphasizes the notable economic growth, dramatically improved efficiency, and lower transaction costs for nations that went cashless.

## Objectives of the study:

The primary objectives of this research are:

- To examine the relationship between currency circulation and GDP growth.
- To examine the historical evolution of coins circulation in India and its impact on GDP over time in India.
- To examine the historical evolution of notes circulation in India and its impact on GDP over time in India.

## Research methodology:

- **Statistical Analysis:** Quantitative data are analyzed using statistical software (e.g., SPSS ver.25) to perform regression and correlation analysis, and other relevant statistical tests. These analyses were helped identify the relationship between currency circulation and GDP.

## Collection of data:

- **Secondary Data:** Date were collected from reputable sources such as the Reserve Bank of India (RBI), the Ministry of Finance, and the World Bank. This data includes historical records, reports, and statistics on coin and currency circulation and GDP.

**Comparison of the circulation of coins and notes**

The following table represents GDP and the circulation of various denominations of currency from the year 2011-12 to 2023-24.

| Year | SC | 1C | 2C | 5C | 10C | 20C | 1N | 2N | 5N | 10N | 20N | 50N | 100N | 200N | 500N | 1000N | 2000N | E50P | E1N | E2N | E5N | E10N | E20N | E50N | E100N | E200N | E500N | TER | TEW | TE | GDP | TC | TN | TTN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011-12 | 739 | 3142 | 3640 | 4990 | 648 | | 299 | 851 | 3643 | 23002 | 7020 | 17438 | 141188 | | 512807 | 346881 | | | | | | | | | | | | | | | 8736329 | 13159 | 1053129 | |
| 2012-13 | 700 | 3289 | 4423 | 5338 | 1267 | | 299 | 851 | 3687 | 25168 | 7650 | 17305 | 144210 | | 535950 | 429900 | | | | | | | | | | | | | | | 9944013 | 15017 | 1165020 | |
| 2013-14 | 700 | 3842 | 4965 | 5789 | 2017 | | 299 | 851 | 3714 | 26648 | 8569 | 17242 | 147646 | | 570248 | 508137 | | | | | | | | | | | | | | | 11233522 | 17313 | 1283354 | |
| 2014-15 | 700 | 3863 | 5407 | 6380 | 2750 | | 299 | 854 | 3702 | 30304 | 8699 | 17436 | 150265 | | 656391 | 561245 | | | | | | | | | | | | | | | 12445128 | 19100 | 1429195 | |
| 2015-16 | 700 | 4178 | 5926 | 7045 | 3703 | | 309 | 853 | 3680 | 32015 | 9847 | 19450 | 157783 | | 785375 | 632568 | | | | | | | | | | | | | | | 13682035 | 21552 | 1641880 | |
| 2016-17 | 700 | 4514 | 6411 | 7891 | 5204 | | 321 | 853 | 3645 | 36929 | 20315 | 35564 | 252801 | | 294098 | 8925 | 657063 | | | | | | | | | | | | | | 15183709 | 24720 | 1310514 | |
| 2017-18 | 700 | 4963 | 6571 | 8324 | 5049 | | 343 | 853 | 3580 | 30645 | 20032 | 36715 | 222149 | 37053 | 773429 | 6610 | 672642 | | | | | | | | | | | | | | 17090042 | 25607 | 1804051 | |
| 2018-19 | 700 | 4673 | 6631 | 8576 | 4905 | | 359 | 853 | 3519 | 31260 | 17425 | 43007 | 200738 | 80010 | 1075881 | 0 | 658199 | | | | | | | | | | | | | | 18899668 | 25485 | 2111251 | |
| 2019-20 | 700 | 4719 | 6703 | 8800 | 5013 | | 370 | 853 | 3478 | 30402 | 16599 | 43004 | 199021 | 107293 | 1472373 | 0 | 547952 | | | | | | | | | | | | | | 20103593 | 25935 | 2421345 | |
| 2020-21 | 700 | 4749 | 6757 | 8968 | 5139 | 179 | 377 | 853 | 3454 | 29368 | 18116 | 43762 | 190555 | 116608 | 1933951 | | 490195 | | | | | | | | | | | | | | 19854096 | 26492 | 2827239 | |
| 2021-22 | 700 | 4777 | 6816 | 9217 | 5404 | 674 | 382 | 853 | 3431 | 27805 | 22026 | 43571 | 181421 | 120881 | 2277340 | | 428394 | | | | | | | | | | | | | | 23597399 | 27588 | 3106104 | |
| 2022-23 | 700 | 4832 | 6946 | 9708 | 5976 | 1697 | 384 | 853 | 3411 | 26212 | 25160 | 42858 | 180584 | 125241 | 2581690 | | 362220 | 0.01 | 0.04 | 0.06 | 0.12 | 0.15 | 0.23 | 0.39 | 0.83 | 1.16 | 2.71 | 5.7 | 10.69 | 16.39 | 26949646 | 29859 | 3348613 | 3348629 |
| 2023-24 | 700 | 4913 | 7119 | 10274 | 6864 | 3133 | 387 | 853 | 3396 | 24951 | 26795 | 44892 | 205656 | 154215 | 3008847 | | 8202 | 0.09 | 0.37 | 0.54 | 1.37 | 2.14 | 3.94 | 8.49 | 20.73 | 32.01 | 164.36 | 234.04 | 0.08 | 234.12 | 29535667 | 33003 | 3478194 | 3478428 |

Source:

https://www.rbi.org.in/scripts/annualPublications.aspx?head=Handbook%20of%20Statistics%20on%20Indian%20Economy

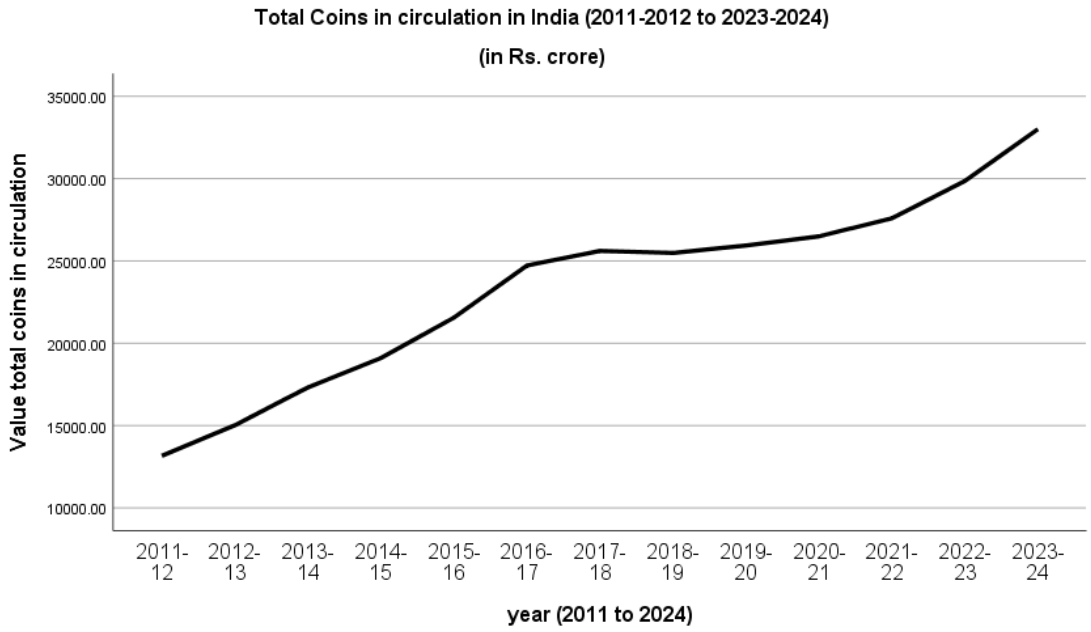
Where:SC= small coins, C= coins, N= notes, TER=total of e-₹ retail

TEW= total of e-₹ wholesale, TE= total of e-₹

The above table depicts GDP and the circulation of various denominations of currency from 2011-12 to 2023-24 in India. It can be seen that the circulation of almost all the coins and notes has been continuously increasing. Also, the circulation of rs. 2000 notes started from 2016-17 after the demonetisation of Rs. 500 and Rs. 1000 banknotes on 8th November 2016, which had a profound impact on the economy(Vansiya & Upadhyay, 2018). Thereafter, the circulation of rs. 200 notes started from 2017-18. Circulation of e₹ started from 2022-23. Circulation of e₹ notes has seen a huge jump in 2023-24 relative to its circulation in 2022-23.

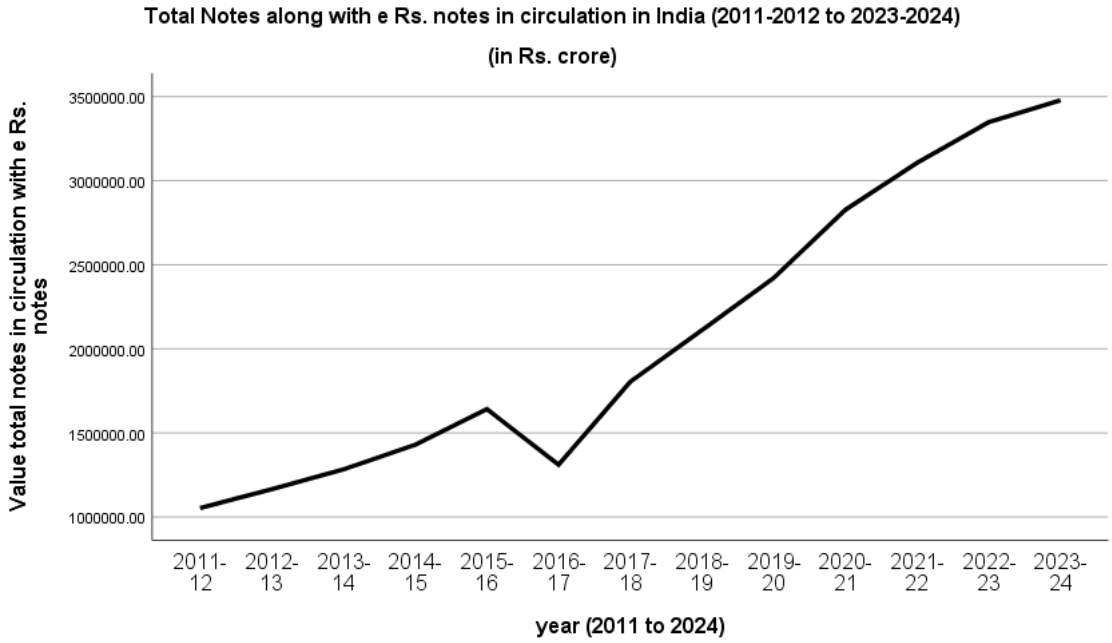
## Data analysis:

The following graph represents the trend of total coins in circulation during the period 2011-12 to 2023-24.



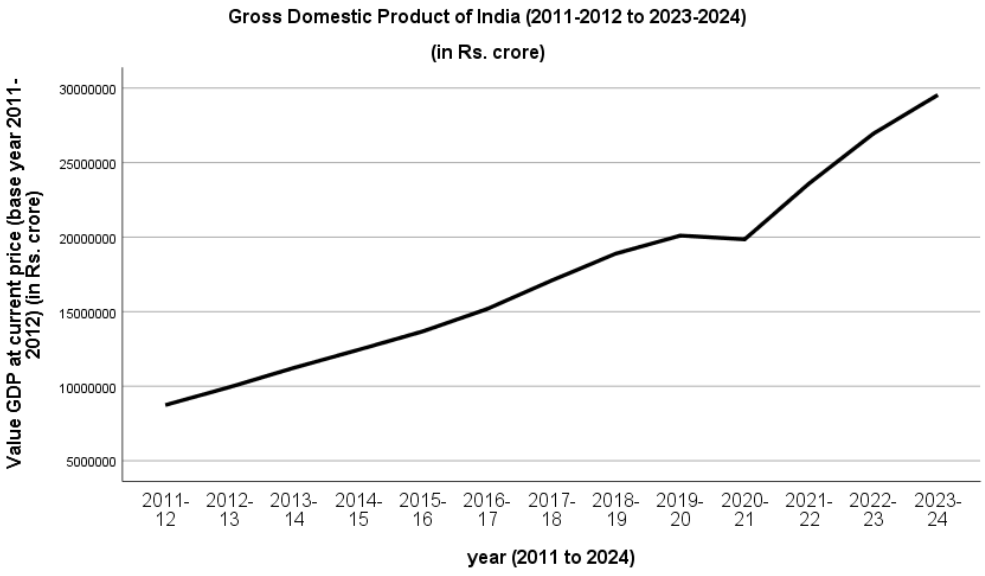

It is observed from the above chart that, the circulation of coins has been continuously increasing from the year 2011-12 (₹13159 crores) to 2023-24 (₹ 33003 crores). The circulation of coins increased at an increasing rate from 2011-12 to 2017-18, there was slight decrease in circulation in the year 2018-19 due to increase in digital payment system. And there after it has been increasing at a moderate rate.

The following graph represents the pattern of total notes with e₹ notes in circulation during the period 2011-12 to 2023-24.



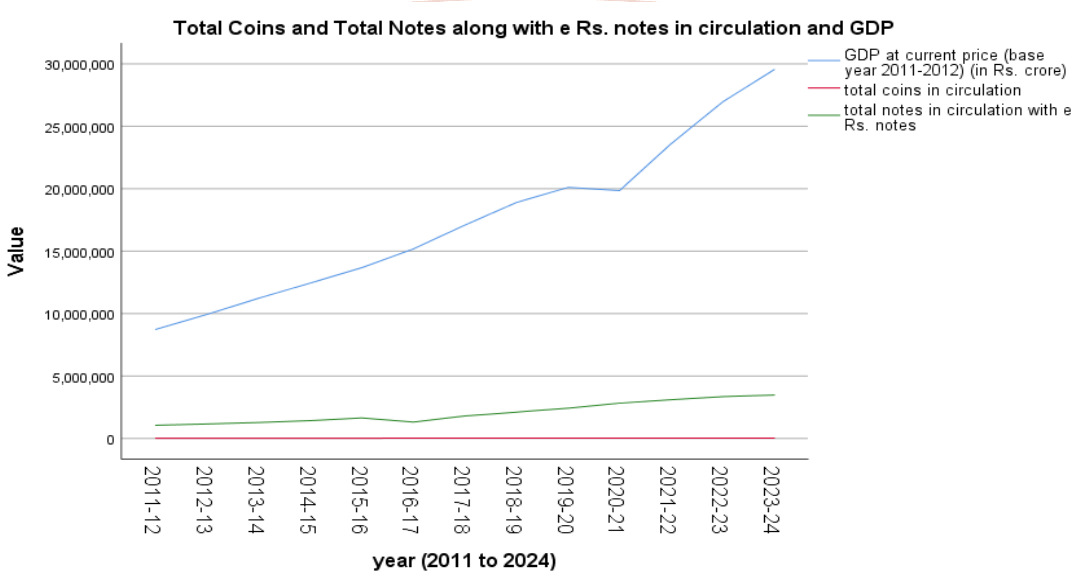

It is observed from the above chart that, the circulation of notes has been continuously increasing from the year 2011-12 (₹1053129 crores) to 2015-16 (₹ 1641880 crores). The circulation of notes decreased significantly in the year 2016-17(₹ 1310514 crores) due to demonetization of ₹ 500 and ₹ 1000 notes. And there after it has been increasing at a moderate rate as India moves towards cashless economy.

The following graph represents the pattern of GDP at current price during the period 2011-12 to 2023-24.



"Gross Domestic Product (GDP) is a conventional metric for gauging economic development and is widely utilised" (Vansiya & Andaish, 2025).It is observed from the above chart that, the GDP has been continuously increasing throughout these years except for the year 2020-21 due to the effect of pandemic covid 19. The upward sloping curve depicts that the GDP of India which was Rs. 8736329 crores in 2011-12 rose continuously to Rs. 20103593 crores in 2019-20. It fell to Rs.19854096 crores in 2020-21 and after that continued to increase till 2023-24 to Rs. 29535667 crores.

The following graph represents the combined pattern of GDP,Total coins and total notes with e₹ notes in circulation during the period 2011-12 to 2023-24.




The above chart shows the combined movement of circulation of coins, bank notes and GDP during the years 2011-12 to 2023-24.

**Table showing descriptive statistics of GDP and currency in circulation:**

| descriptive Statistics | | | | | | |
|---|---|---|---|---|---|---|
| | N | Range | Minimum | Maximum | Mean | Std. Deviation |
| small coins in Rs. Crore | 13 | 39 | 700 | 739 | 703.00 | 10.817 |
| Re. 1 coins in Rs. Crore | 13 | 1821 | 3142 | 4963 | 4342.62 | 622.031 |
| Rs. 2 coins in Rs. Crore | 13 | 3479 | 3640 | 7119 | 6024.23 | 1089.746 |
| Rs. 5 coins in Rs. Crore | 13 | 5284 | 4990 | 10274 | 7792.31 | 1722.537 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Rs. 10 coins in Rs. Crore | 13 | 6216 | 648 | 6864 | 4149.15 | 1909.839 |
| Rs. 20 coins in Rs. Crore | 4 | 2954 | 179 | 3133 | 1420.75 | 1304.823 |
| Re. 1 notes in Rs. Crore | 13 | 88 | 299 | 387 | 340.62 | 37.181 |
| Rs. 2 notes in Rs. Crore | 13 | 3 | 851 | 854 | 852.62 | .961 |
| Rs. 5 notes in Rs. Crore | 13 | 318 | 3396 | 3714 | 3564.62 | 120.425 |
| Rs.10 notes in Rs. Crore | 13 | 13927 | 23002 | 36929 | 28823.77 | 3707.628 |
| Rs. 20 notes in Rs. Crore | 13 | 19775 | 7020 | 26795 | 16019.46 | 6923.602 |
| Rs. 50 notes in Rs. Crore | 13 | 27650 | 17242 | 44892 | 32480.31 | 12402.671 |
| Rs. 100 notes in Rs. Crore | 13 | 111613 | 141188 | 252801 | 182616.69 | 33866.423 |
| Rs. 200 notes in Rs. Crore | 7 | 117162 | 37053 | 154215 | 105900.14 | 37549.183 |
| Rs. 500 notes in Rs. Crore | 13 | 2714749 | 294098 | 3008847 | 1267567.69 | 898629.180 |
| Rs. 1000 notes in Rs. Crore | 9 | 632568 | 0 | 632568 | 277140.67 | 270957.257 |
| Rs. 2000 notes in Rs. Crore | 8 | 664440 | 8202 | 672642 | 478108.37 | 221694.312 |
| e Rs. 0.50 paise in Rs. Crore | 2 | .08 | .01 | .09 | .0500 | .05657 |
| e Rs. 1 notes in Rs. Crore | 2 | .33 | .04 | .37 | .2050 | .23335 |
| e Rs. 2 notes in Rs. Crore | 2 | .48 | .06 | .54 | .3000 | .33941 |

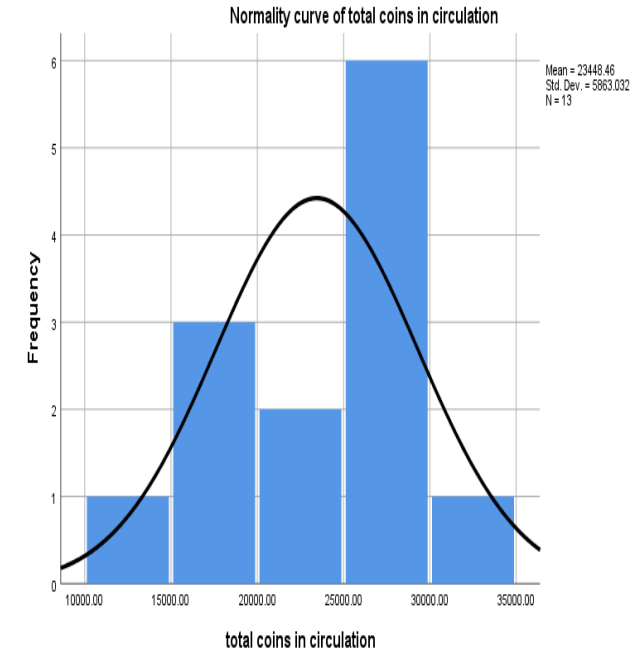
| | | | | | | |
|---|---|---|---|---|---|---|
| e Rs. 5 notes in Rs. Crore | 2 | 1.25 | .12 | 1.37 | .7450 | .88388 |
| e Rs. 10 notes in Rs. Crore | 2 | 1.99 | .15 | 2.14 | 1.1450 | 1.40714 |
| e Rs. 20 notes in Rs. Crore | 2 | 3.71 | .23 | 3.94 | 2.0850 | 2.62337 |
| e Rs. 50 notes in Rs. Crore | 2 | 8.10 | .39 | 8.49 | 4.4400 | 5.72756 |
| e Rs. 100 notes in Rs. Crore | 2 | 19.90 | .83 | 20.73 | 10.7800 | 14.07142 |
| e Rs. 200 notes in Rs. Crore | 2 | 30.85 | 1.16 | 32.01 | 16.5850 | 21.81424 |
| e Rs. 500 notes in Rs. Crore | 2 | 161.65 | 2.71 | 164.36 | 83.5350 | 114.30381 |
| Total e Rs.- Retail in Rs. Crore | 2 | 228.34 | 5.70 | 234.04 | 119.8700 | 161.46076 |
| Total e Rs.- wholesale in Rs. Crore | 2 | 10.61 | .08 | 10.69 | 5.3850 | 7.50240 |
| Total e Rs. In Rs. Crore | 2 | 217.73 | 16.39 | 234.12 | 125.2550 | 153.95836 |
| GDP at current price (base year 2011-2012) (in Rs. Crore) | 13 | 20799338 | 8736329 | 29535667 | 17481142.08 | 6483515.950 |
| total coins in circulation | 13 | 19844.00 | 13159.00 | 33003.00 | 23448.4615 | 5863.03185 |
| total notes in circulation | 13 | 2425065.00 | 1053129.00 | 3478194.00 | 2075376.0769 | 870959.53648 |
| total notes in circulation with e Rs. Notes | 13 | 2425299.12 | 1053129.00 | 3478428.12 | 2075395.3469 | 870992.95887 |
| Valid N (listwise) | 0 | | | | | |

The above given table shows various information like range, maximum, minimum, mean and standards deviations of all individual coins and notes in circulation throughout these years.

| Descriptive Statistics | | | | | | |
|---|---|---|---|---|---|---|
| | N | Range | Minimum | Maximum | Mean | Std. Deviation |
| GDP at current price (base year 2011-2012) (in Rs. crore) | 13 | 20799338 | 8736329 | 29535667 | 17481142.08 | 6483515.950 |
| total coins in circulation | 13 | 19844.00 | 13159.00 | 33003.00 | 23448.4615 | 5863.03185 |
| total notes in circulation with e Rs. Notes | 13 | 2425299.12 | 1053129.00 | 3478428.12 | 2075395.3469 | 870992.95887 |
| Valid N (listwise) | 13 | | | | | |

The above given table shows various information like range, maximum, minimum, mean and standards deviations of total coins and notes in circulation and GDP throughout these years. The Co-efficient of variation of total coins in circulation is 25.0039% and the Co-efficient of variation of total notes in circulation is 41.9675%, which shows that, the circulation of coins has been more stable and consistent.

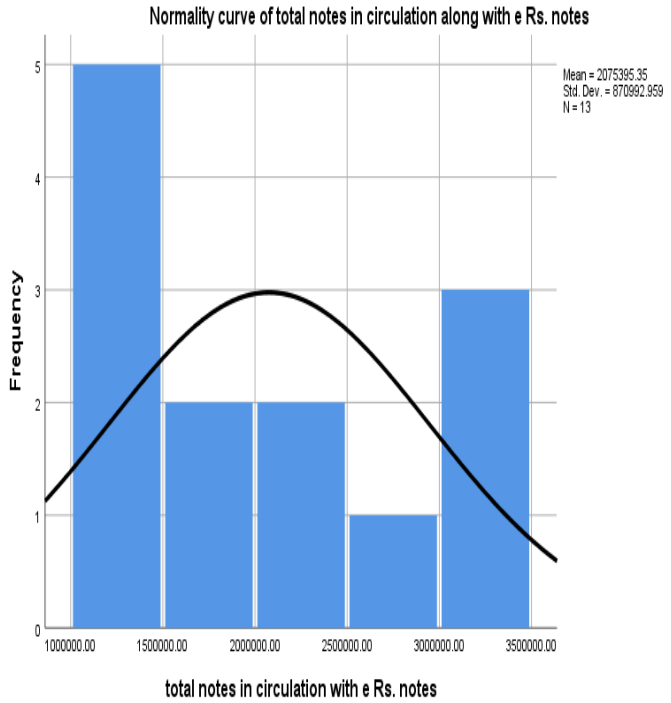
**Normality test of Total coins in circulation:**




| Report | |
|---|---|
| total coins in circulation | |
| Skewness | Kurtosis |
| -.361 | -.598 |

The diagram shows the normality curve of total coins in circulation. From the curve and the value of Skewness (-0.361) and Kurtosis (-0.598), it can be seen that the distribution is not normal.

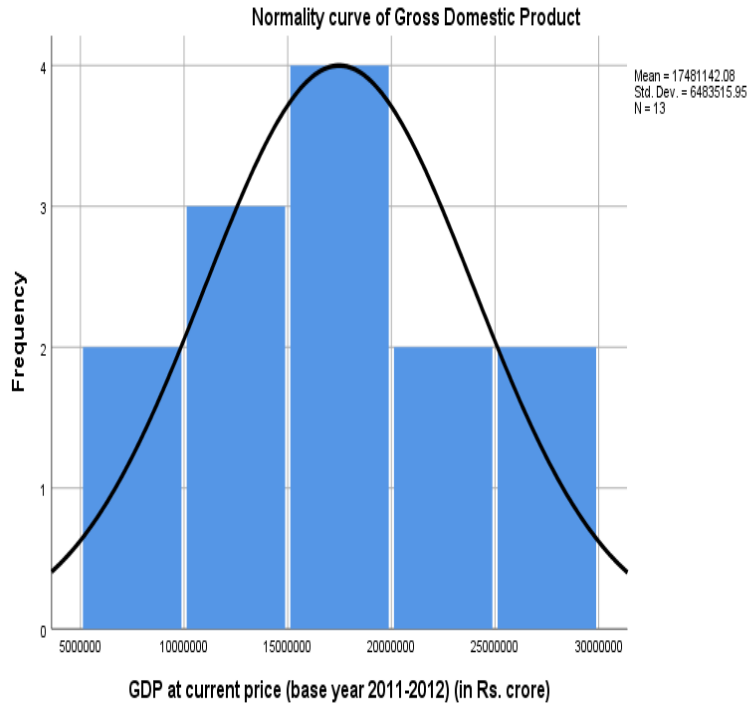
**Normality test of Total notes with e₹ in circulation:**




| Report | |
|---|---|
| total notes in circulation with e Rs. notes | |
| Skewness | Kurtosis |
| .484 | -1.365 |

The diagram reveals the normality curve of total notes in circulation. From the curve and the value of Skewness (0.484) and Kurtosis (-1.365), it can be seen that the distribution is not normal.

**Normality test of GDP:**

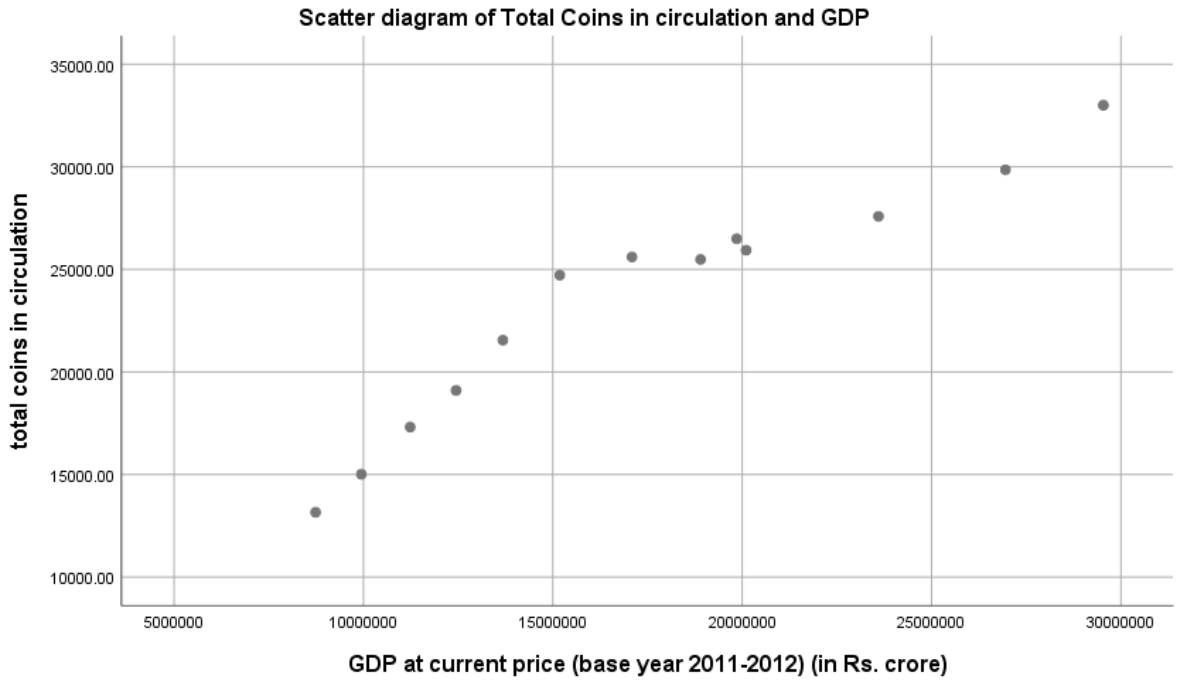



| Report | |
|---|---|
| GDP at current price (base year 2011-2012) (in Rs. crore) | |
| Skewness | Kurtosis |
| .480 | -.641 |

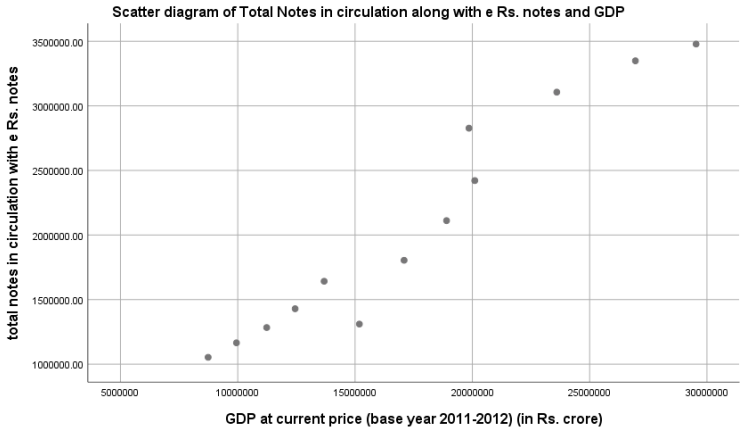
The graph reveals the normality curve of GDP of India. From the curve and the value of Skewness (0.480) and Kurtosis (-0.641), it can be seen that the distribution is not normal.

| Report | | |
|---|---|---|
| Median | | |
| GDP at current price (base year 2011-2012) (in Rs. crore) | total coins in circulation | total notes in circulation with e Rs. Notes |
| 17090042.00 | 25485.0000 | 1804051.0000 |

As it has been proved that, the total coins and notes in circulation and GDP are not normally distributed, appropriate measure of central tendency will be median instead of mean. Median value of GDP is ₹17090042.00 crores and the median values of total coins and notes in circulation are ₹25485.00 crores and ₹1804051.00 crores respectively.




The above diagram presents scatter diagram of total coins and GDP. It can be seen from the diagram that, there is a strong positive correlation between the two as all the points are almost on the same line, which means that both the variables move in the same direction.



The above diagram presents scatter diagram of total notes and GDP. It can be seen from the diagram that, there is a strong positive correlation between the two as all the points are almost on the same line, which depicts that as one variable increases other also increases.

**Correlation Analysis**

| total coins in circulation | | | | | |
|---|---|---|---|---|---|
| | | Freq | % | Valid % | Cumu. % |
| Valid | 13159 | 1 | 7.7 | 7.7 | 7.7 |
| | 15017 | 1 | 7.7 | 7.7 | 15.4 |
| | 17313 | 1 | 7.7 | 7.7 | 23.1 |
| | 19100 | 1 | 7.7 | 7.7 | 30.8 |
| | 21552 | 1 | 7.7 | 7.7 | 38.5 |
| | 24720 | 1 | 7.7 | 7.7 | 46.2 |
| | 25485 | 1 | 7.7 | 7.7 | 53.8 |
| | 25607 | 1 | 7.7 | 7.7 | 61.5 |
| | 25935 | 1 | 7.7 | 7.7 | 69.2 |
| | 26492 | 1 | 7.7 | 7.7 | 76.9 |
| | 27588 | 1 | 7.7 | 7.7 | 84.6 |
| | 29859 | 1 | 7.7 | 7.7 | 92.3 |
| | 33003 | 1 | 7.7 | 7.7 | 100.0 |
| | Total | 13 | 100 | 100 | |

| total notes in circulation with e Rs. Notes | | | | | |
|---|---|---|---|---|---|
| | | Freq. | % | Valid % | Cumu. % |
| Valid | 1053129 | 1 | 7.7 | 7.7 | 7.7 |
| | 1165020 | 1 | 7.7 | 7.7 | 15.4 |
| | 1283354 | 1 | 7.7 | 7.7 | 23.1 |
| | 1310514 | 1 | 7.7 | 7.7 | 30.8 |
| | 1429195 | 1 | 7.7 | 7.7 | 38.5 |
| | 1641880 | 1 | 7.7 | 7.7 | 46.2 |
| | 1804051 | 1 | 7.7 | 7.7 | 53.8 |
| | 2111251 | 1 | 7.7 | 7.7 | 61.5 |
| | 2421345 | 1 | 7.7 | 7.7 | 69.2 |
| | 2827239 | 1 | 7.7 | 7.7 | 76.9 |
| | 3106104 | 1 | 7.7 | 7.7 | 84.6 |
| | 3348629 | 1 | 7.7 | 7.7 | 92.3 |
| | 3478428 | 1 | 7.7 | 7.7 | 100.0 |
| | Total | 13 | 100 | 100 | |

| GDP at curr. price (base year 2011-2012) (in Rs. crore) | | | | | |
|---|---|---|---|---|---|
| | | Freq | % | Valid % | Cumu % |
| Valid | 8736329 | 1 | 7.7 | 7.7 | 7.7 |
| | 9944013 | 1 | 7.7 | 7.7 | 15.4 |
| | 11233522 | 1 | 7.7 | 7.7 | 23.1 |
| | 12445128 | 1 | 7.7 | 7.7 | 30.8 |
| | 13682035 | 1 | 7.7 | 7.7 | 38.5 |
| | 15183709 | 1 | 7.7 | 7.7 | 46.2 |
| | 17090042 | 1 | 7.7 | 7.7 | 53.8 |
| | 18899668 | 1 | 7.7 | 7.7 | 61.5 |
| | 19854096 | 1 | 7.7 | 7.7 | 69.2 |
| | 20103593 | 1 | 7.7 | 7.7 | 76.9 |
| | 23597399 | 1 | 7.7 | 7.7 | 84.6 |
| | 26949646 | 1 | 7.7 | 7.7 | 92.3 |
| | 29535667 | 1 | 7.7 | 7.7 | 100.0 |
| | Total | 13 | 100 | 100 | |

It can be seen from the above table that, the frequency of total coins and notes in circulation and GDP is 1, which means no value is repeated and there is no tie in the distribution. As has been proved above that, the distributions are not normal Pearson's correlation co-efficient will be inappropriate. As there are no ties in the above distributions Spearman's rank correlation will be the best method.

**Correlation between GDP and Total coins in circulation:**

| Correlations | | |
|---|---|---|
| | total coins in circulation | GDP at current price (base year 2011-2012) (in Rs. crore) |

| | | | | |
|---|---|---|---|---|
| Spearman's rho | total coins in circulation | Correlation Coefficient | 1.000 | .989** |
| | | Sig. (2-tailed) | . | .000 |
| | | N | 13 | 13 |
| | GDP at current price (base year 2011-2012) (in Rs. crore) | Correlation Coefficient | .989** | 1.000 |
| | | Sig. (2-tailed) | .000 | . |
| | | N | 13 | 13 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | |

The above table shows the result of the Spearman's rank correlation test, in which the value of correlation co-efficient (r) is 0.989 which shows there is a very strong positive correlation between total coins in circulation and GDP.

**Correlation between GDP and Total notes with e₹ in circulation:**

| **Correlations** | | | | |
|---|---|---|---|---|
| | | | total notes in circulation with e Rs. notes | GDP at current price (base year 2011-2012) (in Rs. crore) |
| Spearman's rho | total notes in circulation with e Rs. Notes | Correlation Coefficient | 1.000 | .978** |
| | | Sig. (2-tailed) | . | .000 |
| | | N | 13 | 13 |
| | GDP at current price (base year 2011-2012) (in Rs. crore) | Correlation Coefficient | .978** | 1.000 |
| | | Sig. (2-tailed) | .000 | . |
| | | N | 13 | 13 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | |

The above table shows the result of the Spearman's rank correlation test, in which the value of correlation co-efficient (r) is 0.978 which shows there is a very strong positive correlation between total notes in circulation and GDP.

From both the above results it can be seen that, the GDS is relatively more strongly correlated with the total coins in circulation.

**Regression analysis between GDP and Total coins in circulation:**

| Variables Entered/Removed[a] | | | |
|---|---|---|---|
| Model | Variables Entered | Variables Removed | Method |
| 1 | total coins in circulation[b] | . | Enter |
| a. Dependent Variable: GDP at current price (base year 2011-2012) (in Rs. crore) | | | |
| b. All requested variables entered. | | | |

| Coefficients[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -7247517.486 | 2419071.909 | | -2.996 | .012 |
| | total coins in circulation | 1054.596 | 100.312 | .954 | 10.513 | .000 |
| a. Dependent Variable: GDP at current price (base year 2011-2012) (in Rs. crore) | | | | | | |

GDP = -7247517.486 + 1054.596 Total coins in circulation

One unit change in the circulation of coins causes 1054.596 units change in GDP. If the circulation of coin increased by 1 unit, GDP will increase by 1054.596. Hence if India's circulation of coins is increased by 1 crore rupees, it will lead to 1054.596 crore rupees increase in GDP.

Hypothesis testing of B (beta):

$H_0$: B = 0

$H_1$: B ≠ 0

To test the above hypothesis t test is used.

In the above table it can be seen that the calculated value of t is 10.513 and its corresponding significant value is 0.000 which is less than 0.05 measures at 95% significant level. Hence null hypothesis is failed to accept.

| Model Summary | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .954[a] | .909 | .901 | 2037341.933 |
| a. Predictors: (Constant), total coins in circulation | | | | |

Explanatory power of model:

In the above table, it can be seen that, the value of adjusted $R^2$ is 0.901 which shows the explanatory power of regression line i.e. how much percentage change in dependent variable is due to independent variable.

In the above regression line, the value of Adjusted R2 0.901, when multiplied by 100, value of 90.10% is obtained. This shows that, in India during the years 2011-12 to 2023-24 90.1% changes occurring in GDP is due to circulation of coins.

From above it can be seen that 9.9% change in India's GDP are due to factors other than coins in circulation which are not included knowingly and unknowingly.

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
| 1 | Regression | 45877336516 1435.000 | 1 | 45877336516 1435.000 | 110.528 | .000[b] |
| | Residual | 45658383685 591.840 | 11 | 41507621532 35.622 | | |
| | Total | 50443174884 7026.900 | 12 | | | |
| a. Dependent Variable: GDP at current price (base year 2011-2012) (in Rs. crore) | | | | | | |
| b. Predictors: (Constant), total coins in circulation | | | | | | |

$H_0$: Regression line is nonlinear

$H_1$: Regression line is linear

In the above ANOVA table it can be seen that, the calculated value of F test is 110.528 and its corresponding significant level is 0.000 which at 95% significant level is less than 0.05 which shows that, at 95% significant level $H_0$ is failed to be accepted, which means regression line is linear.

**Regression analysis between GDP and Total notes in circulation:**

| Variables Entered/Removed[a] | | | |
|---|---|---|---|
| Model | Variables Entered | Variables Removed | Method |
| 1 | total notes in circulation with e Rs. notes[b] | . | Enter |
| a. Dependent Variable: GDP at current price (base year 2011-2012) (in Rs. crore) | | | |
| b. All requested variables entered. | | | |

| Coefficients[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2542077.789 | 1279584.061 | | 1.987 | .072 |
| | total notes in circulation with e Rs. Notes | 7.198 | .572 | .967 | 12.588 | .000 |
| a. Dependent Variable: GDP at current price (base year 2011-2012) (in Rs. crore) | | | | | | |

GDP = 2542077.789 + 7.198 Total notes in circulation

One unit change in the circulation of notes causes 7.198 units change in GDP. If the circulation of notes increased by 1 unit, GDP will increase by 7.198 . Hence if India's circulation of notes is increased by 1 crore rupees, it will lead to 7.198 crore rupees increase in GDP.

Hypothesis testing of B (beta):

$H_0$: B = 0

$H_1$: B ≠ 0

To test the above hypothesis t test is used.

In the above table it can be seen that the calculated value of t is 12.588 and its corresponding significant value is 0.000 which is less than 0.05 measures at 95% significant level. Hence null hypothesis is failed to accept.

| Model Summary | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .967[a] | .935 | .929 | 1725289.342 |
| a. Predictors: (Constant), total notes in circulation with e Rs. notes | | | | |

**Explanatory power of model:**

In the above table, it can be seen that, the value of adjusted $R^2$ is 0.929 which shows the explanatory power of regression line i.e. how much percentage change in dependent variable is due to independent variable.

In the above regression line, the value of Adjusted $R^2$ 0.929, when multiplied by 100, value of 92.2% is obtained. This shows that, in India during the years 2011-12 to 2023-24 92.2% changes occurring in GDP is due to circulation of notes.

From above it can be seen that 7.8% change in India's GDP are due to factors other than notes in circulation which are not included knowingly and unknowingly.

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
| 1 | Regression | 47168889239 8364.700 | 1 | 47168889239 8364.700 | 158.464 | .000[b] |
| | Residual | 32742856448 662.203 | 11 | 29766233135 14.746 | | |
| | Total | 50443174884 7026.900 | 12 | | | |
| a. Dependent Variable: GDP at current price (base year 2011-2012) (in Rs. crore) | | | | | | |
| b. Predictors: (Constant), total notes in circulation with e Rs. Notes | | | | | | |

$H_0$: Regression line is nonlinear

$H_1$: Regression line is linear

In the above ANOVA table it can be seen that, the calculated value of F test is 158.464 and its corresponding significant level is 0.000 which at 95% significant level is less than 0.05 which shows that, at 95% significant level $H_0$ is failed to be accepted, which means regression line is linear.

Both the above test shows that, circulation of coins causes a greater change in GDP compared to circulation of notes. One unit change in the circulation of coins causes 1054.596 units change in GDP whereas one unit change in the circulation of note causes 7.198 units change in GDP.

## Policy implications:

As has been observed that growth of GDP has been the highest in 2021-22, the reason for which is huge surge in the circulation of coins and notes.

Hence if India wants to increase its GDP faster it will have to take measures to increase the circulation of coins, as circulation of coins has a greater impact on the GDP.

## Conclusion:

The research offers a robust perspective and understanding the intricate relationship between currency and economic growth. The analysis demonstrates the pivotal role played by the circulation of currency in facilitating trade, stimulating consumer expenditures, and maintaining liquidity in the economy. Historical events and examples, such as demonetization and the rise of digital payments, illustrate the volatility of currency management and its impact on GDP. This study provides policy implications for policymakers, economists, and financial institutions by observing the Reserve Bank of India's currency policies, while addressing challenges in maintaining currency circulation like counterfeiting and liquidity shortages. Ultimately, combining efficient currency circulation and technological advancements in addition to financial inclusion initiatives will support increased economic growth and stability for the Indian economy.

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