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**India(Home Country)**

For this project we have taken India as our home country, over the past 10 years, India's GDP has grown by an average of 7 percent each year when measured in US dollars, reaching a total of $3.6 trillion. This growth has propelled India from being the eighth largest economy to the fifth largest. Looking ahead, it's expected that India's GDP will likely reach $5 trillion within the next four years, making it the third largest economy by 2027. This would mean surpassing Japan and Germany. India is considered the fastest-growing large economy, benefiting from factors like a consistent labor force, improvements in institutions, and better governance. (“Strong reforms over last 10 years lays foundation of solid growth over next decade: Jefferies - The Economic Times,” n.d.)

In December 2023, India's nominal GDP growth rate was reported at 10.075%, marking an increase from the previous rate of 9.622% in September 2023. This data, which is updated quarterly, has been averaged at 12.009% from June 1997 to December 2023, based on 107 observations. India's nominal GDP growth rate reached its highest point in June 2021 at 32.980% and hit a record low of -21.356% in June 2020. The Ministry of Statistics and Programme Implementation provides this data in local currency, adjusted for inflation, while CEIC calculates the quarterly growth rate from quarterly nominal GDP figures. These numbers reflect how India's economy has been performing over time in terms of its overall size and expansion, offering insights into the country's economic health and trajectory.(“India Nominal GDP Growth | Economic Indicators | CEIC,” n.d.)

The below mention graph from World Bank shows the trend for last 10 years.  
A screenshot of a graph

Description automatically generated(“World Bank Open Data,” n.d.)

**Switzerland(Foreign Country)**

We have taken Switzerland as foreign country. Switzerland is one of the world's most advanced and developed free-market economies. Key drivers of its economy include tourism and the service sector, particularly its renowned Swiss banking industry. Switzerland consistently ranks high in global competitiveness, securing the third position in the Global Competitiveness Report 2020 and holding the top spot in the Global Innovation Index since 2015. According to United Nations data from 2016, Switzerland stands as the third-wealthiest landlocked nation globally, trailing only Liechtenstein and Luxembourg. With a nominal GDP per capita exceeding $70,000.

A screenshot of a graph

Description automatically generated(“World Bank Open Data,” n.d.)

**Reason for Comparison between India and Switzerland**

1. **Trade**: India and Switzerland do a lot of business together.India is Switzerland’s fourth-largest trading partner in Asia and largest in South Asia. In 2018, Swiss exports to India totaled CHF 17.4 billion, primarily consisting of precious metals, machinery, pharmaceuticals, and chemicals. Conversely, imports from India, primarily including chemicals, textiles, precious metals, and agricultural products, amounted to CHF 1.83 billion in the same year. As of the end of 2016, Swiss direct investment in India reached CHF 4.7 billion. Currently, approximately 250 Swiss companies operate in India, either through joint ventures, subsidiaries, or branches.

2. **Investing**: People in India might want to invest in things like Swiss bonds or real estate. Checking exchange rates helps them understand if their money will go further in Switzerland and what they might get back when they cash out.

3. **Travel**: As reported by the Swiss Federal Statistics Office, Switzerland welcomed 347,750 Indian tourists in 2018, resulting in a total of 780,815 overnight stays in the country. Moreover, the agreed minutes from the 17th session of the India-Switzerland Joint Economic Commission (JEC), convened in Berne on March 2, 2020, reveal discussions about the potential signing of a Memorandum of Understanding (MoU) between the two nations in the realm of tourism.

4. **Government** **Decisions**: Indian leaders might watch the exchange rate with Switzerland to make decisions about things like inflation, trade, and how to manage the country's money.

5. **Banks and Finance:** Indian banks and finance groups might deal in Swiss money. Watching the exchange rate helps them make decisions about how to handle their money and keep things stable.

6. **Cooperation in education, research and innovation**: In 2003, Switzerland and India inked a science and technology agreement, followed by a memorandum of understanding on collaboration in the social sciences in 2012. These agreements encompass activities falling under the Indo-Swiss Joint Research Programme. Located in Bangalore, Swissnex India serves as a hub bridging Switzerland and India across various domains, including science, education, arts, and innovation. India holds a prominent position as a priority country for the Swiss Government Excellence Scholarships for Foreign Scholars and Artists, primarily targeting young researchers. Additionally, the Swiss VET Initiative India (SVETII) was initiated in 2008 to commemorate the 60th anniversary of the Treaty of Friendship between Switzerland and India.

7.**Cordial relationship**: Switzerland initiated diplomatic ties with India shortly after its Independence. On August 14, 1948, a Treaty of Friendship was signed between India and Switzerland in New Delhi. This treaty was among the earliest agreements inked by independent India and stands as a significant milestone in Indo-Swiss relations. The year 2023 will commemorate the 75th anniversary of the signing of the India-Switzerland Friendship Treaty.

We obtained our Consumer Price Index (CPI) data from Fred Economic Data spanning a period of 10 years. Simultaneously, we acquired Nominal Exchange rates from Yahoo Finance. Using this data, we computed the Real Exchange rates using a simple formula in Excel. The formula employed was as follows:

Real Exchange Rate = **CPI\_Home \* Nominal Exchange**

**CPI \_Foreign**

**CPI(Consumer Price Index):** The Consumer Price Index (CPI) tracks the collective fluctuation in prices of goods and services commonly purchased by individuals over time. It achieves this by gathering around 53,000 price points on a monthly basis and comparing them to the corresponding prices from the previous month.(“What is the CPI - CSO - Central Statistics Office,” n.d.)

**Nominal Exchange:-** Nominal exchange rates are a commonly known type of exchange rate, providing a straightforward representation of the value of one currency in terms of another. For instance, a nominal exchange rate between pound sterling (GBP) and euros (EUR) might be stated as EUR/GBP = 0.85. This indicates that 85 pence (or 0.85 GBP) can be exchanged for 1 euro. While nominal exchange rates offer a clear snapshot of currency values at a specific moment, they don't necessarily convey the purchasing power of each currency.(“What is the Real Exchange Rate?,” n.d.)

**Real Exchange:** Real exchange rates offer a means to gauge the comparative worth of currencies over time, factoring in the impact of inflation. They assess the value of a country's goods in relation to those of another, proving especially valuable for evaluating a nation's international trade and export competitiveness. Real exchange rates provide insight into a currency's true purchasing power, aiming for a more precise reflection of its value. To understand how real exchange rates function, consider comparing items expected to hold identical value in two countries. For instance, Germany and the UK might both import the same coffee from a shared source, yet the cost of a cup of coffee may differ between the two nations, particularly evident if sold by the same chain operating in both countries.(“What is the Real Exchange Rate?,” n.d.)

**Logarithm**

The next step involves computing the logarithm of all values, with the aim of transforming the data and potentially linearizing relationships that are nonlinear in their original form. Logarithmic transformations are commonly utilized in econometrics and financial analysis to stabilize variance, enhance model fit, and meet the assumptions of statistical tests. Moreover, in the context of exchange rates and Consumer Price Index (CPI) data, logarithmic transformations may facilitate the analysis of percentage changes or growth rates more effectively.

Delving deeper, logarithmic transformations serve various purposes in data analysis. Initially, they are utilized to normalize heavily skewed data distributions, compressing the data range to reduce the influence of outliers and promote a more symmetric distribution. Additionally, logarithmic transformations can improve the interpretability of relationships between variables, particularly in regression analysis and statistical modeling, often resulting in a more interpretable linear relationship between variables.Logarithms aid in stabilizing variance, especially in scenarios where the data's variance increases with the mean (heteroscedasticity). By stabilizing variance, logarithmic transformations make the data more suitable for certain types of analyses. Finally, logarithmic transformations are beneficial for analyzing relative changes or growth rates over time. By converting multiplicative changes into additive changes, logarithms simplify the analysis and interpretation of trends and patterns, providing valuable insights into the data.Overall, the employment of logarithmic transformations assists in enhancing the distribution of data, making it more suitable for subsequent analysis and modeling endeavors.

Absolute PPP

The result of the Engle-Granger Test for cointegration indicates that the residuals from regressing the log CPI of Home on the log CPI of Foreign are stationary. Here's the interpretation:

1. ADF Statistic: The ADF statistic value of approximately -8.52 is highly negative, indicating strong evidence against the null hypothesis of non-stationarity. This means that the series of residuals is likely stationary.

2. p-value: The p-value is approximately \(1.12 \times 10^{-13}\), which is significantly less than the conventional significance level of 0.05. Thus, we reject the null hypothesis of non-stationarity.

3. Critical Values: The critical values at 1%, 5%, and 10% levels are provided for comparison. The ADF statistic is well below all of these critical values, further supporting the rejection of the null hypothesis.

4. Interpretation: Since the residuals are stationary, it suggests that there is a long-term relationship (cointegration) between the log CPI of Home and the log CPI of Foreign. In the context of absolute Purchasing Power Parity (PPP), this implies that changes in the exchange rate between the two countries should be reflected in changes in the price levels (CPI) in a manner that maintains parity over the long run.

Overall, the result supports the concept of absolute PPP, indicating that there exists a stable relationship between the price levels of the two countries after accounting for exchange rate movements.

Relative PPP

The results you've provided are from Augmented Dickey-Fuller (ADF) tests conducted on different variables, likely related to testing for stationarity in the context of relative Purchasing Power Parity (PPP). Here's how we can interpret these results in relation to relative PPP:

1. diff\_Log\_Nominal\_Exchange\_Rate:

- The test statistic is highly negative (-12.9671), and the p-value is very low (close to zero).

- This indicates strong evidence against the null hypothesis of non-stationarity, suggesting that the difference in the log of nominal exchange rates is stationary.

- Stationarity of the exchange rate difference is important in the context of relative PPP, as it suggests that the relative changes in exchange rates over time are mean-reverting, which is a key assumption of relative PPP.

2. diff\_Log\_Real\_Exchange\_Rate:

- Similar to the nominal exchange rate, the test statistic is highly negative (-12.4823), and the p-value is very low (close to zero).

- This suggests that the difference in the log of real exchange rates is also stationary.

- The real exchange rate adjusts the nominal exchange rate for differences in price levels between two countries, making it particularly relevant for testing relative PPP.

3. diff\_Log\_CPI\_Home:

- Again, the test statistic is highly negative (-8.5804), and the p-value is very low (close to zero).

- This indicates that the difference in the log of Consumer Price Index (CPI) for the home country is stationary.

- Stationarity of the home CPI difference is crucial for assessing relative PPP as it reflects changes in the price level in the home country.

4. diff\_Log\_CPI\_Foreign:

- The test statistic here (-1.4304) is negative but not as significant, and the p-value (0.5676) is relatively high.

- This suggests that the difference in the log of CPI for the foreign country is not stationary.

- While this might seem contrary to the other variables, it's important to note that relative PPP primarily focuses on comparing changes in price levels between the home and foreign countries. The non-stationarity of the foreign CPI difference doesn't necessarily invalidate the application of relative PPP, as long as the other variables are stationary.

In summary, the stationarity of the differences in the log of nominal exchange rates, real exchange rates, and the home CPI supports the applicability of relative PPP, indicating that relative changes in exchange rates and price levels over time follow a stationary process, consistent with the theory of relative PPP.

In short, keeping an eye on the exchange rate between India and Switzerland is important for lots of reasons, helping people, businesses, and governments make smart choices in a global economy.

Reference

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