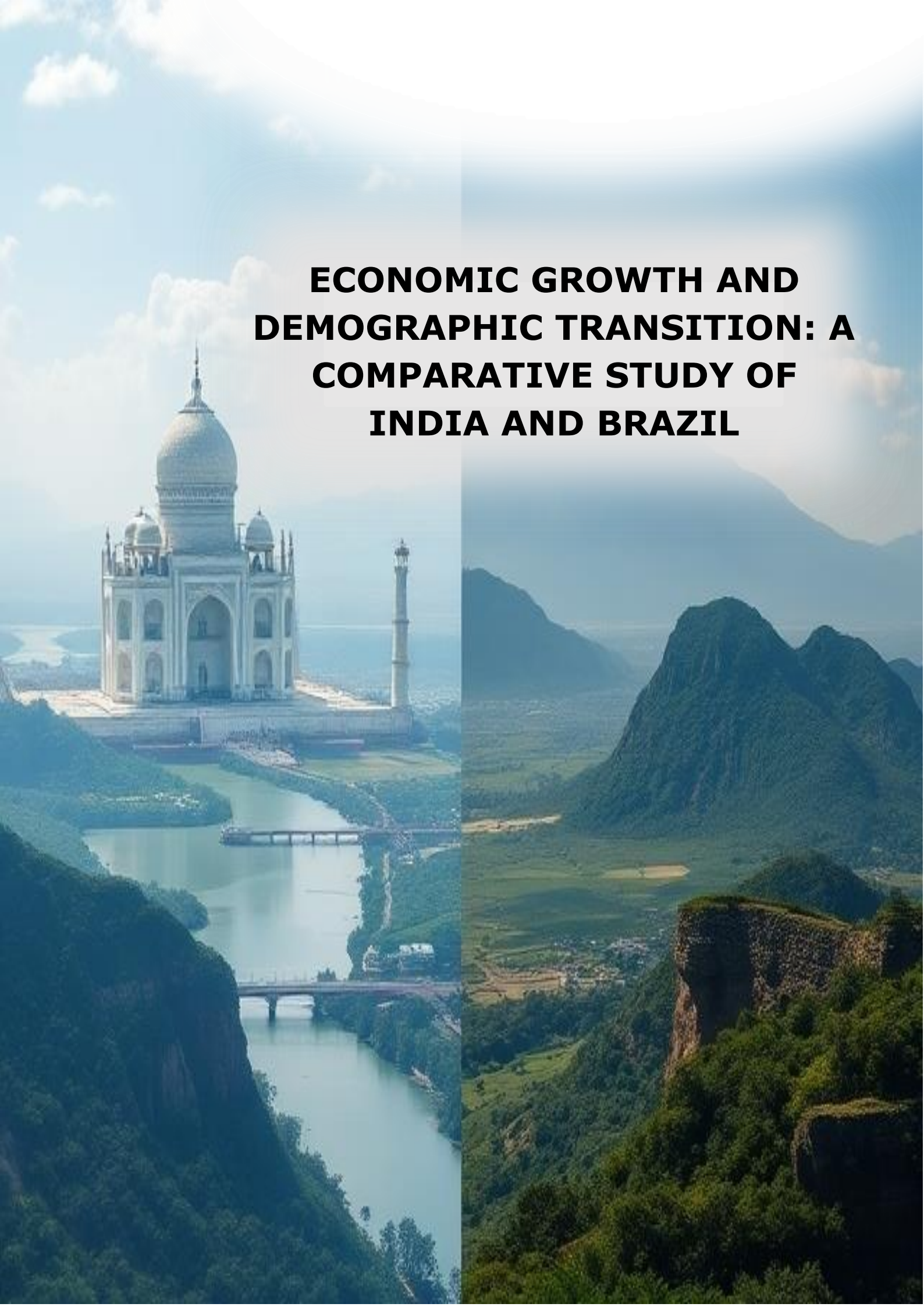
ECONOMIC GROWTH AND DEMOGRAPHIC TRANSITION: A COMPARATIVE STUDY OF INDIA AND BRAZIL



INDIA AND BRAZIL

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INTRODUCTION

Over the past few years, the world order has been undergoing a chaotic transformation. BRICS, which consists of Brazil, Russia, India, China, and South Africa, is emerging as a new economic bloc.

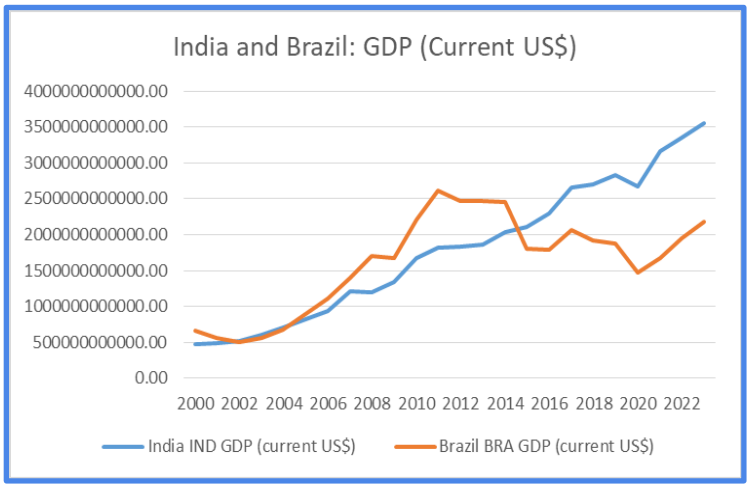
Over the years, India has emerged as a rising superpower in Asia, driven by its robust economic growth, large population, and strategic geopolitical position. With a rapidly expanding economy, India focuses on sectors like technology, manufacturing, and renewable energy to enhance its global competitiveness. Brazil, another emerging economy in South America, can be a valuable partner in India's journey to becoming a major economic powerhouse.

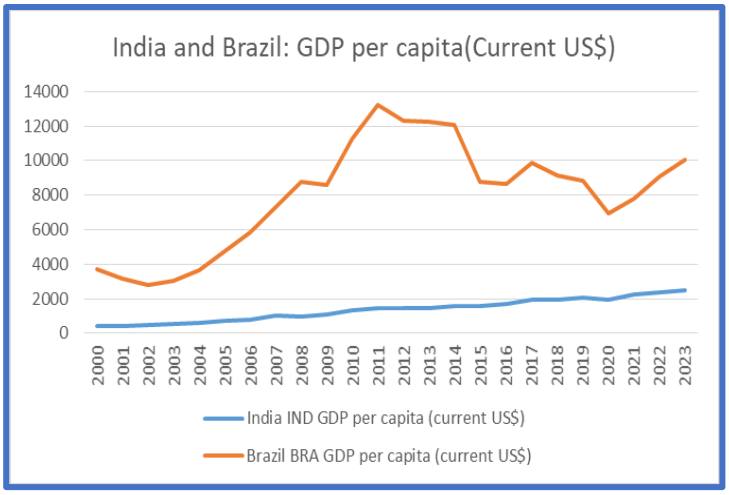
Gross Domestic Product (GDP) and GDP per capita

Our economic exploration starts with the most well-known macroeconomic indicator, gross domestic product (GDP). The graph below shows GDP in (current US$) for India and Brazil from 2000 to 2023.

India’s consistent upward trajectory faced a downturn in 2020 owing to COVID-19 but has now rebounded and is exhibiting healthy trends consistent with pre-pandemic levels.

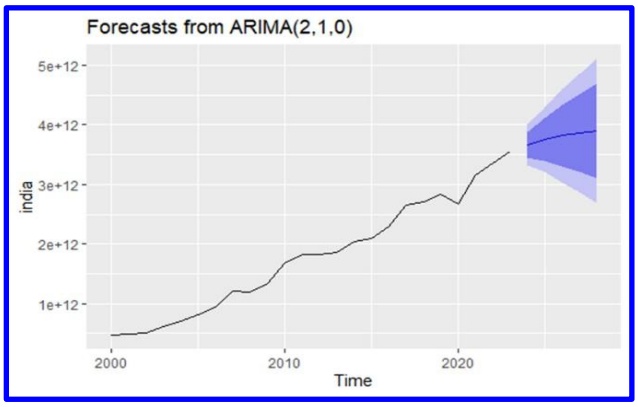
Brazil's GDP per capita, consistently higher than India's due to a smaller population, showed an upward trend until 2011, followed by a general decline until a steady rise resumed after 2020.





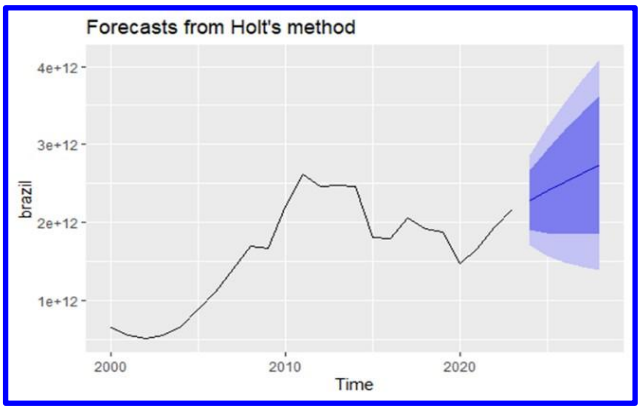
Time Series Analysis of Gross Domestic Product and Gross Domestic per capita

India




```
Series: india
ARIMA(2,1,0)

Coefficients:
          ar1     ar2
      0.2486  0.3413
s.e.  0.1883  0.1906

sigma^2 = 2.988e+22:  log likelihood = -626.93
AIC=1259.86   AICc=1261.13   BIC=1263.27
```

Brazil




```
Call:
holt(y = brazil, h = 5)

  Smoothing parameters:
    alpha = 0.9999
    beta  = 0.0226

  Initial states:
    l = 211703946665.958
    b = 141589139393.923

  sigma:  295345687448
```

The inception of the millennium saw India's economy show significant growth in GDP due to major structural changes and economic liberalisation. In 2003, India's economy defied expectations, growing by 8.5% due to a strong rebound in agriculture (+9.6% after the drought), robust industrial growth (+6.6%), and significant improvements in the service sector (+9.1%). Indian GDP growth slowed significantly from 9% in 2007–2008 to 6.7% in 2008–2009. The service sector, buoyed by public spending, grew at the cost of the industrial sectors which were hit hard. The government announced three **fiscal stimulus packages** in December 2008, January, and March 2009, totalling about $21 billion or 2% of GDP, to combat softening demand. Measures included tax reductions, infrastructure investments, and support for export-oriented industries. **Foreign capital** inflows to India reversed in 2008-2009, with FII outflows leading to a stock market decline and reduced primary market activity. Declines in ECBs and FDI further strained capital availability. Capital outflows and higher foreign exchange demand led to a 27% depreciation of the Indian rupee against the US dollar between April 2008 and March 2009. This benefited exporters but increased import costs and corporate

debt burdens. Indian banks remained insulated due to prudent regulation and lower exposure to high-risk assets. The Reserve Bank of India (RBI) imposed higher provisioning requirements for loans to real estate, curbing excessive lending.

Brazil's economy recovered from the subprime crisis in 2009 owing to various factors. **The central bank measures** included slashing interest rates, maintaining domestic liquidity, and increasing credit flows. The government's **expansionary fiscal policy** included tax cuts and higher spending. The **revaluation of the Brazilian Real** consolidated the soundness of the institutions and the cautious monetary policy.

The Brazilian economy's remarkable resilience helped it to stage a rapid recovery in 2010 with 7.5% GDP growth, the highest rate observed since 1986. This expansion was fuelled by a robust domestic market and revitalised exports.

India's GDP per capita saw a significant structural break during the 2010–2013 period. This period marked a transition from rapid economic growth to a slowdown, impacting the overall economy and GDP per capita. Several factors can be counted as the culprits-

Policy Paralysis: Political issues like corruption scandals (e.g., the 2G spectrum case, and coal allocation issues) delayed economic reforms, investments, and infrastructure development.

Rupee Depreciation: The Indian Rupee depreciated during 2011–2013, largely due to capital outflow and high current account deficit (CAD) that hit its peak in 2012-2013 at 4.8% of GDP.

Global Slowdown: While India remained fast-growing, the global economic slump post-2008, especially the Eurozone crisis and a fall in exports, hurt economic performance.

In 2014, the newly-elected Modi government's 2016 Demonetisation scheme caused a shortterm economic shock, particularly in cash-dependent sectors. It caused a temporary slowdown in economic activity, but the economy largely recovered in subsequent years.

From 2014-'16, the Brazilian economy faced one of the worst recessions in history according to the Business Cycle Dating Committee of (Codace) of the Getulio Vargas Foundation. The Brazilian economic crisis lasted 11 consecutive quarters from 2014 (2nd quarter) to 2016 (4th quarter) when GDP fell by 3.5% in 2015 and 3.3% in 2016. The crisis was caused by a number of factors, including:

Investment decline: Total investment in Brazil declined by 6% on average since early 2014 owing to Petrobras (public oil producer) cutting investment by 33% in 2014 and 2015 to adjust to lower oil prices and a corruption case.

Political crisis: The economic crisis was compounded by a political crisis that resulted in the impeachment of President Dilma Rousseff. Political scandals and the "Car Wash Operation" fuelled public discontent and opposition to the government.

Commodity price shock: Falling commodity prices, particularly for iron ore, raw sugar, and oil, negatively impacted Brazil's exports and foreign capital. The IMF's commodity price index fell 29.3% between June and December 2014, with the decline continuing until January 2016.

The recession caused the unemployment rate to climb from 6.8% in September 2014 to 8.9% in 2015 and 11.8% in 2016.

India experienced a sharp structural break in 2020, owing to the pandemic. Where sectors like manufacturing, retail, transportation, and services were severely affected. The sudden contraction in economic activity, steep decline in GDP, and widespread disruptions to both formal and informal sectors represented a sharp deviation from the previous trend.

The **GDP shrank by 7.3% in 2020-2021** (India's fiscal year runs from April to March), the worst contraction in India's post-independence history. By 2021, India was on the road to recovery as restrictions gradually eased and vaccination efforts ramped up. GDP growth rebounded sharply, recording **8.7% growth in FY 2021-2022**. However, the **2020 contraction** and the subsequent recovery highlighted a major structural shift, with increasing formalisation in sectors like retail and finance, due to digitalisation.

Brazil's GDP experienced a drastic recession and a structural break in 2020 due to the pandemic. The GDP fell by 4.1% in 2020, the sharpest fall in decades. To address this, Brazil implemented a series of fiscal, monetary, and structural policies aimed at economic stabilisation, boosting demand, and supporting key sectors. Hence, a solid recovery in 2021 was followed by slower, yet positive, growth in 2022 and 2023. However, structural challenges like inflation, fiscal policy constraints, and global economic conditions continued to be pain points.

Coming to the forecasts above, we predict, that by 2025 India will be a 3.7 Trillion USD economy and by 2028, India will be at the doorstep of a 4 Trillion dollar economy.

```
> arimafore
     Point Forecast        Lo 80        Hi 80        Lo 95        Hi 95
2024   3.662309e+12 3.440783e+12 3.883834e+12 3.323514e+12 4.001103e+12
2025   3.757299e+12 3.402926e+12 4.111672e+12 3.215332e+12 4.299266e+12
2026   3.819273e+12 3.309899e+12 4.328647e+12 3.040253e+12 4.598294e+12
2027   3.867102e+12 3.215162e+12 4.519042e+12 2.870045e+12 4.864158e+12
2028   3.900144e+12 3.109359e+12 4.690930e+12 2.690743e+12 5.109546e+12
```

Compared to India Brazil will reach 2.4 Trillion USD by 2025 and will cross over 2.7 Trillion dollars by 2028.

```
Forecasts:
     Point Forecast        Lo 80        Hi 80        Lo 95        Hi 95
2024   2.286479e+12 1.907978e+12 2.664979e+12 1.707612e+12 2.865346e+12
2025   2.399299e+12 1.857958e+12 2.940639e+12 1.571390e+12 3.227208e+12
2026   2.512119e+12 1.841644e+12 3.182593e+12 1.486716e+12 3.537521e+12
2027   2.624938e+12 1.842079e+12 3.407797e+12 1.427659e+12 3.822218e+12
2028   2.737758e+12 1.852777e+12 3.622740e+12 1.384296e+12 4.091221e+12
```

By 2025, India's GDP per capita would reach $2658 compared to Brazil's $10811.17, over 4 times that of India. By 2028, India would exhibit almost $3000 GDP per capita whereas Brazil would be closing in on a $12000 GDP per capita.

India

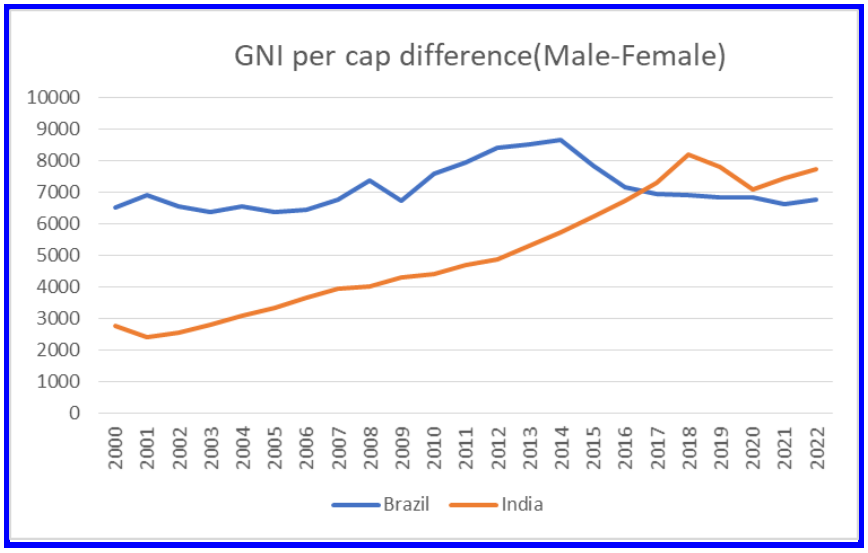
```
> arimafore = forecast(india.Arima.gdppc, h=5)
> arimafore
     Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
2024       2567.402 2435.365 2699.439 2365.469 2769.335
2025       2658.164 2491.364 2824.964 2403.065 2913.262
2026       2747.054 2547.911 2946.197 2442.492 3051.617
2027       2836.372 2610.197 3062.547 2490.467 3182.277
2028       2925.592 2675.134 3176.050 2542.549 3308.634
```

Brazil

```
Forecasts:
     Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
2024       10427.37 8530.035 12324.70 7525.649 13329.08
2025       10811.17 8057.946 13564.40 6600.477 15021.86
2026       11194.98 7736.500 14653.45 5905.693 16484.26
2027       11578.78 7484.702 15672.86 5317.428 17840.13
2028       11962.58 7272.095 16653.08 4789.099 19136.07
```

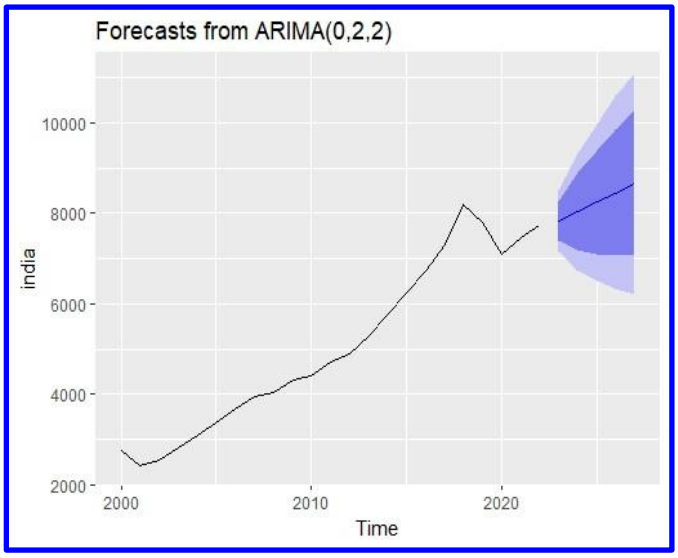
Gross National Income Per Capita (GNIPC):

We have plotted this as the difference between male GNI and female GNI.



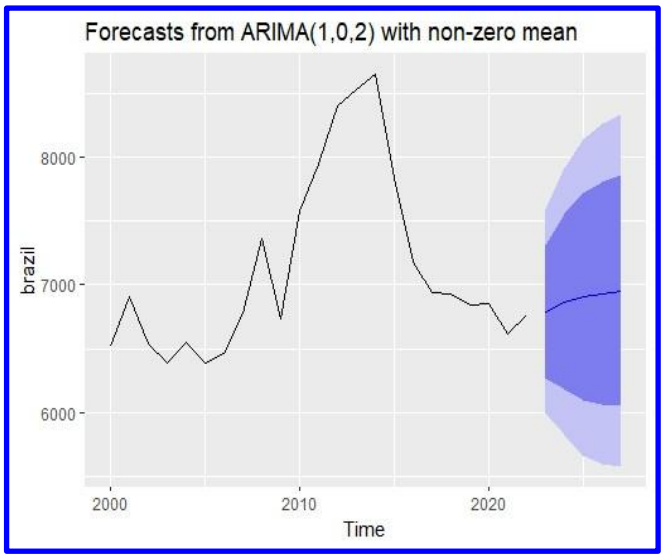
Time Series Analysis of Gross National Income per Capita (Male-Female)

India




```
Series: india
ARIMA(0,2,2)

Coefficients:
          ma1      ma2
      -0.3500  -0.6500
s.e.   0.3092   0.2862

sigma^2 = 108337:  log likelihood = -151.81
AIC=309.62   AICc=311.03   BIC=312.75
```

Brazil




```
Series: brazil
ARIMA(1,0,2) with non-zero mean

Coefficients:
         ar1     ma1     ma2       mean
      0.7367  0.1261  0.2015  7008.8095
s.e.  0.1626  0.2754  0.2322   347.0558

sigma^2 = 164078:  log likelihood = -169.15
AIC=348.31   AICc=351.84   BIC=353.99
```

The widening GNIPC gap between men and women in India since 2000 can be attributed to several social, economic, and policy-related factors:

Labour Market Inequality: Women face lower wages and fewer formal employment opportunities, especially in sectors with high earning potential.

Educational and Skill Gaps: Gender disparities in education and vocational training limit women's access to higher-paying jobs.

Cultural and Social Barriers: Traditional gender roles often prioritise men in economic roles, constraining women's labour force participation.

For Brazil, we find the difference steadily rising till 2015, after which we see a decline.

The widening gap in Gross National Income between men and women in Brazil is primarily driven by factors like:

Occupational segregation: Women are often concentrated in lower-paying sectors like service industries, clerical work, and domestic labour, while men dominate higher-paying fields like engineering, finance, and management.

Gender pay gap: Women face significant pay disparities compared to men even in the same occupation due to systemic discrimination and unequal negotiation power. In countries like India and Brazil, women often bear the bulk of childcare and household responsibilities, limiting their full-time work and career advancement opportunities. This results in lower labour force participation and earning potential.

However, the 2015-2016 economic recession unexpectedly reduced income inequality and narrowed the gender pay gap, as lower-wage workers comprised a larger share of the workforce.

Coming to the forecasts, our model predicts GNIPC for India to increase to 8653.545 by 2027. For Brazil, GNIPC will remain largely unchanged in the next five years.

India

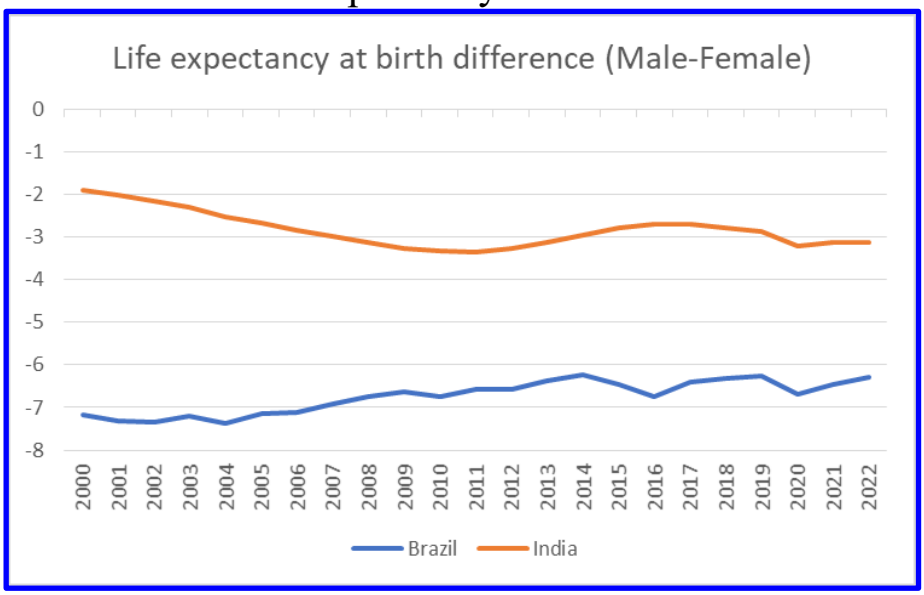
	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2023	7829.399	7398.426	8260.372	7170.282	8488.515
2024	8035.435	7188.572	8882.298	6740.270	9330.600
2025	8241.472	7105.193	9377.751	6503.683	9979.261
2026	8447.509	7066.350	9828.667	6335.208	10559.809
2027	8653.545	7051.489	10255.601	6203.412	11103.679

Brazil

```
> arimafore
     Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
2023       6792.353 6273.241 7311.465 5998.439 7586.267
2024       6868.064 6182.424 7553.704 5819.468 7916.660
2025       6905.118 6093.358 7716.877 5663.639 8146.597
2026       6932.417 6059.802 7805.032 5597.868 8266.966
2027       6952.529 6048.597 7856.460 5570.085 8334.973
```

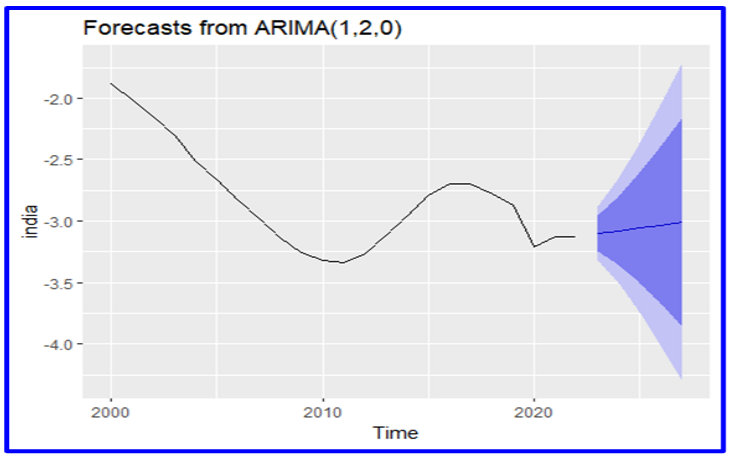
,

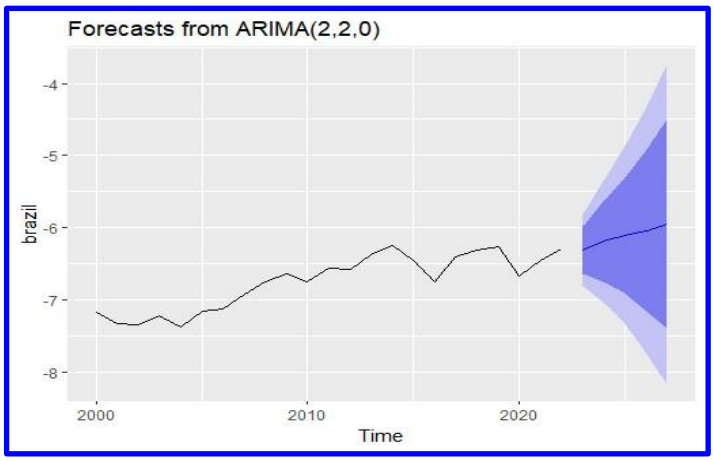
Life Expectancy Difference



Time Series Analysis of Life Expectancy difference between male and female

India **Brazil**






```
> summary(india.Arima.1ebd)
Series: india
ARIMA(1,2,0)

Coefficients:
          ar1
      -0.3507
s.e.   0.1994

sigma^2 = 0.01273:  log likelihood = 16.47
AIC=-28.94   AICc=-28.27   BIC=-26.85
```

```
Coefficients:
          ar1      ar2
      -0.6573  -0.3328
s.e.   0.2115   0.2299

sigma^2 = 0.06567:  log likelihood = -0.41
AIC=6.82   AICc=8.23   BIC=9.96
```

From the graph, we can infer that women's life expectancy is higher than that of men in India. As the 2022 statistic shows, women live on average close to 3 years longer than men. This has increased from 2 years in 2000. Thus, the difference between life expectancy at birth has risen, with women expected to live longer than men.

There was a structural break in the difference between male and female life expectancy at birth in India around 2013. During the early 2000s, female life expectancy gradually increased relative to male life expectancy, following trends in healthcare improvements and reductions in maternal mortality. This led to a growing gender gap in life expectancy, peaking around 3.5 years in 2013. This structural break can be attributed to several factors:

Improvements in Maternal and Reproductive Health: Increased investment in maternal health led to a significant reduction in female mortality from childbirth-related complications. The shift was particularly evident in states with high maternal mortality and contributed to increased longevity for women.

Higher Mortality Among Older Men: Male mortality remained high, especially in older age groups, largely due to lifestyle-related diseases and limited healthcare access for chronic illnesses. This disparity contributed to the widening gap until about 2013, after which the gap stabilized.

Since 2013, the difference in life expectancy between men and women has remained stable, indicating a structural shift rather than a continued trend. This stabilization suggests that

although women continue to outlive men on average, further gains in life expectancy are now balanced across genders due to more uniform health improvements.

As we can see, in Brazil the life expectancy at birth is higher for women than men. A study in Campinas, Brazil found that women aged 60 live an average of four more years in good health than men. Although the gender gap had decreased to 7.6 years in 2010, mainly due to the reduction in homicide rates among men, the mortality differences between sexes are still excessive. Research on gender health disparities shows that women's longer life expectancy is often offset by a higher burden of disability, mobility issues, and physical decline. Key reasons for the gender gap in life expectancy in Brazil:

Biological factors: Oestrogen, a female hormone, is believed to have protective effects against cardiovascular diseases, which are a leading cause of death in men.

Health behaviours: Women are more likely to practice preventative healthcare, such as regular check-ups and screenings, and tend to have healthier dietary habits and lower rates of smoking compared to men.

India's inequality steadily declines first to -3.05 in 2025 and then to -3.008 in 2027. Brazil's life expectancy inequality also declines from -6.04 in 2025 to -5.95 in 2027.

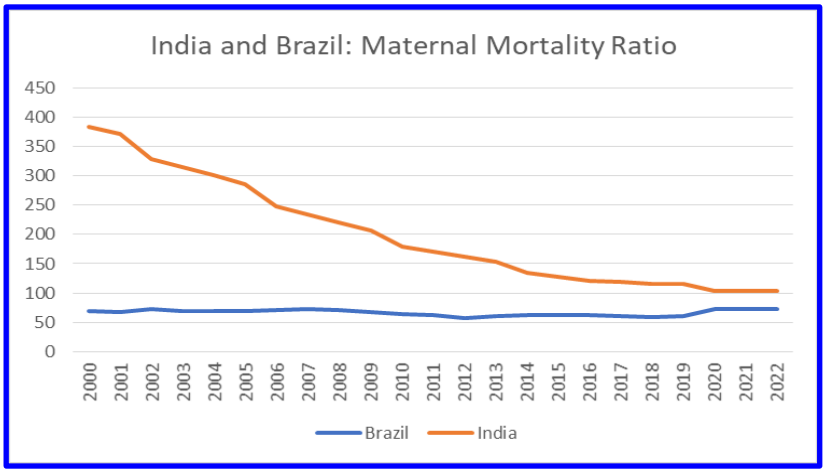
India

```
> arimafore
     Point Forecast     Lo 80     Hi 80     Lo 95     Hi 95
2023      -3.097348 -3.241945 -2.952751 -3.318490 -2.876206
2024      -3.077042 -3.355940 -2.798145 -3.503580 -2.650505
2025      -3.053459 -3.501114 -2.605805 -3.738088 -2.368831
2026      -3.031025 -3.669743 -2.392308 -4.007859 -2.054191
2027      -3.008188 -3.859759 -2.156618 -4.310553 -1.705824
```

Brazil

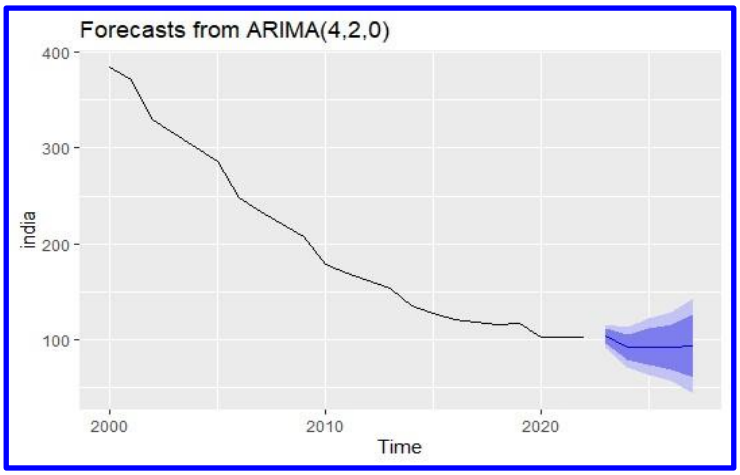
```
> arimafore
     Point Forecast     Lo 80     Hi 80     Lo 95     Hi 95
2023      -6.311730 -6.640153 -5.983307 -6.814010 -5.809451
2024      -6.192179 -6.742005 -5.642353 -7.033066 -5.351293
2025      -6.105429 -6.909060 -5.301798 -7.334476 -4.876381
2026      -6.040811 -7.161890 -4.919732 -7.755354 -4.326268
2027      -5.950728 -7.409404 -4.492052 -8.181580 -3.719875
```

Maternal Mortality Ratio



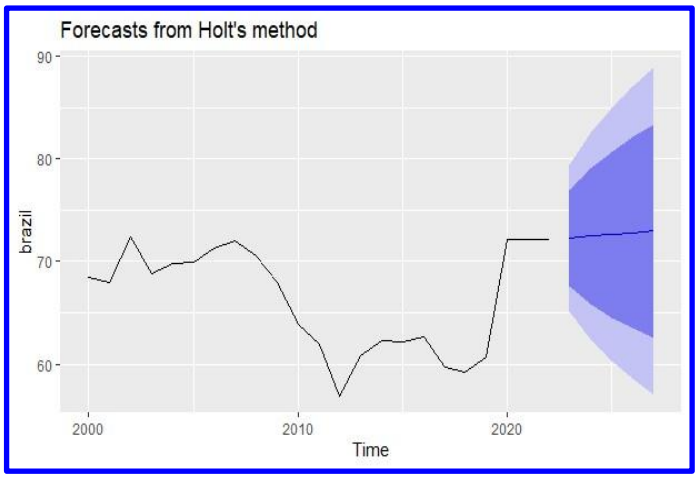
Time Series Analysis of Maternal Mortality Ratio

India




```
Series: india
ARIMA(4,2,0)

Coefficients:
          ar1      ar2      ar3     ar4
      -0.5562  -0.5036  -0.4712  0.4306
s.e.   0.2042   0.2051   0.2132  0.2037

sigma^2 = 36.47:  log likelihood = -68.14
AIC=146.29   AICc=150.29   BIC=151.51
```

Brazil




```
Forecast method: Holt's method

Model Information:
Holt's method

Call:
holt(y = brazil, h = 5)

  Smoothing parameters:
    alpha = 0.9999
    beta  = 1e-04

  Initial states:
    l = 69.1544
    b = 0.1613

  sigma:   3.6352

     AIC     AICc      BIC
137.0932 140.6226 142.7707
```

India has seen a remarkable decline in its maternal mortality ratio (MMR) from 2000 onwards. Around the year 2002, there was a fall in the MMR due to initiatives such as the National Population Policy and Janani Suraksha Yojana. The decline was even sharper around 20072008, with expanded access to rural healthcare, the help of ASHA workers and an increase in skilled birth attendance. In 2013, there was another fall in the ratio due to Janani Shishu
Suraksha Karyakram, which provided free healthcare services for pregnant women and infants, including transportation, medications, and surgical procedures. In the most recent period (2014-22), the MMR has seen a steady decline due to expanded focus on immunizations, free antenatal care, and improved SDGs committed to decreasing the MMR, creating the required policy momentum. Along with this, improved health infrastructure and health workers helped bring down the ratio.

The maternal mortality ratio in Brazil declined until 2011-2012, ignoring a few slight increases. However, since then, the ratio has increased, except for a few exceptions. Since 2020, the ratio has remained relatively stable. Government initiatives promoted regular prenatal checkups, and the expansion of public health services, including more available hospital beds and qualified medical professionals, particularly in poorer regions, helped to decrease the trend. Policies such as the Bolsa Família program provided financial assistance to families leading to increased healthcare utilization among pregnant women. Focus on family planning helped women to better manage their pregnancies and reduce unwanted complications. However, disparities remain between the north and northeast regions compared to the south and southeast, as well as racial inequalities.

The MMR for India is expected to decline to around 37.74 by 2026 and to 33.86 by 2027. For Brazil, MMR continues to mildly fluctuate around 72 for the next 5 years.

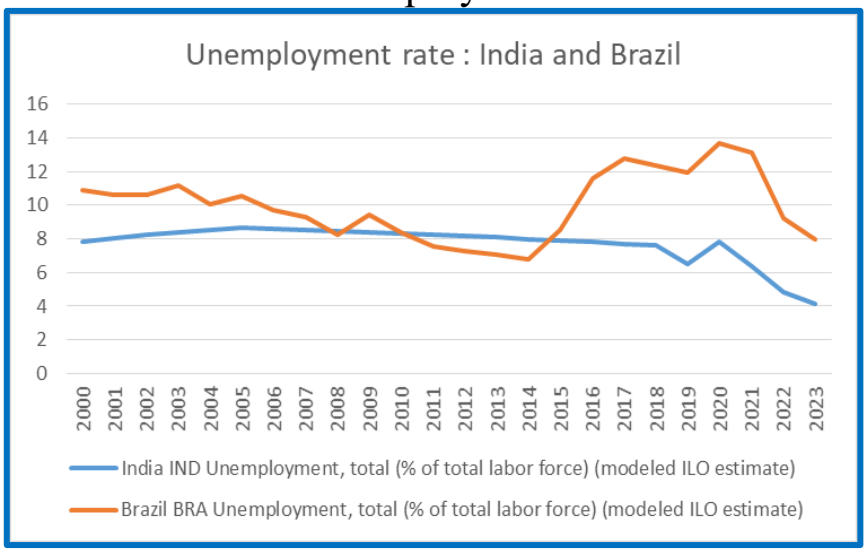
India

```
> arimafore
     Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
2023       41.63745 39.94776 43.32715 39.05328 44.22162
2024       39.69291 37.30332 42.08250 36.03834 43.34748
2025       37.74836 34.82172 40.67501 33.27245 42.22428
2026       35.80382 32.42442 39.18321 30.63548 40.97216
2027       33.85927 30.08099 37.63755 28.08089 39.63765
```

Brazil

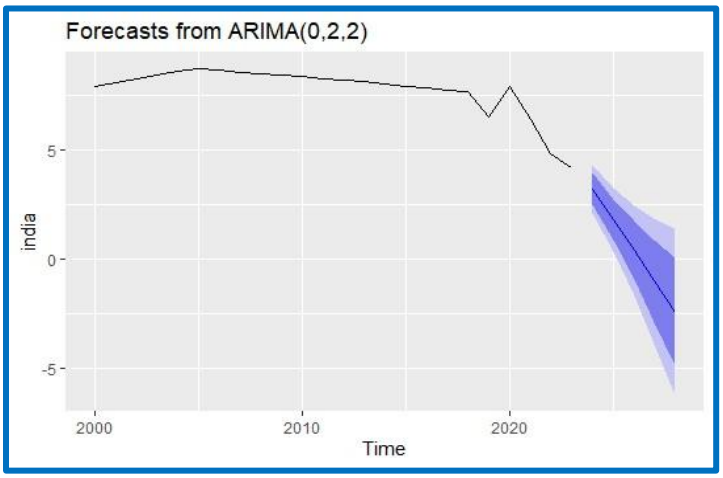
```
Forecasts:
     Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
2023       72.30874 67.64999 76.96749 65.18379 79.43369
2024       72.46993 65.88146 79.05840 62.39373 82.54612
2025       72.63112 64.56165 80.70058 60.28994 84.97230
2026       72.79230 63.47410 82.11051 58.54134 87.04327
2027       72.95349 62.53496 83.37203 57.01972 88.88727
```

Unemployment



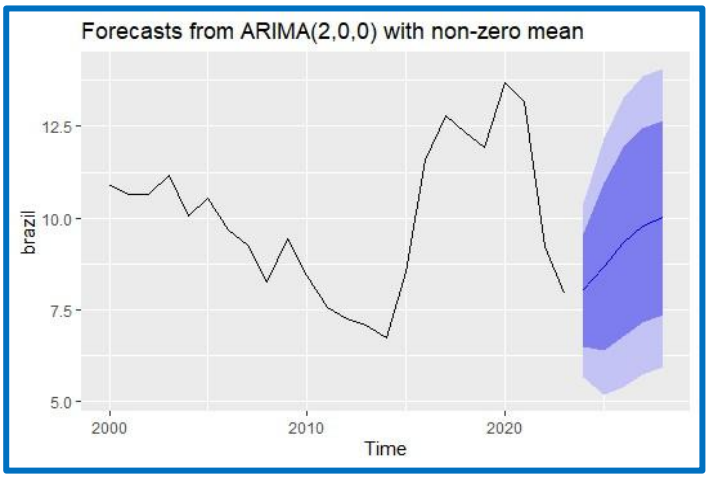
Time Series Analysis of Unemployment

India




```
Series: india
ARIMA(0,2,2)

Coefficients:
          ma1      ma2
      -1.1759   0.6477
s.e.   0.2437   0.2547

sigma^2 = 0.3277:  log likelihood = -18.79
AIC=43.59   AICc=44.92   BIC=46.86
```

Brazil




```
Series: brazil
ARIMA(2,0,0) with non-zero mean

Coefficients:
         ar1      ar2    mean
      1.0937  -0.4224  9.8712
s.e.  0.1821   0.1793  0.6799

sigma^2 = 1.45:  log likelihood = -37.56
AIC=83.12   AICc=85.22   BIC=87.83
```

In India there was a decline in the unemployment rate around 2005-2006 because of **Rapid Economic Growth** driven by a boom in information technology (IT) and service sectors, creating jobs for skilled workers and **Rural Employment Schemes**: Introduction of the **National Rural Employment Guarantee Act (NREGA, 2005)**, which provided minimum wage jobs to rural households, reducing rural unemployment.
We find an Increase in unemployment starting around 2008, due to the **subprime crisis (2008)** which led to job losses in export-driven sectors like textiles and manufacturing as global demand fell.

By 2018, India suffered from economic stagnation due to falling investment, reduced consumer demand, and stagnation in the manufacturing sector. Many workers in informal sectors faced employment volatility, and the workforce's lack of social security made it vulnerable to economic shocks.

Lockdowns of 2020 led to large-scale job losses, especially in the informal sector, hospitality, retail, and other service-based industries. The migration of workers back to rural areas exacerbated rural unemployment.

India's Post-Pandemic Recovery shows reopening of sectors like retail, hospitality, and travel created employment opportunities, especially in urban areas. Growth in e-commerce, fintech, and digital services has created new job avenues, particularly for young, tech-savvy workers.

Unemployment in Brazil declined until 2014, despite a few slight increases. However, since then, it has been on the rise, with a few exceptions. After 2020, the rate has started to decline

again. Unemployment in Brazil decreased until 2014 due to a combination of factors, including **Real minimum wage increases** and an increase in the supply of skilled labour.

After 2014, Brazil's economy entered a recession, which led to a rise in unemployment and informality. The 2014 Brazilian recession had a significant impact on unemployment, with the unemployment rate rising from 6.8% in 2014 to 12.0% in 2016: The Brazilian economy lost over 1.5 million jobs in 2015, and an estimated 2.8 million private-sector jobs were cut over the two years. The job market worsened most for young people, with the unemployment rate for people aged 14–17 years at 44.5% in the first quarter of 2019. The trend reversed for the better after 2020, with unemployment rates declining.

This decline can be attributed to a combination of factors including economic recovery following the COVID-19 pandemic, increased hiring in sectors like construction and retail, government social programs, a gradual return to pre-pandemic activity levels, and a decrease in labour force participation rate.

By 2026, India's unemployment rate is expected to be 0.36%; by 2028, the rate is projected to be -2.45%. Furthermore, for Brazil, the rates are 9.34% and -2.45% respectively. A negative unemployment rate occurs when an economy is producing more than its efficient level and is in the expansion phase of a business cycle.

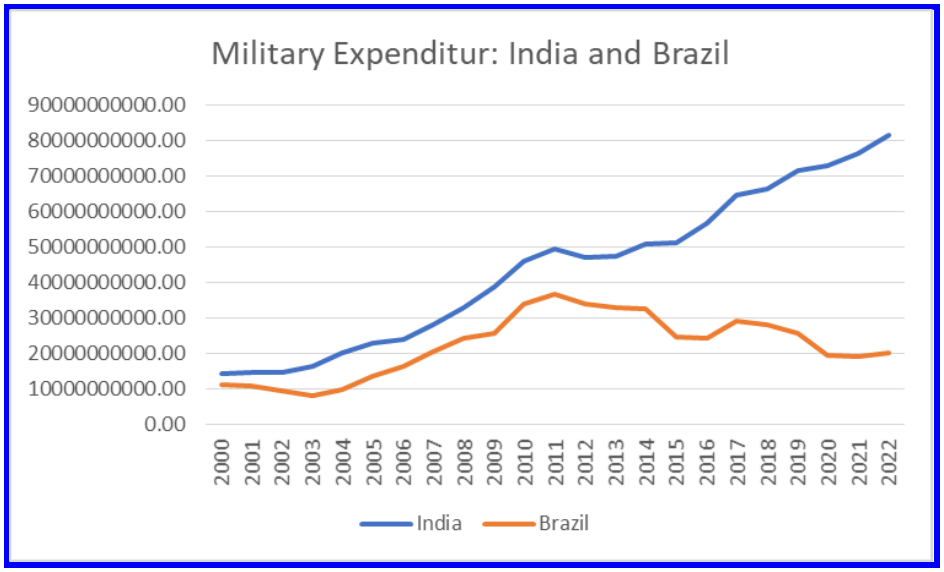
India

```
> arimafore
     Point Forecast      Lo 80      Hi 80      Lo 95    Hi 95
2024      3.1812622  2.4476809 3.91484345  2.0593465 4.303178
2025      1.7729618  0.8223713 2.72355219  0.3191592 3.226764
2026      0.3646613 -0.9797330 1.70905565 -1.6914124 2.420735
2027     -1.0436391 -2.9115420 0.82426374 -3.9003500 1.813072
2028     -2.4519395 -4.9395518 0.03567271 -6.2564142 1.352535
> autoplot(arimafore)
```

Brazil

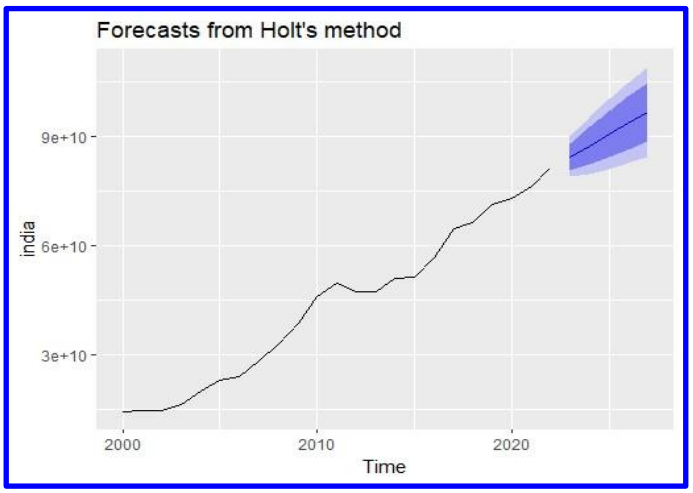
```
> arimafore
     Point Forecast    Lo 80     Hi 80    Lo 95    Hi 95
2024       8.040357 6.496941  9.583774 5.679905 10.40081
2025       8.680290 6.392988 10.967592 5.182164 12.17842
2026       9.342037 6.761684 11.922389 5.395727 13.28835
2027       9.795494 7.147826 12.443162 5.746235 13.84475
2028      10.011926 7.360326 12.663525 5.956655 14.06720
```

Military Expenditure



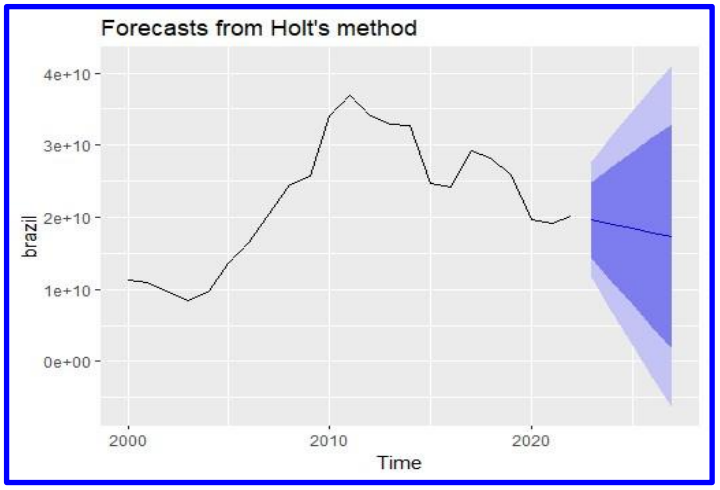
Time Series Analysis of Military Expenditure

India




```
Call:
holt(y = india, h = 5)

  Smoothing parameters:
    alpha = 0.9999
    beta  = 1e-04

  Initial states:
    l = 7990158801.7108
    b = 3065018036.3447

  sigma:  2827336693

     AIC     AICc      BIC
1078.802 1082.331 1084.479
```

Brazil




```
  Smoothing parameters:
    alpha = 0.9999
    beta  = 0.1519

  Initial states:
    l = 5379965609.0355
    b = 1850618603.2938

  sigma:  4116618186

     AIC     AICc      BIC
1096.084 1099.613 1101.761
```

During the period 2000-2020, Indian military expenditure increased steadily. This increase was likely driven by escalating regional tensions, the need to upgrade military doctrine and capabilities in response to conflicts in the Gulf, Afghanistan, and Pakistan, and the completion of India's nuclear doctrine in 2003. India faced heightened tensions with Pakistan (e.g. in 20012002, 2016 and, 2019), as well as increased security concerns along the border with China, leading to significant budgetary reallocations or increases in defence spending. Sustained economic growth allowed India to allocate more funds to defence, initiating extensive modernization programs for the army, navy and air force. Additionally, the Indian government's "Make in India" program, launched in 2014, has further impacted defence spending by promoting self-reliance in defence production.

Brazil's military expenditure increased until 2011, driven by modernization efforts, regional power ambitions, counter-drug operations, and internal security concerns, including potential internal threats, leading to a focus on acquiring advanced weaponry and improving military capabilities. Brazil’s military and power ambitions to dominate in South America required investment in advanced technology to maintain dominance over neighbouring countries. The growing influence of cartels in the regional borders spurred the need for military improvements to combat drug trafficking operations. While Brazil experienced economic growth during this period, the increased military spending was still subject to budgetary constraints.

After 2011, Brazil's military expenditure declined (except for the years 2015-16). This is attributable to the country's economic struggles, including a recession before the COVID-19 pandemic, which forced the government to prioritise funding towards healthcare and other essential services and slash defence spending. Moreover, unlike others, Brazil faces no major external security threats, allowing for a reduction in military spending.

By 2025, India is expected to have a military expenditure of 90.6 USD; by 2027, the number is projected to be 96.7 USD. Furthermore, for Brazil, the numbers are 18.5 and 17.3 USD respectively.

India

Forecasts:

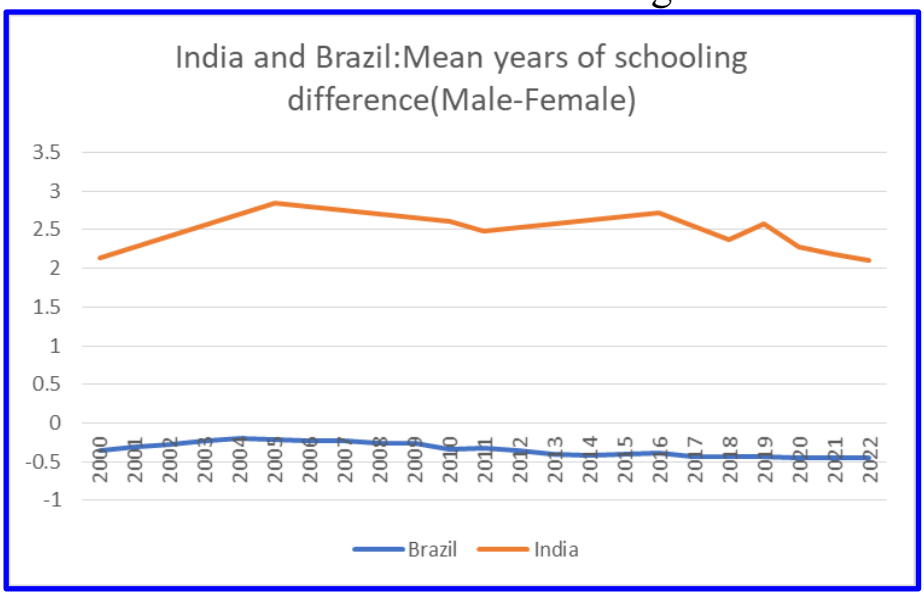
	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2023	84428299358	80804921592	88051677123	78886821267	89969777448
2024	87493605429	82369375457	92617835401	79656771966	95330438892
2025	90558911500	84282827898	96834995102	80960469928	100157353072
2026	93624217571	86376918460	100871516682	82540430055	104708005087
2027	96689523643	88586432247	104792615038	84296914773	109082132512

Brazil

Forecasts:

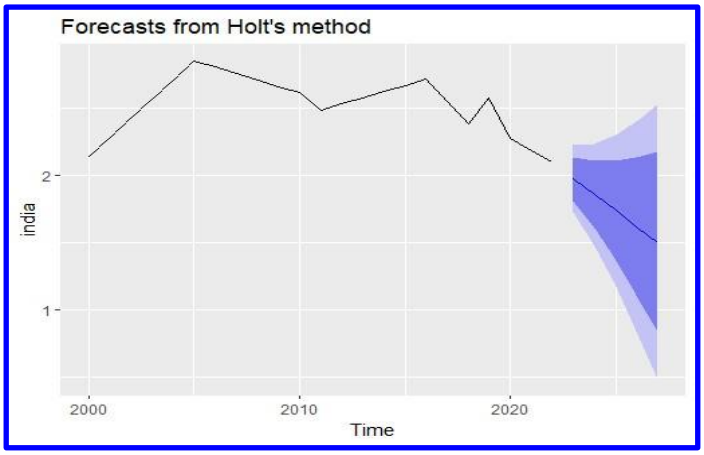
	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2023	19630430900	14354772419	24906089381	11562007517	27698854283
2024	19050263497	11003280905	27097246089	6743465636	31357061357
2025	18470096093	7884569977	29055622209	2280930942	34659261245
2026	17889928690	4812673542	30967183838	-2110007165	37889864545
2027	17309761287	1723826191	32895696382	-6526869461	41146392034

Mean Years of Schooling:



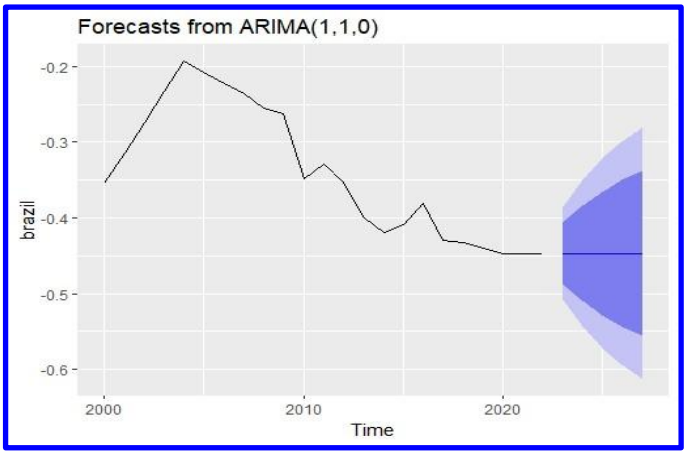
Time Series Analysis of Mean Years of Schooling

India




```
Model Information:
Holt's method

Call:
holt(y = india, h = 5, damped = F)

  Smoothing parameters:
    alpha = 0.6602
    beta  = 0.5

  Initial states:
    l = 1.9787
    b = 0.1537

  sigma:  0.1274

      AIC      AICc       BIC
-17.06496 -13.53555 -11.38749
```

Brazil




```
Series: brazil
ARIMA(1,1,0)

Coefficients:
         ar1
      0.2213
s.e.  0.2105

sigma^2 = 0.000982:  log likelihood = 45.45
AIC=-86.91   AICc=-86.28   BIC=-84.73
```

Since 2000, the gender gap in mean years of schooling in India has narrowed, with female educational attainment increasing significantly. However, a gap of approximately two years persists, with men averaging 7.6 years of schooling compared to women's 5.6 years in 2022. This can be attributed to a combination of policy initiatives, social changes, and economic factors:

Government Initiatives for Girls' Education: Government initiatives like the 2015 Beti Bachao, Beti Padhao campaign have significantly increased awareness and opportunities for girls, particularly in rural and disadvantaged areas, by reducing dropout rates and promoting school attendance through financial incentives and infrastructure improvements.

Expansion of School Infrastructure: Investments in school infrastructure and the Sarva Shiksha Abhiyan improved access to primary education, especially in rural areas, by reducing travel distances and addressing cultural and safety barriers that disproportionately affected girls.

Shift in Social Attitudes: A gradual shift in societal attitudes has led more Indian families to recognize the economic benefits of educating their daughters, contributing to greater investment in girls' education.

In Brazil, women have had higher mean years of schooling than men since the 2000s due to significant educational access and opportunities for females, where they have been actively

pursuing higher education at a faster rate than men. Causes can be social changes and policies promoting gender equality in education, particularly after women gained the right to vote in 1932. This has closed the gender gap in education, with women now surpassing men in educational attainment, even though the traditional Brazilian society favoured male education and limited women's access to higher learning.

The 20th century saw international conferences, like the IV Conference on Women (1995), advocating for improved female access to education. Public policies like the School Scholarship Scheme and efforts toward universal basic education also benefited women. The feminist movement, pushing for women's rights, was a significant factor in women gaining better access to education. Over time, women increasingly challenged cultural norms, enabling them to pursue higher education. While men's education also improved, they lagged behind women, especially in younger cohorts, due to greater age/grade lags and higher dropout rates, reducing their average years of schooling. By the end of the 20th century, Brazilian women had surpassed men in terms of average years of schooling at all levels of education, particularly in higher education.

The gendered difference in mean years of schooling for India is projected to reach 1.74 (approximately) in 2025 and fall further to 1.5 by 2027. For Brazil, the forecast remains stable at around 0.45.

India

Forecasts:

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2023	1.970511	1.8072685	2.133754	1.7208530	2.220170
2024	1.853048	1.6030161	2.103081	1.4706570	2.235440
2025	1.735586	1.3668565	2.104315	1.1716631	2.299508
2026	1.618123	1.1079202	2.128325	0.8378353	2.398410
2027	1.500660	0.8306779	2.170642	0.4760109	2.525309

Brazil

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2023	-0.4465223	-0.4866828	-0.4063617	-0.5079425	-0.3851020
2024	-0.4465223	-0.5099155	-0.3831290	-0.5434739	-0.3495707
2025	-0.4465223	-0.5278943	-0.3651503	-0.5709700	-0.3220745
2026	-0.4465223	-0.5427965	-0.3502481	-0.5937609	-0.2992836
2027	-0.4465223	-0.5557283	-0.3373162	-0.6135385	-0.2795060

CONCLUSION

Brazil and India, two economic giants in their rights, have had distinct growth trajectories over the years. Both countries, though equally blessed with abundant natural resources and a large working population, have had their economic landscapes shaped by unique political and historical factors.

Brazil’s economy, which is propelled primarily by oil, iron ores, and agriculture, has experienced periods of growth spurts and economic setbacks due to global price fluctuations. The Indian economy, contrarily, has diversified, with a strong emphasis on services, especially information technology. This perhaps explains its resilient performance in the face of adversity. However, both countries have their unique sets of challenges. Brazil has been persistently plagued by inequality, corruption, and political instability. India’s growth, on the other hand, has failed to resolve issues such as poverty, infrastructural deficiencies, and environmental concerns.

To conclude, the two economies are contrasting but complementary. While Brazil’s resourcerich economy has abundant potential to excel, its deep-rooted structural issues must be resolved. India’s service-driven is resilient and dynamic, but it must focus on growth that is inclusive and sustainable. Addressing these challenges through policies will help them realise their full growth potential.

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APPENDIX

```
#Loading the libraries

library(forecast)
library(strucchange) library(ggplot2)
library(tseries)

#India dataset

india = scan()
india = ts(india, start = 2000)

#plotting the data and modeling

autoplot(india, ylab = "   ") tsdisplay(india)
india.ARIMA = auto.arima(india, trace = T, stepwise = F, approximation = F)
#2,1,0 and 1,1,0

#Final Model
india.Arima.gdppc = Arima(india, order=c( ,  , ), include.drift = TRUE)
summary(india.Arima.gdppc)

#holt modEl india.hlt=holt(india,h=5)
summary(india.hlt)
autoplot(india.hlt)

#Diagonastics
checkresiduals(india.ARIMA)
checkresiduals(india.hlt) #normality of
the residual
shapiro.test(india.ARIMA$residuals)
jarque.bera.test(india.ARIMA$residuals)
jarque.bera.test(india.hlt$residuals)

#hetroscedasticity of sq. residuals acf(india.ARIMA$residuals^2)
pacf(india.ARIMA$residuals^2)

#forecasting
arimafore = forecast(india.ARIMA, h=5)
arimafore autoplot(arimafore)
```

#accuracy

ts_train=window(india, start= 2000, end=2015) ts_test=window(india,
start= 2016, end=2023) ARIMA11=Arima(ts_train, order=c(, ,))
ARIMA12=Arima(ts_train, order=c(, ,))
ARIMAF1=forecast(ARIMA11, h=8)
ARIMAF2=forecast(ARIMA12, h=8)
accuracy(ARIMAF1, ts_test) accuracy(ARIMAF2,
ts_test)

#structural break
model1 = Fstats(india~1, from= 0.01) sctest(model1)
#H0 There is no structural break in a series. here there are structural change
strucchange::breakpoints(india~1)

#Bai perron test. bp.india =
breakpoints(india~1, h=3)
summary(bp.india)
coefficients(bp.india)