A Panel Data Analysis of Macroeconomic Indicators Using World Bank Data

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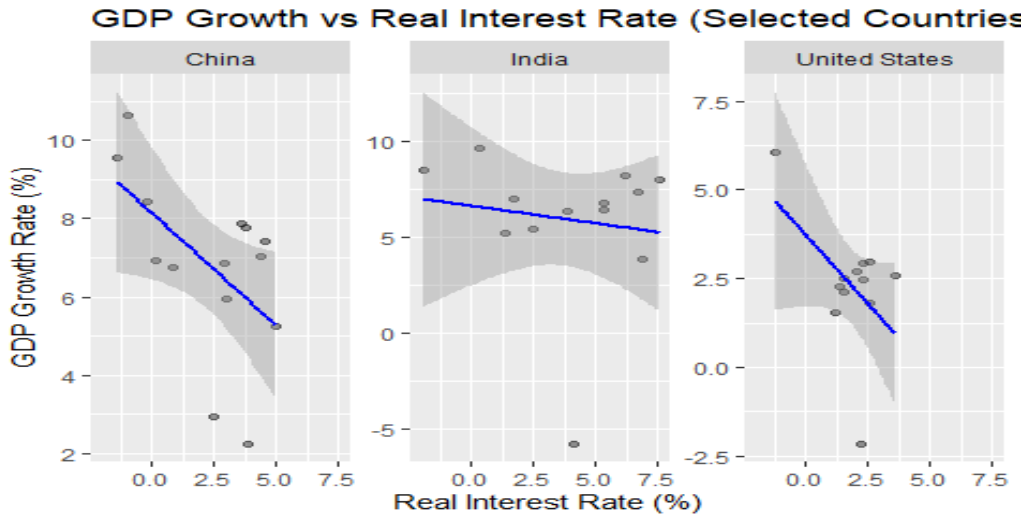
Introduction:

This document analyzes the relationship between GDP growth, inflation, real interest rate, and current account balance across countries using World Bank data.

1. Data Analysis for GDP growth vs. Real Interest Rate:

Here we will try to run fixed effects model and random effects model followed by Hausman test to choose the appropriate one. Then we'll provide a major country level visualization for India, China and the United States.

```
##  Hausman Test
## data:  gdp_growth ~ real_rate
## chisq = 2.4865, df = 1, p-value = 0.1148
## alternative hypothesis: one model is inconsistent
```



```
## GDP Growth vs Real Interest Rate
## ================================================
##                       Dependent variable:
##              ---------------------------------
##                           gdp_growth
##                  Fixed Effects     Random Effects
##                       (1)               (2)
## ------------------------------------------------
## real_rate           0.008             0.030*
##                    (0.022)           (0.017)
##
## Constant                             3.029***
##                                      (0.204)
##
## ------------------------------------------------
## Observations        1,725             1,725
## R2                  0.0001            0.002
## Adjusted R2         -0.091            0.002
## F Statistic  0.122 (df = 1; 1580)     2.944*
## ================================================
## Note:                *p<0.1; **p<0.05; ***p<0.01
```

Here we have run both random effects model and fixed effects model and then by Hausman test we finally chose RE model as p value was 0.1148. In the RE specification, the coefficient of the real interest rate was positive (≈ 0.03) but it was marginally significant (as p ≈ 0.086). This suggests a weakly statistically significant positive association between real interest rates and economic growth at the global level. The explanatory power of the model was very low, with $R^2 \approx 0.002$, implying that real interest rate alone explains very little of the total variation in GDP growth across countries.

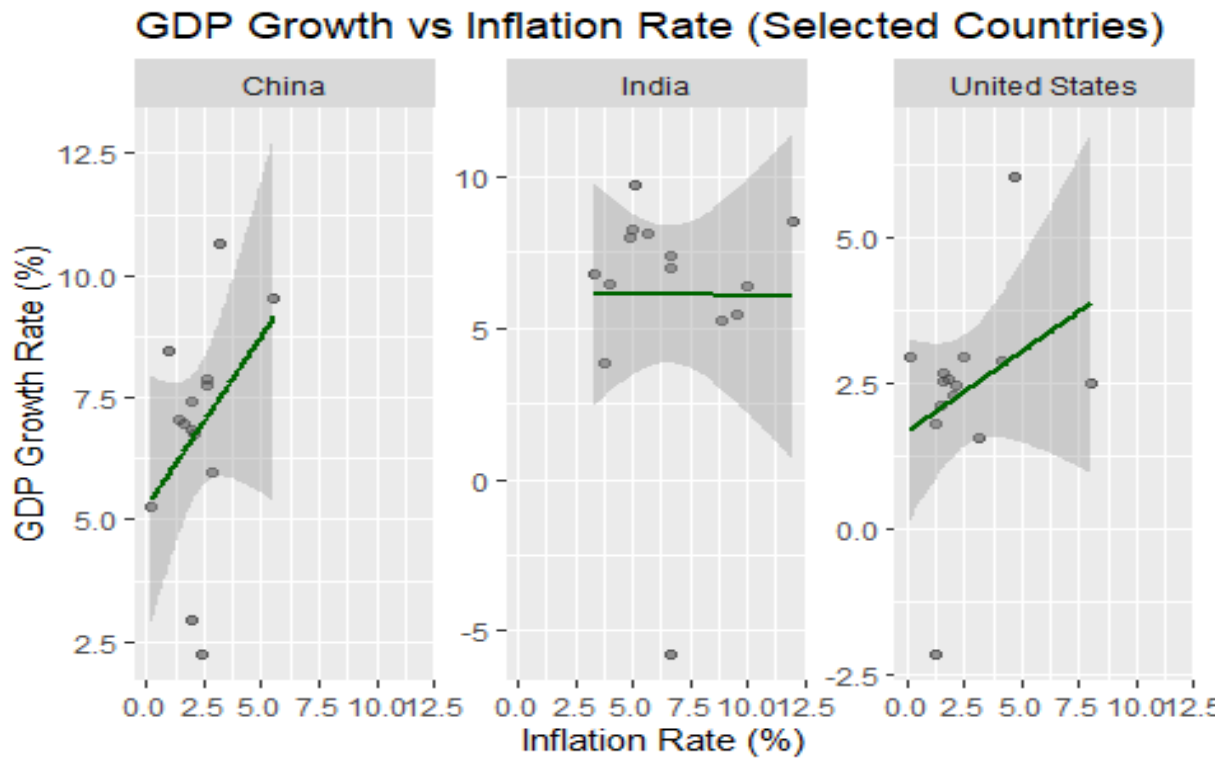
The country level visualizations provided us further meaningful insights. For China and the United States we have seen slightly negative relationships, which is consistent with the theoretical underpinning that as real interest rate rises, the investment level goes down thereby reducing the growth. India, however, showed no clear pattern, indicating a possible domination of structural and/or policy factors. The slope is nearly flat (or very slightly negative) with high confidence intervals; which means high dispersion in GDP growth across similar real rates of interest. Hence, this analysis reveals that while real interest rates might have very little influence on GDP growth in some economies, the effect is neither uniform nor strong enough to draw generalized conclusions across the economies.

2. Data Analysis for GDP growth vs. Inflation:

Here we will again try to run fixed effects model and random effects model followed by Hausman test to choose the appropriate one. Then we'll provide a major country level visualization for India, China and the United States.

```
##  Hausman Test
## data:  gdp_growth ~ inflation
## chisq = 0.085756, df = 1, p-value = 0.7696
## alternative hypothesis: one model is inconsistent

##
## GDP Growth vs Inflation
## ================================================
##                         Dependent variable:
##              ---------------------------------
##                              gdp_growth
##                    Fixed Effects       Random Effects
##                         (1)                 (2)
## ------------------------------------------------
## inflation           -0.032***           -0.031***
##                      (0.008)             (0.007)
##
## Constant                                 3.191***
##                                          (0.170)
##
## ------------------------------------------------
## Observations          2,545               2,545
## R2                    0.007               0.007
## Adjusted R2           -0.074              0.006
## F Statistic  16.218*** (df = 1; 2353)   18.079***
## ================================================
## Note:                     *p<0.1; **p<0.05; ***p<0.01
```



Here too the Hausman test result impedes us to use the random effects model as p-value = 0.7696. We see here that there is a statistically significant negative relationship between inflation rate and GDP growth. However, the effect size is small with the coefficient for inflation being -0.0306 ($p < 0.001$), and the model explaining about 0.68% variation in the growth rates. The finding is consistent with macroeconomic theory implying rising inflation rates can have contractionary effects on GDP growth. However, we clearly see that $R^2 \approx 0.7\%$, implying a very low explanatory power of this model and indicating that inflation plays only a modest role in determining cross-country growth variations.

From the diagrammatic exposition it is clear that China and US show positive relationship between inflation and GDP growth, which is contradictory to our panel regression results and also standard macroeconomic theory. This may be due to the two countries' growth driven policies or the type of inflation being most probably demand pull rather than cost push. For India, the line is nearly flat implying the presence of structural factors or other policy regimes may be very dominant thereby blurring the usual inflation-growth relationship.

3. Cointegration between Real Interest Rate and Inflation:

Here we'll try to see the long run cointegrating association between real interest rate and inflation rate. If a cointegrating relationship exists, it suggests that despite short-term deviations, the two variables move together in the long run.

```
##  Augmented Dickey-Fuller Test
## data:  residuals_coint
## Dickey-Fuller = -16.968, Lag order = 11, p-value = 0.01
## alternative hypothesis: stationary

##  Augmented Dickey-Fuller Test
## data:  resid_india
## Dickey-Fuller = -3.1025, Lag order = 2, p-value = 0.1524
## alternative hypothesis: stationary
```

In the global (panel) level the inflation rate and the interest rate exhibit a cointegrated long term relationship assuring underlying macroeconomic theory (e.g. Fisher effect). However, this relationship breaks down when it comes to India. It may be due to the structural shifts, monetary interventions and policy oriented idiosyncrasies.

4. Effect of Inflation on Current Account Balance:

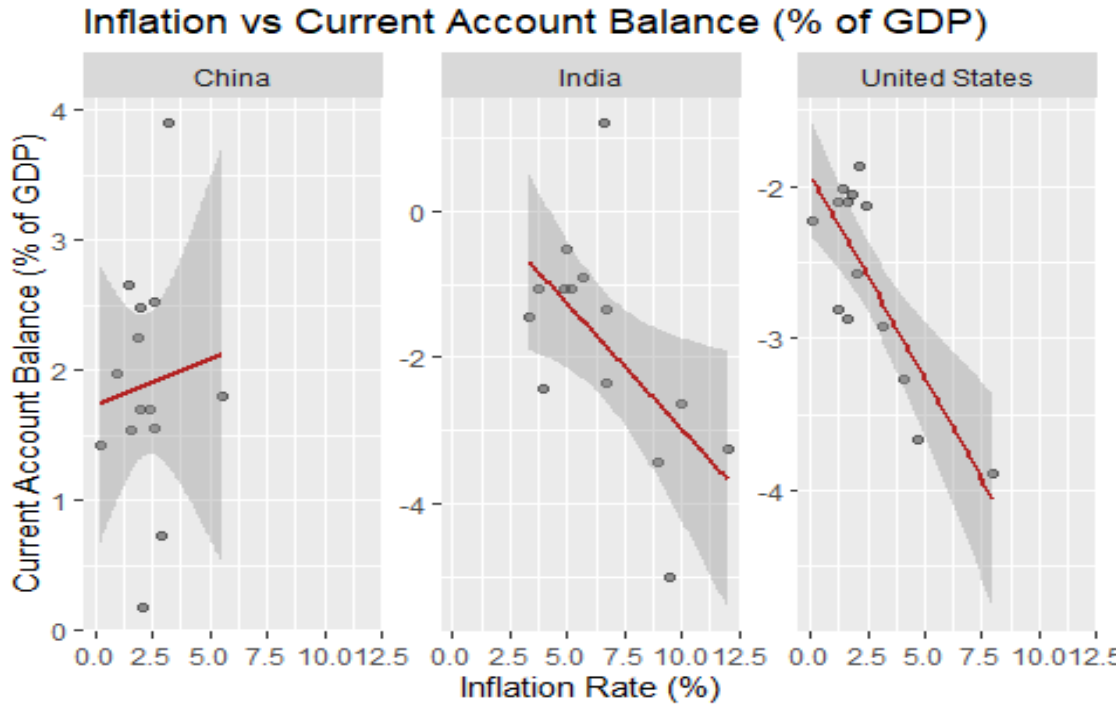
Here we will similarly try to run fixed effects model and random effects model followed by Hausman test to choose the appropriate one. Then we'll provide a major country level visualization for India, China and the United States.

```


##  Hausman Test
## data:  current_account ~ inflation
```

```
## chisq = 5.0965, df = 1, p-value = 0.02397
## alternative hypothesis: one model is inconsistent

##
## Effect of Inflation on Current Account Balance
## ================================================
##                       Dependent variable:
##               ---------------------------------
##                         current_account
##                   Fixed Effects     Random Effects
##                        (1)               (2)
## ------------------------------------------------
## inflation            0.019             0.015
##                     (0.012)           (0.011)
##
## Constant                              -2.853***
##                                        (0.740)
##
## ------------------------------------------------
## Observations         2,425             2,425
## R2                   0.001             0.001
## Adjusted R2          -0.082            0.001
## F Statistic  2.697 (df = 1; 2237)      1.771
## ================================================
## Note:                 *p<0.1; **p<0.05; ***p<0.01
```



Here by inspecting the results of Hausman test we go for fixed effects model; but see that inflation rate and current account balance are not significantly related to each other.

It suggests that inflation is not a meaningful predictor of current account balances across countries, and other structural idiosyncrasies or policy factors likely play a more prominent role.

The graphical exposition asserts that for China the relationship between current account balance and inflation is positive with a very wide confidence interval and narrow sample range. This relationship may be spurious or driven by isolated years. For the US and India, the relationship is negative implying that a domestic inflationary scenerio may increase imports and reduce export competitiveness leading to a higher deficit. For US, this may be also due to the global dollar dynamics and NOT MERELY just due to Inflation.