*Theoretical and Applied Economics*
*Volume XXVII (2020), No. 2(623), Summer, pp. 215-224*

# Impact of exchange rate regimes on inflation: An empirical analysis of BRICS countries

**Babu RAO G.**
Dr. Abdul Haq Urdu University, Kurnool, India
baburaopcu@gmail.com

**Abstract.** *Emerging market economies (EMEs) are increasingly important drivers of global economic growth, as witnessed by the substantial increases in their share of world output during the last four decades. The choice of an exchange rate regime is a recurring issue in international macroeconomics. Recently, the currency crisis in Asia, Russia, Brazil and Argentina has increased interest in this area and the effects of exchange rate regimes become even more important in developing countries. Hence, the purpose of this study is to revisit the effects of exchange rate regimes on inflation in BRICS countries. The data used for this research covers over the period from 1970 to 2012. This study finds that BRICS countries under the Pegged exchange rate regime have lower inflation rate compare to those under the non-Pegged exchange rate regime. The analysis in this study proposes that exchange rate regimes choice and money supply influence the inflation dynamics in the BRICS countries. In addition, the empirical results attained from the analysis of inflation show that the real depreciation resulting from a nominal depreciation will be unwound in a short-time which will reduce the advantages of a flexible exchange rate regime. The analysis in this study also shows that there is a positive relationship between monetary expansion and inflation in the BRICS countries.*

**Keywords:** exchange rate regimes, inflation models, pegged and non-pegged exchange rates, price stability, macroeconomic variables, financial crisis.

**JEL Classification:** E52, F33, F43, E6, F439, G010.

## 1. Introduction

In the current competitive economic world, the exchange rate regime plays a major role to determine and improve the country's economic activities and growth performance and acts as the fundamental macroeconomic policy choice for small and developing countries.

There are debates on the exchange rate regimes which have been prevalent in many policy circles. They have infrequently been independent of the regulations of international financial markets. According to the study of Calvo and Vegh (1994), the emphasis on issues in academic literature has been changed since 1980. The economists in the 1980s have tried to study the best stabilization instruments to implement the exchange rate regimes. Their debate focuses on, in what way different regimes will act as absorbers of external shocks or provide a shield against speculative attacks. The lack of consensus on the subject has been running parallel due to the recent developments in the real world. The debate on the exchange rate regime is questionable due to its differentiation in its categorization.

The influence of exchange rate regimes in developing countries has been a debatable issue and it is one of the most important arguments in the international economies. For the last four decades, there are many small and developing countries have been facing these types of issues. They are Mexican economic crisis (1982 and 1995), Crisis in East Asia (1997), Argentina's Great Depression (1998-2002) and Turkey crisis (2001). These issues have become a big challenge to the global economy since the great depression and provided a severe "stress test" for the global economic performance. Change in exchange rate regime has led to the high inflation rates and low or negative growth rates. There is an ongoing discussion in many countries over the years about the choice of countries' exchange rate regimes. Their main focus is how the regimes have contributed to macroeconomic instability; and how the choice of exchange rate regimes might fix that macroeconomic turmoil and economic performance in developing countries. On the basis of these questions, this study is focusing only on BRICS countries to study the impact of exchange rate regimes on inflation in BRICS countries.

This study is organized as follows: Data and definitions of variables and sample period and data frequency are explained in section 1.2. The exchange rate regime classification procedure and coding are covered in section 1.3. Section 1.4 briefly discussed the econometric issues and methodology, the theoretical framework of inflation model and methodology. Empirical analysis and results, empirical findings of inflation performance are discussed in section 1.5. Section 1.6 tells the summary and conclusion.

## 2. Data and definitions

The study delves into the annual observations of economic variables of BRICS' countries from 1993 to 2012.

### 2.1. Variables

**Table 1.** *Definitions and sources*

| Variables | Definitions and Sources |
|---|---|
| **%ΔGDP** | Rate of growth of real GDP (WDI) |
| **π** | Annual percentage change in the Consumer Price Index (WDI) |
| **%ΔMS** | Rate of growth of Money Supply (WDI) |
| **TOP** | Openness: it is ratio of sum of the Exports and Imports to real GDP (WDI) |
| **TI** | Terms of Trade; the ratio of the price exports to price of imports (WDI) |
| **PEGGED** | A binary variable. It takes the value 1 when a country has a pegged regime; takes the value 0 when a country has a non-pegged regime. |
| $\pi_{t-1}$ | One year lagged value of inflation rate. |

### 2.2. Sample period and data frequency

The annual sample period covers from the year 1993 to 2012. The data frequency is determined according to the variable with the lowest frequency published, as a result, is expected with a strong relationship between Exchange rate regimes on inflation affected variables included in this study.

## 3. Exchange rate regime classification procedure and coding

There are different methods to classify exchange rate regimes to different countries. The IMF uses De Jure classification system to give coding for the countries that have fixed exchange rates for many years. There are few countries which have declared their regime choice whereas some other countries are not able to declare their regimes choice.

De Facto classification is a kind of coding that is based on the exchange rate movements and interest rate differentials. Some of these countries can use intervention data and direct intervention of currency markets. The changes in domestic interests ensure that the government is actively managing the exchange rate.

By using these annual classifications, it is determined that the exchange rate stayed within ± 2% bands against base currency. Technically, it is testified that if the month end maximum and a minimum value of exchange stay within 0.4, this can be considered as pegged exchange rate regime. If it exceeds 0.04, it can be categorized as non-pegged. In order to prevent breaks in the peg status due to one-time realignments, if an exchange rate possesses the value of zero in eleven out of twelve months is considered to be a fixed entity. By using the annual data of BRICS countries from 1993 to 2012, out of 200 country/year observations with exchange rate data 87 are coded as Pegged, 101 as Non-Pegged and 12 do not have any data.

## 4. Econometric issues and methodology

The following section deals with the theoretical framework and model building.

### 4.1. Theoretical framework of inflation model

The earlier studies prove that the Inflation is mostly affected by the following variables like exchange rate, money supply, government consumption, real GDP, population, Terms of Trade and Trade openness. Based on these variables' relationship we present a functional form of these variables' impact of exchange rate regimes on inflation of BRICS countries.

The most typical association of fixed exchange rates with lower inflation rates is based primarily on the belief that a peg may play the role of a commitment mechanism for monetary authorities. On that basis, this effect works entirely through the behavior of the monetary aggregates in the case of BRICS countries. The very important issues are that a credible peg may also lead to higher money demand and low inflation expectations and reduce the sensitivity of prices with respect to upward changes in money growth.

According to its supporters, many of suggested that lower inflation rates are associated because of following pegged exchange rate regime system. As mentioned above, a pegged regime may play a role as an anti-inflationary tool for developing countries. In addition, the literature focuses on a credibility effect of a pegged rate expectations on inflation that may soothe the velocity of money and price fluctuations in the developing world. In theory, a pegged exchange rate regime is expected to have an impact on the link between money and prices. Since a pegged regime is expected to affect the relationship between prices and money. This study uses a standard money demand theory as the core model to explain inflation performance. Therefore, the base model takes the form of a simple demand function in a time series model as the following:

$$\frac{M_t V_t}{P_t} = Y_t^{\alpha}\, i_t^{-\beta} \quad \alpha, \beta > 0 \tag{1}$$

where $M_t$ is broad money, $V_t$ is residual velocity controlling for interest and income effect,$P_t$is the price level, $Y_t$ is the real income, and $i_t$ is the nominal interest rate at time t. Money demand increases with real income and decreases with nominal interest rate. Nominal interest rate can be formed by the Fisher equation, as the following:

$$i_t = r_t + \pi_t^e \tag{2}$$

Where $r_t$is, the real interest rate and $\pi_t^e$is the expected rate of inflation, which can be defined as:

$$\pi_t^e = \ln(P_{t+1}^e) - \ln(P_t) \tag{3}$$

In money market equilibrium it requires that money demand equals money supply; hence, money supply and money demand are denoted by$M_t$. By taking the natural logarithm and representing all variables but the real interest rate by lower case letters (i.e. ln Z=z), this study uses the following equation:

$$m_t + v_t = p_t + \alpha y_t - \beta(i_t) \tag{4}$$

This can be formed and expressed as a percentage of change terms by taking the first difference of each variable. After rearranging the equation and using the Fisher equation in the equation (4), the study finds that inflation ($\pi_{i,t}$), is the percentage change in prices, and

it's a function of the percentage change of money supply ($\%\Delta m_{i,t}$), the percentage change of income ($\%\Delta yi,t$), and the expected inflation rate ($\pi^{e}_{i,t}$), which is the lagged dependent variable, "inflation", to bring out the effect of past policies on present expectations. Therefore, a core regression equation is based on:

$$\pi_{i,t} = \emptyset\%m_{i,t} + \beta\pi^{e}_{i,t} - \alpha\%\Delta y_{i,t} + \in_{i,t} \quad (5)$$

$\in_{i,t}$ is a regression error term defined as the sum of the unobservable change in the real interest rate (Δrt) and the change in the money shock (Δvt).

Finally, we come to the main regression model to bring out the effects of exchange rate regime policies on inflation; this study includes a regime of dummy variable (PEGGED). It shows, PEGGED takes the value of 1 when a country is categorized as a pegged and takes the value of 0 when a country is categorized as a non-pegged. Lastly, a dummy variable PEGGED is measured by using the Jay C. Shambaugh de facto scheme. Thus, the regression framework for inflation performance is the following:

$$\pi_{i,t} = \beta_0 + \beta_1\%\Delta MS_{i,t} + \beta_2\pi_{i,t-1} + \beta_3\%\Delta GDP_{i,t} + \beta_4 PEGGED_{i,t} + \beta_5 TOP_{i,t} + \beta_6 TI_{i,t} + \epsilon_{i,t} \quad (6)$$

Based on the equation (6), the annual percentage change in inflation for country *i* (*I* = 1, 2… 5) over time period *t*, with *t* = 1993, 1994- …-, 2012, depends on upon other explanatory variables. TOP is the openness to trade; it is the ratio of the sum of exports and imports to real GDP. TOP is included to capture the effect of international trade on inflation in BRICS countries. TOP is predictable to be associated with lower rates of inflation because greater openness to trade creates incentives for adopting stable macroeconomic policies. Stable macroeconomic policies reduce fluctuation in prices. Moreover, an increase in openness to trade leads to a great variety in consumption, which could also reduce price volatility in BRICS economies. Another explanatory variable in the inflation model is the Terms of trade (TI). TI is the ratio of a country's price of exports to its price of imports. TI is contained within in the model to control the effect of outward shocks. TI is predictable to be a negative relation to inflation as long as the terms of trade rising for a country. Finally, to bring out the effect of past policies of inflation on present expectations, the lagged variable of the dependent variable is also used ($\pi_{t-1}$) in this model.

### 4.2. Methodology

The study uses econometric models to explain the effects of currency policies on inflation. The country fixed effects model is used to control unobserved or difficult to measure country characteristics in panel data when such variables differ crosswise countries but do not change over time in inflation model. For instance, cultural or historical ties could also play a role the choice of currency policies that do not change dramatically over time, but it differs across developing countries. Therefore, by using the country fixed effects model, the study can capture the effects of these unobserved omitted variables on inflation and eliminate the omitted variable bias in analysis part. Moreover, clustered standard errors are used in country fixed effects regressions. Clustered standard errors allow for heteroskedasticity and for autocorrelation within a country, but are uncorrelated across entities. Therefore, clustered standard errors are valid whether or not there are issues on heteroskedasticity, autocorrelation or both.

Additionally, time dummies are also used in inflation model. The reason is that common shocks from corner to corner countries (such as spikes in oil prices or fluctuations in the U.S dollar) influence all economies beyond the effects focused through the observed variables. Therefore, the time dummies can control for unobserved or difficult to measure variables that are constant across countries but evolve over time.

## 5. Empirical analysis and results

The following section divided into two sub-sections. Section 5.1 explains the Unit root test analysis. Section 5.3. Explains the empirical analysis and discussion of the results.

### 5.1. Unit root test analysis

The following tables 2 and 3 briefly shows the unit root results and discussion as follows.

**Table 2.** *Unit root test results at level*

| Variables | LLC | IPS | Fisher-ADF | Fisher PP |
|---|---|---|---|---|
| INF | -4.16961(0.0000) | -4.20007(0.0000) | 35.6489(0.0000) | 31.8379(0.0001) |
| %ΔMS | -3.43076(0.0003) | -4.54052(0.0000) | 37.2691(0.0000) | 51.4209(0.0000) |
| %ΔGDP | -6.51825(0.0000) | -5.84321(0.0000) | 49.1617(0.0000) | 61.3495(0.0000) |

**Source:** Author's calculations.

**Table 3.** *Unit root test results with 1st difference*

| Variables | LLC | IPS | Fisher-ADF | Fisher PP |
|---|---|---|---|---|
| TI | -0.85367(0.1966) | -3.46002(0.0003) | 41.9743(0.0000) | 45.4341(0.0000) |
| TI (2nd) | -12.1019(0.0000) | -13.4656(0.0000) | 124.250(0.0000) | 86.5067(0.0000) |
| TOP | -6.86453(0.0000) | -6.44938(0.0000) | 54.8049(0.0000) | 111.932(0.0000) |

**Source:** Author's calculations.

Unit root test statistics of Fisher-ADF, Fisher-PP, IPS and LLC, test statistics in Table 2, includes two stages viz, first, at level and second, with a1st difference. The above tests have been applied to test stationarity property of the variables used in the present study. A regression using non-stationary variables may provide a spurious result (Granger and Newbold, 1974). Table 2 shows the stationarity at a level for the INF, %ΔMS and %ΔGDP variables and remaining got all non-stationary variables at level. Other variables like, TI and TOP got stationary at the difference. In direction to apply co-integration technique, all non-stationary variables must have the same level factor of integration. But, our results show that non-stationary variables have mixed pattern level of integration. For, this reason co-integration analysis doesn't apply here. These estimated results are showed in Table 4.

### 5.3. Empirical analysis and discussion of the results

**Table 4.** *Estimates Fixed-effects GLS regression (Dependent Variable INFL) Dependent variable Inf*

| Infl. | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| %Δmsl | 0.7678 | 0.1662 | 4.62 | 0.000 | 0.4376 | 1.0981 |
| Linfl | 0.4373 | 0.0753 | 5.81 | 0.000 | 0.2876 | 0.5869 |
| %Δgdp | 0.0584 | 0.1064 | 0.55 | 0.584 | -0.1530 | 0.2699 |
| Pegged | -0.2004 | 0.0812 | -2.47 | 0.016 | -0.3618 | -0.0389 |
| Topl | 0.7350 | 0.4513 | 1.63 | 0.107 | -0.1613 | 1.6323 |
| Til | -0.5127 | 0.2776 | -1.85 | 0.068 | -1.0644 | 0.3897 |
| _cons | 5.9868 | 2.9384 | 2.04 | 0.045 | 0.1482 | 11.825 |
| sigma_u | 0.3502 | | | Prob > F = 0.000 | | |
| sigma_e | 0.3023 | | | R-sq: 0.5407 | | |

**Source:** Authors' calculation.

**Table 5.** *Random-effects GLS regression*

**Dependent variable Infl**

| Infl. | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| %Δmsl | .845 | .150 | 5.64 | 0.000 | .551 | 1.14 |
| Linfl | .485 | .069 | 6.95 | 0.000 | .348 | .622 |
| %Δgdp | .071 | .081 | 0.88 | 0.379 | -.087 | .230 |
| Pegged | -.190 | .075 | -2.51 | 0.012 | -.338 | -.042 |
| Topl | .398 | .239 | 1.66 | 0.097 | -.071 | .868 |
| Til | -.084 | .065 | -1.29 | 0.197 | -.214 | .044 |
| _cons | 1.32 | .643 | 2.06 | 0.040 | .062 | 2.58 |
| sigma_u | 0 | | | Prob > F = 0.000 | | |
| sigma_e | 0.302 | | | R-sq: 0.7470 | | |

**Source:** Authors' calculation.

**Table 6.** *Hausman Fixed Random*

| | (b) | (B) | (b-B) | Sqrt (diag(v_b-v_B)) |
|---|---|---|---|---|
| | Fixed | Random | Difference | S.E |
| %ΔMsl | 0.767 | 0.845 | -0.077 | 0.071 |
| Linfl | 0.437 | 0.048 | -0.048 | 0.028 |
| %Δgdpl | 0.058 | 0.071 | -0.012 | 0.068 |
| Pegged | -0.2 | -0.19 | -0.01 | 0.029 |
| Topl | 0.735 | 0.398 | 0.337 | 0.382 |
| Til | -0.512 | -0.084 | -0.427 | 0.269 |
| Chi2 (6)= 6.39 | | Prob >Chi2= 0.380 | | |

**Source:** Authors' calculation.

### 5.3.1. Empirical findings of inflation performance

Most importantly we have to see before analysing the regression results in the inflation model, one might suspect that the variable " inflation" has a unit-root since time series are more likely to have unit-roots and are non-stationary (i.e. lagged value of inflation is used as an independent variable). Based on the Fisher test for using of panel root an Augmented Dickey-Fuller Test with one lag, the null hypothesis (that "inflation" has a unit root) is rejected, since the probability of Chi2 is less than 1%. Therefore, the variable "inflation" do not have a unit root and is also at stationary.

Table 6 reports the regression results. As mentioned, time dummy variables are used in all the regressions to control the effects of common unobservable shocks across countries. Table 6 explains the BRICS countries analysis. This chapter empirically analyses inflation models across all BRICS nations, to see the differences of regime impact on inflation.

The above table explains the regression results. Results indicate under a pegged exchange rate regime rate of inflation is negatively associated. Coefficients of other variables like Change in money supply (%ΔMS) would have a progressive impact on inflation ($\alpha > 0$), as it is given that any increase in money supply is expected to increase the price rise. It is significant and positively related to inflation and on other hand GDP growth also should have positive impact ($\beta > 0$) as it is seen in the Philips curve, as we assume that a high growth rates are expected to cause economic activity to heat up the wages and rise of prices. Here, our results show that the %ΔGDP is positively related to inflation but it is not significant. %ΔGDP is positively impacted on inflation rate. The trade openness (TOP) is significant with a positive coefficient. Trade openness increases the costs of a monetary expansion, which is logically have to imply lower inflation in open economies. On the other

hand, the terms of trade (TI) is significant and with a negative coefficient. Finally the PEGGED has played a negative effect on the inflation performance. It implies that the countries following PEGGED regimes have witnessed lower inflation rate when compared with non-pegged exchange rate regimes.

## 6. Summary and conclusion

This study analyzed the effects of exchange rate regimes on inflation of BRICS countries, with 20 years of yearly data from 1993-2012. A brief literature review of the theoretical and empirical literature on inflation of BRICS economies specified the importance of theories of inflation in explaining the issues on inflation.

This study examined the impact of exchange rate regimes on inflation on BRICS. It mainly examined the role of exchange rate regimes in the inflation performance and more specifically, on choosing what type of regimes will help for the BRICS countries to control the inflation.

The panel co-integration tests were not run due to stationarity test results not satisfying the prerequisites. In the consumption basket there was a high content of imports in the consumption basket (both way indirectly as inputs to services and goods, and directly as consumption goods) and the incapability to inspiration prices in the importing countries, domestic prices are extremely approachable to the changes in foreign prices but suggest some price stickiness in the short run. Conferring to the variance analysis, shocks to inflation are explained mostly by its own past values, suggestive of inflation inertia. The second most key source to foreign prices is Shockwave of the variation in domestic prices, followed by the nominal exchange rates and exchange rate policies. The anticipated long-run relationship based on the monetary theory of inflation indicated that an increase in money supply is inflationary, feasible due to structural bottlenecks.

The analysis in this chapter proposes that exchange rate regimes choice and money supply influence the inflation dynamics in the BRICS countries. In addition, the empirical results attained from the analysis of inflation show that the real depreciation resulting from a nominal depreciation will be unwound in a short-time which will reduce the advantages of a flexible exchange rate regime. The analysis in this chapter also shows that there is a positive relationship between monetary expansion and inflation in the BRICS countries.

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