# Capital Formation Through Public & Rights Issues in Indian Primary Capital Market: An Econometric Forecasting using Box-Jenkins ARIMA Model

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**Abstract**

The primary capital market is the appropriate route for the capital formation in corporate sectors through public offers, rights issues and private placement, etc. The largest sources of funds from the primary capital market to the corporate sectors are mobilized through public and rights issues. Basically, an invitation is made by a company to the public to subscribe to its securities offered through prospectus is called as public offers, which can be adopted either under fixed price, book- building method or pure auction method. Public issues are of two types, namely Initial Public Offer (IPO) and Further Public Offer (FPO). On the other hand, the existing equity shareholders of the company are given opportunity to invest their money in the form of rights issues. The study analyses the forecasting of money mobilization through public and rights issues in Indian primary capital market during 2000-2001 to 2020-2021 based on data during 2000-2001 to 2018-2019 using ARIMA Modeling. The study finds that the MA (1) model has become the best model to depict the behaviour of the first differences of the capital raised through public and rights issues over the study period. The study also explores that the forecast values of capital raised through public and rights issues in India for 2018-2019, 2019-2020 and 2020-2021, may be 80,796.10, 84,446.55 and and 88,097.01 (crore in rupees), respectively.

**Keywords:** Capital Formation, Indian Primary Capital Market, Resource Mobilization, Public and Rights Issues, ARIMA Model.

## 1. Introduction

The primary capital market is the appropriate route for the capital formation in corporate sectors through public offers, rights issues and private placement, etc. The largest sources of funds from the primary capital market to the corporate sectors are mobilized through public and rights issues. Basically, an invitation is made by a company to the public to subscribe to its securities offered through prospectus is called as public offers, which can be adopted either under fixed price, book- building method or pure auction method (Saha, 2015). On the other hand, the existing equity shareholders of the company are given opportunity to invest their money in the form of rights issues. A rights issue is a primary source for a listed company to raise additional capital from the primary market. As the right issue is made by a listed company, the market price becomes the basis for the price of the right issue. Since the right issue has to be made to the existing shareholders of the company, it has to be priced more favourably for the existing shareholders. However, capital formation is made in the Indian primary capital market through capital issue management process performed by the SEBI registered merchant bankers as book runner lead managers (BRLMs).When a company makes a fresh issue to new investors and/or offer of securities is made to new investors for becoming part of shareholders' family of the issuer, it is called public issues. Public issues are of Initial Public Offer (IPO) and Further Public Offer (FPO). In case of public issues ( either IPOs or FPOs), company makes only (a) fresh issue of securities to the public through offer document/red herring prospectus or (b) makes fresh issue of securities to the public along with offer for sale through offer document/red herring prospectus. This offer for sale is made by the existing shareholder(s) of a company (i.e. promoters or other shareholders of the company) (Saha, 2018). Capital formation for economic growth has always been a strategic concern in every economy including Indian economy. Truly speaking, capital market is the main driver of capital formation and an indicator of economic development. (Ahuja, 2012). Because of conservative financial policies by the Government, credit based financial system and financial repression in the post independence era, economic reform took place in India in 1991and Liberalization policies led to economic growth. Deregulation, an urge for attaining global benchmark, scope of accessing global market and increased inflow of foreign capital also acted as a positive catalyst to the development of this market. With the introduction of several new concepts (e.g. book building method, IPO grading, green shoe option, etc.), resource mobilization in the primary market has become very popular. Abolition of Capital Issues Control Act, 1947 and establishment of Securities Exchange Board of India (SEBI) in 1988 as a statutory body to control operation of stock exchanges and other market intermediaries, promote development of this market and protect interest of corporate stakeholders also appealed to a huge section of middle class Indian population (Saha, 2013). Data on total capital generated through public and rights issues in a year from 2000-2001 to 2017-2018 has been collected from SEBI Bulletin. Based on secondary data on overall capital generated in primary capital market through public and rights issues in post-reforms period, the study seeks to analyze the econometric forecasting of money mobilization through public and rights issues in Indian primary capital market during 2018-2019 to 2020-2021 considering data during 2000-2001 to 2018-2019 using Autoregressive Integrated moving Average (ARIMA) Model.

**2. Review of Literature**
Indian primary capital market has become an important subject matter of research for researchers across the world. Saha (1988) in his paper has opined that the strategy of merchant bankers should not be to develop an instrument for raising capital from the market, but to develop a process that makes creation and delivery of the instruments possible in accordance with the pace and requirements of the issuers. Murthy (1993) in his paper has examined the cost of raising capital from the public issues floated during 1992-93.He has compared the cost of raising capital of issues through the OTC (over the counter) route and regular stock exchange option and found that the cost of raising capital through OTC route was lower than the issues that opted for regular stock exchange route. Narta (1996) has conducted a research study to find out the growth of new issue market and underwriting of capital issues in India, and to analyze the cost of raising capital during the period 1970-71 to 1988-89. Burch & Foester (2004) in their book has given special emphasis on United States (US) Initial Public Offer (IPO) market. Chakraborti & De (2010) have considered an analytical approach to assess operational efficiency of Indian primary market. Nayak (2010) in their study also discussed common grievances in the new issue market and regulatory measures to address the same. Ahuja (2012) in his research has made a comparative study between Indian primary capital market with primary market of other developing countries of the world. Juman & Irshad (2015) in their paper have reviewed the process of growth of capital markets, their evolving structure and their functioning through stock exchanges in India. They have examined existing technical analysis for investment decision making and suggested modifications with special emphasize on recent development after the implementation of New Economic Policy. Saha (2016) in his book has incorporated issue of securities under different route in Indian primary capital market. Pricing of public issues, allotment process, green shoe option operation are also elaborated as per SEBI (ICDR) Regulations. 2009. Rubani (2017) in his paper has analyzed the structure of financial market in India and discussed the functions of Indian capital market. Jenica (2017) in her paper has explored the role of Indian primary market in resource mobilization during 2014-2016 covering several method of resource mobilization like offer for sale, private placement, qualified institution investor, right issues and so on.

**2.1. Research Gap**
Studies reviewed so far, have considered different aspect of capital markets in India and abroad. However, none of the studies consulted, so far, took an attempt to explore the forecasting of capital formation through public and rights issues in Indian primary capital market during 2018-2019 to 2020-2021 based on data during 2000-2001 to 2018-2019 using ARIMA Model.

**3. Objectives**
The objective of this study is to forecast the capital raised through volume of public and rights issues for 3 years (2018-2019 to 2020-2021) beyond the end of sample period (2000-2001 to 2017-2018). This study employs Box-Jenkins methodology of building ARIMA model to achieve the aim of the study. The study also has made a diagnostic checking of the model.

**4. Data and Methodology**
An attempt has been made in the study to build a time series model in order to forecast the volume of public and rights issues in Indian primary capital market over the coming period. Annual time series secondary data for the capital raised through volume of public and rights issues in India over the period of 2000-2001 to 2017-2018 obtained from SEBI Bulletin have been used for the study. Out of enormous forecasting models ranging from simple models to sophisticated ones, Box-Jenkins methodology has been employed to build ARIMA model. Accuracy and the selected models have been tested by performing different diagnostics tests to ensure the accuracy of the results obtained. The computer program -Eviews-8 has been used for data analysis and forecasting. The study has considered only Augmented Dickey Fuller test for stationary test and forecasting the capital raised through volume of public and rights issues has been made using ARIMA Model and the selected models are tested considering different diagnostic tools to ensure the accuracy of the results obtained.

**4.1.Testing for Stationarity**
Stationarity implies that mean, variance and covariance of the return distribution are time independent. In any time series analysis, the test for stationarity is important because, in the presence of non-stationary series, the

standard estimation procedures are not applicable. There are two principal methods of detecting non-stationarity: (a) Graphical inspection of correlogram; (b) Formal statistical tests for Unit Root using Augmented Dickey – Fuller Tests (ADF) or other tests.

**4.2.Graphical Inspection of Correlogram: Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF)**

For the time series $Y_t$, the autocorrelation of order k is known as ACF of order k. The ACF at lag k is defined as follows:

$$\rho_k = \frac{\gamma_k}{\gamma_0} = \frac{Cov(y_t, y_{t-k})}{Var(y_t)} \quad \text{.....(1)}$$

A graphical plot of $\rho_k$ against k is called correlogram. The correlogram helps to understand whether the series is stationary. If the value of $\rho_k$ at various lags around zero, the series is stationary, otherwise, it is non-stationary. The autocorrelation function (ACF) and partial autocorrelation function (PACF) of time series are plotted in order to identify the appropriate model.

**4.3 Test of Autocorrelation: Box-pierce Q Test**

The Q-statistic can be used to test whether a group of autocorrelation is significantly different from zero or not. Box-Pierce (1970) used the sample autocorrelations to form the Q-statistic as,

$$Q_{BP} = T\sum_{k=1}^{m} \rho_k \quad \text{.....(2)}$$

Where, T = number of observations and m = maximum lag length and $\rho_k$ be the k-th order sample autocorrelation coefficient. Under the null hypothesis that all values of $\rho = 0$, Q is asymptotically Chi-square ($\chi^2$) distribution with k degrees of freedom. If the calculated value of Q exceeds the appropriate critical value in a chi-square table ($\chi^2_{obs} > \chi^2_{Tab}$),the null hypothesis can be rejected and the series is non-stationary.

**4.4 Formal statistical tests for Unit Root using Augmented Dickey – Fuller Tests (ADF)**

If the data is non-stationary, the regression results using such data would be spurious, and the usual 't' test would not be applicable to test the significance of coefficients. To examine whether the data and its first difference are stationary, out of several test, the Augmented Dickey-Fuller (ADF) test can be applied for the time series. The unit root test for stationarity can be represented as Augmented Dickey Fuller (1979, 1981) Regression:

Dickey and Fuller (1979) actually consider three different regression equations: first is a pure random walk model, the second model adds an intercept term or drift term and the third include both a drift and a linear time trend that can be used to test for the present the unit root. The models are:

$$\Delta y_t = \gamma y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta y_{t-i} + e_t$$

$$\Delta y_t = \alpha + \gamma y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta y_{t-i} + e_t$$

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta y_{t-i} + e_t \quad \text{.....(3)}$$

Where $\gamma = (\rho - 1)$, α is a constant (drift), β is the coefficient on a time trend and *p* is the lag order of the autoregressive process and $e_t$ is a white noise error term.

Unit root test is realized under the null hypothesis that the series has unit root, and the alternative is the series has no unit root; i.e.,

$$H_0 : \gamma = 0 \;\; i.e. \; \rho = 1 \;\; and \;\; H_1 : \gamma < 0 \;\; i.e. \; \rho < 1 \quad \text{.....(3.1)}$$

The test statistic is $DF_\tau = \frac{\hat{\gamma}}{SE(\hat{\gamma})}$ .....(3.2)

If the ADF test-statistic ( $\tau$ - stat.) is greater than (in the absolute value) than Mackinnon critical t-value, the null hypothesis of a unit root can be rejected for the time series and hence, it can be said that the series is stationary at their levels. Otherwise, the null hypothesis of unit root can be accepted and it can be said that the series has unit root, and hence, the series is non-stationary at level.

### 4.5 Econometric Forecasting: Box-Jenkins (BJ) Methodology

In this section, an attempt has been made to discuss one of the most popular approaches towards econometric forecasting which is known as Autoregressive Integrated moving Average (ARIMA) forecasting method. Box and Jenkins (1976) introduced first the ARIMA model and hence this method is known as the Box-Jenkins methodology. ARIMA is a combination of AR (***Autoregressive*), I (*Integrated*), and MA (*Moving Average*) process. A convenient notation for ARIMA model is ARIMA (p, d, q). (Bhaumik, 2015). Box and Jenkins put forward a new generation forecasting tool, popularly known as the Box–Jenkins (BJ) methodology, technically known as the ARIMA methodology. The BJ-type time series models allow $Y_t$ to be explained by past, or lagged, values of *Y* itself and stochastic error terms. The BJ methodology is based on the assumption that the time series under the study is stationary. If a time series is stationary, it can be modeled in a variety of ways. $Y_t$ is an autoregressive model of order *p* or AR (*p*) process in following difference equation or model,

$$y_t = \rho_1 y_{t-1} + \rho_2 y_{t-2} + \ldots\ldots + \rho_p y_{t-p} + e_t \qquad \ldots(4)$$

On the other hand, $Y_t$ is expressed as weighted or moving average of the current and past white noise error terms, it is known as Moving Average of order *q* or MA (*q*) model. It is written as follows.

$$y_t = e_t + \theta_1 e_{t-1} + \theta_2 e_{t-1} + \ldots\ldots + \theta_q e_{t-q} \qquad \ldots(5)$$

By combining AR and MA models, one can get the ARMA *(p, q)* model, with *p* autoregressive terms and *q* moving average terms. It is shown as below:

$$y_t = \rho_1 y_{t-1} + \rho_2 y_{t-2} + \ldots\ldots + \rho_p y_{t-p} + e_t + \theta_1 e_{t-1} + \theta_2 e_{t-2} + \ldots\ldots + \theta_q e_{t-q} \qquad \ldots(6)$$

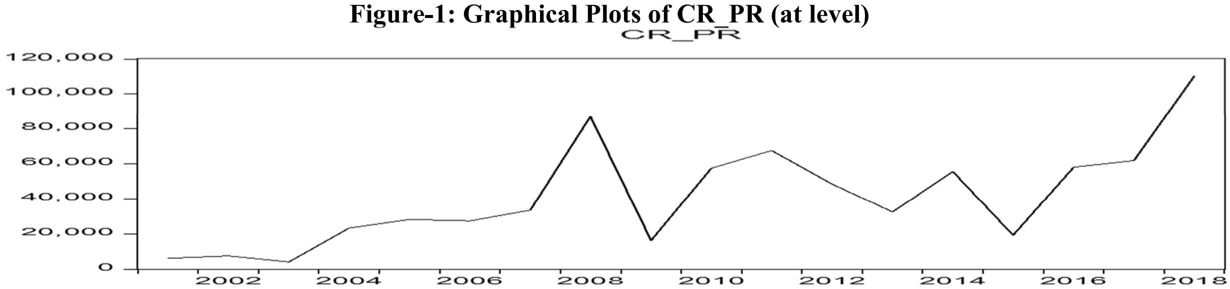
If a time series is integrated of order *d* and ARMA (*p, q*) model is applied to it, it can be said that the original time series is generally known as Auto Regressive Integrated Moving Average or ARIMA (*p, d, q*) model, where d denotes the number of times a time series has to be differenced to make it stationary. If time series is stationary at level only, therefore they can be termed as I(0) and there is an absence of *d.* However, the BJ forecasting method comprising few steps: identification of best fit ARIMA model; estimation of the best fitted model**;** diagnostics checking; forecasting using the best fit ARIMA model; forecast Evaluation. Models can be identified on the basis of the ACF and PACF and resulting correlograms, which are simply the plots of ACFs and PACFs against the lag length. Once estimated model has been found adequate, it can be used for forecasting. After estimating the model, evaluating the model with forecast evaluation statistics (goodness of fit) is required to measure the performance of forecast or forecast accuracy. Some of the statistical measures of forecast accuracy are RMSE (Root Mean Square Error), MAE (Mean Absolute Error), MAPE (Mean Absolute Percentage Error), and the Theil inequality Coefficient.

## 5. Empirical Results and Analysis

### 5.1 Plotting Time Series Data

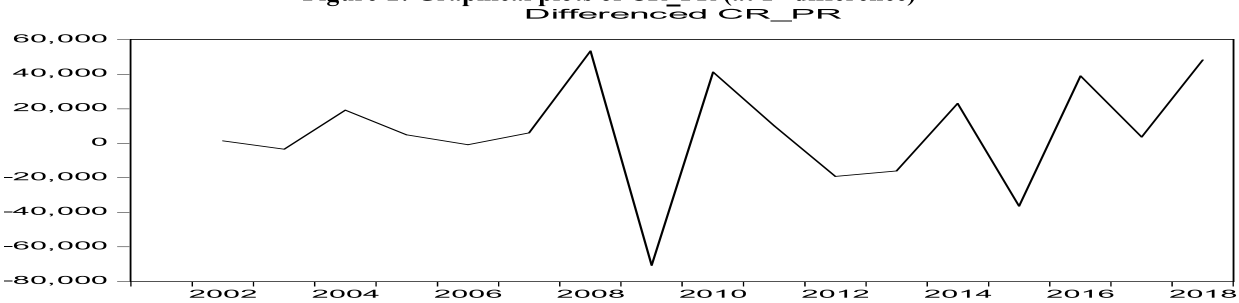
We begin with a visual inspection of the time plot of capital raised through public and rights issues (CR_PR) and its first difference (D(CR_PR)) for the period (2000-01 to 2017-18) under review and these are presented in Figure –1 and Figure –2 respectably. A time plot shows the data against the time.

**Figure-1: Graphical Plots of CR_PR (at level)**




(Source: Author's calculation based on data from SEBI)

**Figure-2: Graphical plots of CR_PR (at 1st difference)**




(Source: Author's calculation based on data from SEBI)

From the above plot (Figure –1), a time series data with a linearly upward trend is displayed. Plot (Figure –2) is the 1st order differenced plot for the same data showing the difference data (residual) does not display any trend.

### 5.2 Descriptive Statistics

Descriptive statistics are calculated and shown in Table-1 in order to specify the distributional properties of the data (CR_PR) during the period under study. It is seen that the CR_PR during the study period varies from 4070 to 110140. Therefore, a wide range of fluctuation in data series can be observed. The mean during the study period is 41360.22. The skewness statistics for data is 0.6987 which is less than 1, the distribution is moderately skewed. Furthermore, the kurtosis is 2.856, suggests that the underlying distribution is platykurtic distribution. It is also observed that the JB statistics is insignificant at 1% level. It means that the null hypothesis of normality is the normality assumption, i.e., the data series is positively skewed and platykurtic.

**Table–1. Descriptive Statistic of CR_PR (at level)**

| Descriptive Statistic | CR_PR |
|---|---|
| Mean | 41360.22 |
| Median | 32981.50 |
| Minimum | 4070.00 |
| Maximum | 110140.00 |
| Range | 106070.00 |
| Standard Deviation | 29164.56 |
| Skewness | 0.6987 |
| Kurtosis | 2.8568 |
| Jarque-Bera | 1.4803 |
| Probability | 0.4770 |
| Sum | 744484.00 |
| Sum sq. Dev. | 1.45E+10 |
| Observation | 18 |

(Source: Author's calculation based on data from SEBI)

### 5.3 Stationarity Test: Unit Root Test Analysis

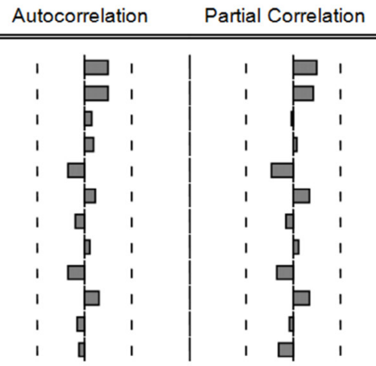
*5.3.1 Stationarity Test using Correlogram*

In this segment, an attempt has been made to test stationarity using correlogram, which is followed by application of ADF test to examine the presence of unit root (non-stationary) in the CR_PR series. The correlogram of the series CR_PR is shown here.

**Figure–3: Correlogram of CR_PR**

Sample: 2001 2018
Included observations: 18



| Lag | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|
| 1 | 0.223 | 0.223 | 1.0562 | 0.304 |
| 2 | 0.244 | 0.205 | 2.3986 | 0.301 |
| 3 | 0.075 | -0.016 | 2.5331 | 0.469 |
| 4 | 0.098 | 0.041 | 2.7799 | 0.595 |
| 5 | -0.157 | -0.213 | 3.4656 | 0.629 |
| 6 | 0.105 | 0.164 | 3.7937 | 0.705 |
| 7 | -0.084 | -0.073 | 4.0254 | 0.777 |
| 8 | 0.048 | 0.046 | 4.1070 | 0.847 |
| 9 | -0.164 | -0.164 | 5.1776 | 0.819 |
| 10 | 0.134 | 0.172 | 5.9905 | 0.816 |
| 11 | -0.078 | -0.048 | 6.3036 | 0.852 |
| 12 | -0.061 | -0.140 | 6.5244 | 0.887 |

(Source: Author's calculation using Eviews-8 based on data from SEBI)

(Source: Author's calculation using Eviews-8 based on data from SEBI)

The first two columns of the correlogram graphically display autocorrelations (AC) and partial autocorrelations (PAC) of the CR_PR series at various lags, which is provided in third column. The corresponding numerical values of AC and PAC are shown in the fourth and fifth column respectably. As a rule of thumb, the computed value of AC and PAC are statistically significant if it outside $0 \pm 1.96/\sqrt{T}$ band (shown by dotted line), where T stands for number of observation. The last two columns shows the values of Ljug-Box Q-statistic and P-value associated with computed LB-statistic. Figure-3 exhibits random walk behaviour in the data series CR_PR. It demonstrates that capital raised through public and rights issues (CR_PR) series is non-stationary at level. Hence, transformation is needed to make it stationary. Now, let us check the unit root test by applying ADF test.

*5.3.2 Stationarity Test using ADF Test*

Table – 2 depicts the ADF test statistic at level with three variations as without trend and intercept, Intercept, and trend & intercept.

**Table – 2: Unit root test of CR_PR (at level)**

| Model | t-stat. | Prob. | C.V (1%) | Null hypothesis ($H_0$): CR_PR has unit root (Decision Rule: if the absolute value of $\lvert\tau_{Obs}\rvert > \lvert\tau_{Tab}\rvert$, $H_0$ is rejected) | Remarks (non-stationary series =I(1)/ stationary series =I(0)) |
|---|---|---|---|---|---|
| **No Intercept & No Trend/ None** | 0.626 | 0.841 | -2.717 | **$H_0$ accepted** | I(1) |
| **Intercept** | -2.216 | 0.208 | -3.887 | **$H_0$ accepted** | I(1) |
| **Intercept & Trend** | -3.796 | 0.043 | -4.616 | **$H_0$ accepted** | I(1) |

(Source: Author's calculation using Eviews-8 based on data from SEBI)

It is observed (Table – 2) that the null hypothesis of unit root in all three variations is accepted at 1% significant level. Hence, our data set (CR_PR) has unit root at level indicating non-stationary. In order to make it stationary, there is a need to take first difference of the variable and again check the stationary at first difference. The results of this test are as follows:

**Table – 3: Unit root test of CR_PR (at first difference)**

| Model | t-stat. | Prob. | C.V (1%) | Null hypothesis ($H_0$): CR_PR has unit root (Decision Rule: if the absolute value of $\lvert\tau_{Obs}\rvert > \lvert\tau_{Tab}\rvert$, $H_0$ is rejected) | Remarks (non-stationary series =I(1)/ stationary series =I(0)) |
|---|---|---|---|---|---|
| **No Intercept & No Trend** | -6.693 | 0.000 | -2.717 | **$H_0$ rejected** | I(0) |
| **Intercept** | -6.904 | 0.000 | -3.920 | **$H_0$ rejected** | I(0) |
| **Intercept & Trend** | -6.687 | 0.000 | -4.667 | **$H_0$ rejected** | I(0) |

It is evident (Table – 3) that the null hypothesis of unit root in all three variations is rejected at 1% significant level. Hence, data set (CR_PR) has no unit root at the first difference indicating stationary series. Now let us move to forecasting using ARIMA Model.

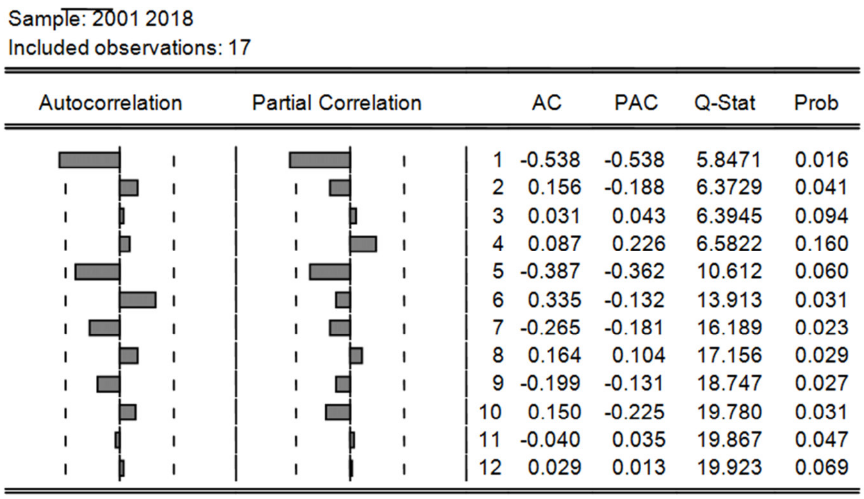
### 5.4 Econometric Forecasting of CR_PR: BJ-ARIMA Model

It is observed that the capital raised through public issues (CR_P) is non-stationary at level, while the first difference of that [d(CR_PR)] is stationary. With a view to exploring which ARMA model fits d(CR_PR), the following BJ methodology can be followed.

*5.4.1 Identification of the Model*

Since CR_P series is non-stationary, it is appropriate to obtain the correlogram of first differenced series for CR_PR [d(CR_PR)]. Such correlogram is presented here (Figure-4).

**Figure–4. Correlogram of D(CR_PR)**




(Source: Author's calculation using Eviews-8 based on data from SEBI)

From the Figure-4, it observed that Q-statistics is significant at almost all lags. It indicates that there is present serial correlation in the residuals. It implies that the growth rate of CR_PR is stationary. On the other hand, the ACF and PACF for d(CR_PR) shows that there are significant spike at lag 1 in both. This shows that the series have become stationary and the stationarity of the series d(CR_PR) can be confirmed by applying the ADF test, which is given in the Table–3. From the Figure-4, it is observed that the absolute value of test statistic is greater than that of critical value at 1% significance level. Thus, null hypothesis of unit root is rejected. So, it can be stated that the first difference of CR_PR has stationary. Now, let us move to actual model of ARIMA forecasting using correlogram of first difference of CR_PR series. We know that the 95% confidence interval for the true correlation coefficient is about $0 \pm 1.96 / \sqrt{T}$. The correlation coefficients lying outside these bounds are statistically significant at the 5% level. We now identify the ARIMA structure of the d(CR_PR) series. From Figure-4, it shows that both ACF and PACF of the d(CR_PR) series contains significant spikes at lag 1. Inspection of ACF and PACF for d(CR_PR) series suggests that it might be modeled as an ARMA (1,1) structure.

*5.4.2 Estimation and Selection of the ARIMA Model*

This section estimates the parameters of the autoregressive and moving average terms included in the model. This can be done using least square technique. Before estimating such a model, the sample range can be resized and an attempt has to be made to forecast the capital raised through volume of public and rights issues for next three years. We have estimated three ARIMA model like as ARMA (1,1), MA (1) and AR(1) for forecasting of the series CR_PR over the study period (2000-01 to 2017-18 using EViwes-8. These three estimated ARIMA models are shown in Table–4 with estimated the coefficient of the estimated model. In ARMA (1,1) model, it is observed that the AR(1) coefficient is not significant , while MA(1) coefficient is significant at 1% level. As a result, the AR(1) term is dropped and the equation has been re-estimated. In this case, the resultant model is MA(1) model, in which the MA(1) term is significant at 1% level. In addition to that, AR(1) model is estimated again and it is observed that AR(1) term is significant at 1% level.

However, it can be summed up (Table–4), that the MA (1) model is probably an appropriate model to depict the behaviour of the first differences of the CR_PR over the study period. The estimated coefficient of MA (1) terms is statistically significant at 1% level. Now we can say that the chosen MA (1) structure is stationary and the model has been correctly specified.

**Table–4 : Estimated ARIMA model**

| | | | | |
|---|---|---|---|---|
| Dependent Variable: D(CR_PR), Method: Least Squares | | | | |
| Sample (adjusted): 2003 2018, Included observations: 16 after adjustments | | | | |
| Convergence achieved after 27 iterations | | | | |
| **ARMA(1,1)** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| | | | | |
| C | 3372.429 | 1289.809 | 2.614673 | 0.0214 |
| AR(1) | -0.169 | 0.315917 | -0.537754 | 0.5998 |
| MA(1) | -0.901 | 0.068418 | -13.17266 | 0.0000 |
| | | | | |
| Akaike info criterion | 23.29159 | Hannan-Quinn criter. | | 23.29901 |
| Schwarz criterion | 23.43645 | Durbin-Watson stat | | 1.749156 |
| | | | | |
| Inverted AR Roots | -.17 | | | |
| Inverted MA Roots | .90 | | | |
| **MA(1)** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| | | | | |
| **C** | 3650.453 | 1311.306 | 2.783 | 0.013 |
| **MA(1)** | -0.903 | 0.068 | -13.122 | 0.000 |
| | | | | |
| Akaike info criterion | 23.120 | Hannan-Quinn criter. | | 23.130 |
| Schwarz criterion | 23.218 | Durbin-Watson stat | | 2.014 |
| | | | | |
| Inverted MA Roots | 0.90 | | | |
| **AR(1)** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| | | | | |
| **C** | 5302.572 | 4286.502 | 1.237039 | 0.236 |
| **AR(1)** | -0.610 | 0.233 | -2.616 | 0.020 |
| Akaike info criterion | 23.402 | Hannan-Quinn criter. | | 23.407 |
| Schwarz criterion | 23.498 | Durbin-Watson stat | | 2.141 |
| | | | | |
| Inverted AR Roots | 0.61 | | | |
| | | | | |

(Source: Author's calculation using Eviews-8 based on data from SEBI)

Table-4 shows that all the information criteria – AIC, SBC and HQ of the MA (1) model are minimum as compared to other models. The criterion is that it has to be lowest all possible ARIMA models that might be estimated with the CR_PR series. On the basis of information criterion, the best ARIMA model is ARIMA (0, 1, 1). MA root is inverted and lies within the unit circle. So, the current model MA (1) is satisfactory.

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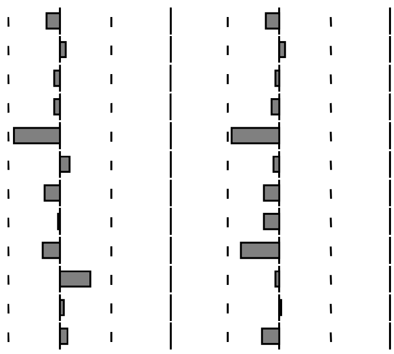
*5.4.3 Diagnostic Checking*

*(i) Stationarity Test using Correlogram*

Now we examine the ACF and PACF of the residual series corresponding to the estimated MA(1) model. ACF and PACF of residuals of estimated MA(1) model are shown below. All the Q-statistics of estimated model are insignificant. It means that it is free from serial autocorrelation. It can also be verify the DW statistic which is 2.014 very close to 2, meaning that there is absence of autocorrelation in the residual of the model.

**Figure–5: Residual Correlogram of the estimated MA (1) Model**

Sample: 2001 2021
Included observations: 17
Q-statistic probabilities adjusted for 1 ARMA term




| | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|
| 1 | -0.129 | -0.129 | 0.3373 | |
| 2 | 0.060 | 0.044 | 0.4136 | 0.520 |
| 3 | -0.061 | -0.049 | 0.4995 | 0.779 |
| 4 | -0.054 | -0.071 | 0.5718 | 0.903 |
| 5 | -0.432 | -0.453 | 5.5867 | 0.232 |
| 6 | 0.082 | -0.049 | 5.7862 | 0.328 |
| 7 | -0.147 | -0.153 | 6.4841 | 0.371 |
| 8 | -0.010 | -0.145 | 6.4876 | 0.484 |
| 9 | -0.163 | -0.366 | 7.5584 | 0.478 |
| 10 | 0.290 | -0.049 | 11.437 | 0.247 |
| 11 | 0.027 | 0.009 | 11.478 | 0.322 |
| 12 | 0.070 | -0.159 | 11.793 | 0.379 |

(Source: Author's calculation using Eviews-8 based on data from SEBI)

*(ii) Stationarity Test using ADF Test*

Unit root test results of Residual of the estimated MA (1) Model is presented here in order to know stationarity of the residual series.

**Table – 5: Unit root test results of Residual of the estimated MA (1) Model**

| Model | t-stat. | Prob. | C.V (1%) | Null hypothesis ($H_0$): CR_PR has unit root (Decision Rule: if the absolute value of $\lvert\tau_{Obs}\rvert > \lvert\tau_{Tab}\rvert$, $H_0$ is rejected) | Remarks (non-stationary series =I(1)/ stationary series =I(0)) |
|---|---|---|---|---|---|
| **No Intercept & No Trend (None)** | -4.015 | 0.001 | -2.717 | **$H_0$ rejected** | I(0) |

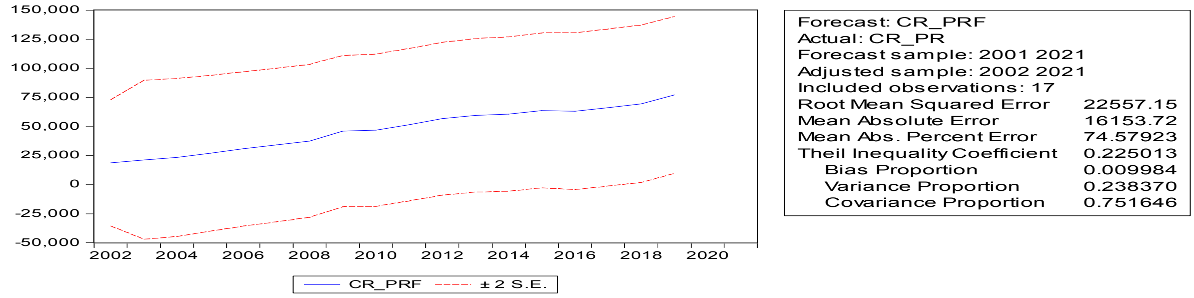
(Source: Author's calculation using Eviews-8 based on data from SEBI)

It is observed (Table-5) that the null hypothesis of unit root is rejected. So, the residual of the estimated MA (1) model has stationary or white noise. Hence, MA (1) model can be used for forecasting.

*5.4.4 Forecasting with ARIMA*

Once a particular ARMA model is fitted, that fitted model can be used for forecasting. There are two types of forecast: static and dynamic forecast. The static forecast uses the actual current and lagged values of the forecast variable, where as in dynamic forecasts, after the first period forecast, we use previously forecast value of the forecast variable. Using the MA (1) model, the static forecast is shown in Figure–6. This figure gives the forecast values of CR_PR as well as the confidence interval of forecast.

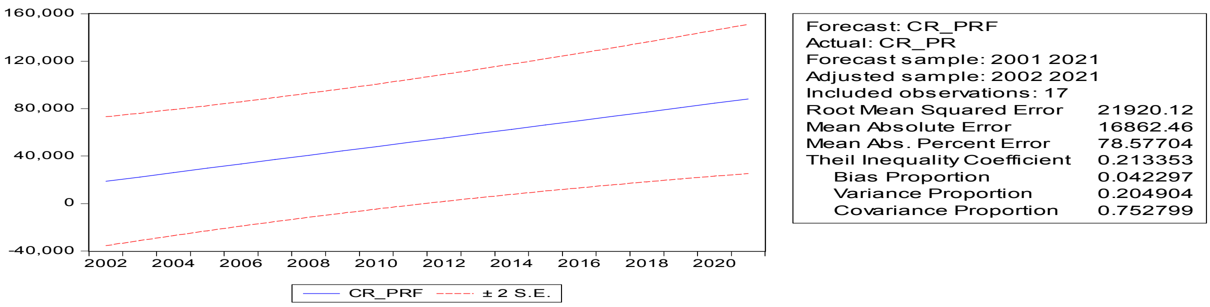
**Figure–6: Graphical Display of Static Forecast of CR_PR**




(Source: Author's calculation using Eviews-8 based on data from SEBI)

The picture of the dynamic forecast is depicted in Figure–7. This figure gives the forecast values of CR_PR as well as the confidence interval of forecast.

**Figure–7: Graphical Display of Dynamic Forecast of CR_PR**




(Source: Author's calculation using Eviews-8 based on data from SEBI)

The actual values of capital raised through public and rights issues (CR_PR) during 2000-2001 to 2017-2018 and forecast values of CR_PR during 2000-2001 to 2020-2021 are given in Table–6 under Dynamic Forecast. The table shows the forecast values of CR_PR in India for 2018-19, 2019-20 and 2020-21, which are 80,796.10, 84,446.55 and 88,097.01 (crore in rupees), respectively.

**Table –6: Actual and Forecast Level of Capital Raised through Public and rights Issues (CR_PR)**

| Year | Actual amount of public and rights issues ( Rs. in Crore) | Forecasted amount of public and rights issues ( Rs. in Crore) |
|---|---|---|
| 2001 | 6108.000 | NA |
| 2002 | 7543.000 | 18738.39 |
| 2003 | 4070.000 | 22388.84 |
| 2004 | 23272.00 | 26039.30 |
| 2005 | 28256.00 | 29689.75 |
| 2006 | 27382.00 | 33340.20 |
| 2007 | 33508.00 | 36990.66 |
| 2008 | 87029.00 | 40641.11 |
| 2009 | 16220.00 | 44291.56 |
| 2010 | 57555.00 | 47942.02 |
| 2011 | 67609.00 | 51592.47 |
| 2012 | 48468.00 | 55242.93 |
| 2013 | 32455.00 | 58893.38 |
| 2014 | 55652.00 | 62543.83 |
| 2015 | 19202.00 | 66194.29 |
| 2016 | 58167.00 | 69844.74 |
| 2017 | 61848.00 | 73495.19 |
| 2018 | 110140.0 | 77145.65 |
| 2019 | NA | 80796.10 |
| 2020 | NA | 84446.55 |
| 2021 | NA | 88097.01 |

(Source: Author's calculation using Eviews-8 based on data from SEBI)

*5.4.5 Evaluation of Forecasts*

The accompany table of forecast graph ( figure-6 and 7) gives the measures of the quality of the forecast, such as root mean square, mean absolute error, mean absolute percentage error and the Theil Inequality coefficient. In fact, the criterion is that all those value should be lowest in all possible ARIMA models that might be estimated with the series. The value of Root mean Square Error for the estimated MA (1) model is 22557.15 (Figure–6) under static forecast, which seems to be low as compared to other two models. On the other side, the value of Root mean Square Error for the estimated MA (1) model is 21920.12 (Figure–7) under the dynamic forecast, which seems to be low in comparison with other two models. However, it is evident that the value of Root mean Square Error for the estimated MA (1) model under dynamic forecast is lower than that of the estimated MA (1) model under the under static forecast. Hence, the dynamic forecast may provide better result than static forecast. Moreover, the static forecast shows Theil coefficient 0.225 in comparison with dynamic forecast showing Theil coefficient 0.213. Based on Theil coefficient, it can be stated that the dynamic forecast may provide better result than static forecast as dynamic forecast gives lowest results of Theil coefficient. The values of 'bias proportion', 'variance proportion' and 'covariance proportion' are 0.042, 0.204, and 0.752, respectively (Figure–6) under dynamic forecast. Since the values of bias and variance proportions are low and that of covariance proportion is high; the forecast may be considered satisfactory.

## 6. Conclusions

The ARIMA Model has been considered in the present study in order to analyze the econometric forecasting of capital formation through public and rights issues in Indian primary capital market during 2018-2019 to 2020-2021 considering data during 2000-2001 to 2018-2019. The paper has estimated three ARIMA models such as ARMA (1, 1), MA (1), and AR (1) for forecasting of the series CR_PR over the study period (2000-2001 to 2017-2018). It can be stated that the MA (1) model has become the best model to depict the behaviour of the first differences of the CR_PR over the study period. Moreover, the residual of the estimated MA (1) model has stationary or white noise and MA (1) model has been used for forecasting of the series CR_PR for the year 2018-19, 2019-20 and 2020-21. The forecast values of capital raised through public issues in India for 2018-2019, 2019-2020 and 2020-2021, may be 80,796.10, 84,446.55 and 88,097.01 (crore in rupees), respectively showing upward trend till 2020-2021. However, let us wait and observe the actual result for the period 2018-2019, 2019-2020 and 2020-2021 that may advocate the forecast values of capital raised through public issues in India for those periods.

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