An Empirical Analysis to Assess the GDP Projection of Gujarat State of India

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***Abstract*—This study is conducted to forecast the GDP of Gujarat using 34 years data of GDP and explanatory variables. It employs Box-Jenkins methodology through ARIMA model. This projection for in-of-sample and out-of-sample are estimated based on regression coefficients which are measured using univariate and multivariate econometric models. In ARIMA(2) model,the estimated RMSFE values are lowest and Chi^2 values are statistically significant, thus produce better results.Projected results based on univariate model demonstrates that Gujarat's GDP would be increased from INR 48,093,236 to INR 66,387,416 Million by 2050. Also, GDP growth is expected to be increased by 11.35% to 12.50% by 2050. Moreover, estimates also specify that GDP growth would be 8.81% to 9.29% during 2016-2020.Empirical results based on multivariate model is also confirming the previous results by depicting increasing trend for GDP,from INR 87,55,119 to INR 91,95,090 Million.It provides several policy suggestions to achieve estimated GDP growth in Gujarat.**

***Index Terms*—GDP projection; GDP growth; Univariate and multivariate model; AR(1); AR(2); MA(0); MA(1); MA(2); ARMA(1); ARMA(2); Gujarat.**

I. INTRODUCTION

Gross domestic product (GDP) growth is a crucial determinant to assess the financial health of a country as whole (Maity and Chatterjee, 2012). It is a best estimator to measure the development and economic performance of a nation (Daga et al., 2004; Gu et al., 2012). GDP deals with financial activities that includes the economic contribution of all sectors to explore the current position of a country (Maity and Chatterjee, 2012).It is defined as the economic value of all final goods and services produced in an economy in a given time period (Gu et al., 2012). Economic values of all goods and services produced in national boundary can be estimated at market prices (Daga et al., 2004). GDP has four major components: consumption, investment, government expenditure and net exports.In recent years, researchers and international development organizations have projected the value of various components of the economy (e.g., GDP growth, urbanization, population growth, inflation). The forecasting is a statement about a specific variable in the future with certain probability. Forecasting estimation of a macroeconomic parameter is helpful for government agents and development organizations to adopt an efficient development strategy(Maity and Chatterjee, 2012). Forecasting of real GDP growth is most significant economic authority and representative to take a well-organized policy decision (Carlomagno et al., 2013). GDP growth projection plays an imperative role to get insightful idea for future health of an economy (Maity and Chatterjee, 2012). Policy makers and business organizations closely monitor the movement of the GDP as it reflects the economic activities of the country. Low GDP value implies that the economy in the stage of stagnation. Boomin GDP value implies that economy is running efficiently as a result of a fiscal or monetary policy applied by the government. Additionally, GDP projection based on past scenarios would facilitate the numerous positive actions for development thinker, stake holders, financial experts and government agents to choosea sustainable development plan. However, it might be unable to facilitate suitable economic policies and distribution of funds on various heads in a country (Maity and Chatterjee, 2012).Alarge number of studies are undertaken to forecast GDP in western economies. Although, in India,few studies could estimate GDP projection and its growth in various forms (Daga et al., 2004; Maity and Chatterjee, 2012). However, above-mentioned studies hardly given significant attention to discover the factors which may affect the behavior of projected GDP. Few studies are considered to estimate GDP projections at state level in India. State level GDP projection may be useful for policy makers to implement state level policies. So, the present study is an attemptto forecasts the GDP for the Gujarat. This study is addressed following research questions: 1) What are crucial determinants of GDP? 2) How GDP is significantly get affect as changing socio-economic variables? 3) What would be the projected trend of Gujarat's GDP in future? 4) Which method would be reliable and rational to estimate GDP projection? In order to achieve the answer on aforementioned research questions, the present study develop aviable econometric model to forecast the GDP of Gujarat. It also assesses the influence of various variables on GDP using ARIMA model.Further, it facilitates several policy recommendations to enhance the GDP of Gujarat.

II. MATERIAL AND METHODS

A. Data Sources and Description

The present study is comprised 34 years data as time series (1981-2014) for Gujarat. Information on GDP and its associated indicators(i.e., agriculture; forestry and logging; fishing; mining and quarrying; manufacturing; electricity, gas and water supply; construction; trade, hotels, transport, storage, communication; financing, insurance,

real estate and business services; and community, social and personal services), and share of other sectors in aggregate GDP (i.e., agriculture, industry and service sectors) are taken from Centre Monitoring Indian Economy (CMIE). Arable land, forest area, gross irrigated area, gross area sown, route road length, educational institutions and enrolments, postal networks,railway road length are also derived from CMIE. Working population, rural and urban population are taken from Census (GoI). Literate population, literacy rate, credit deposit ratio, and urbanization are taken from Planning Commission (GoI). Consumer price index is taken from Central Statistics Office Ministry of Statistics and Programme Implementation (GoI). Information on climatic factors (i.e., minimum and maximum temperature, and rainfall) are derived from the Indian Meteorological Department (GoI). Proposed regression models are run using SPSS and STATA statistical software.

B. Theoretical Framework of Box-Jenkins (B-J) Methodology

Box-Jenkins forecasting technique is based on statistical concepts that captures the wide spectrum of time series behavior. It has multiple component to select anappropriate approach and to recognizea reasonable functional form of a model.B-J technique is considered as a most significant technique to forecast a macro-level parameter. It is required at least 40 or 50 equally-spaced period of data to getsrational results (Cordeiro and Neves, 2009). Autoregressive integrated moving average [ARIMA(p, d, q)]time series forecasting technique is a segregation of B-J methodology. Here,p is the number of autoregressive terms, d is the number of non-seasonal difference that needs for stationary, and q is the number of lagged forecast-error in the prediction equation. ARIMA(p, d, q) forecasting equation has threeprocesses i.e., autoregressive (AR), moving average (MA), and autoregressive and moving average (ARMA). When regular difference is applied together with AR and MA, it is considered as autoregressive integrated moving average (ARIMA) model. Here,'I' indicates the 'integrated' that refer to the difference procedure. In brief, B-J approach includes four steps: (i) Model identification, (ii) Estimation, (iii) Diagnostics checking, and (iv) Forecasting.Model identification is the most complex step among all the steps. There are three measures to estimate the future projection of a variable, i.e., point based forecast, lower limit based forecast and upper limit based forecast (Maity and Chatterjee, 2012). Point based forecast is a best estimator to produce better forecasting results (Daga et al., 2004; Cordeiro and Neves, 2009; Maity and Chatterjee, 2012; Carlomagno et al., 2013).

III. FORMULATION OF UNIVARIATE ECONOMETRIC MODEL

To examine the GDP projection, this study applied univariate and multivariate econometric models using Time Trend Factor, AR(1), AR(2), MA(0), MA(1), MA(2), ARMA(1), and ARMA(2) (Daga et al., 2004; Andersson, 2007; Bessonovs, 2014). In proposed models, time trend factor is included for easy forecasting for in-off-sample and out-off-sample (Maity and Chatterjee, 2012).

A. Time Trend Factor Model (TTF)

It assumes that time tend factor is an independent variable and has a significant influence on GDP. It also accepts that there is no multi-collinearity, auto-correlation and homoscedasticity in time series.So, time series is normally and independently distributed (NID i(0, ?2)). Here, time trend factor model is considered as a standard benchmark model to compare the consistency with other models. The model is defined as follows: Here, log(GDP)

$$log\ (GDP)_t = \alpha_0 + \alpha_t(Year) + \hat{u}_t \quad (1)$$

is natural logarithm of GDP, ?0 is intercept coefficient, ?1 is regression coefficient of time trend factor, and t is error termin equation (1).

B. Autoregressive (AR) Regression Model

It is a simplest econometric techniquein which Yt (dependent variable) is regressed against its own lags values. It is very simple to forecasta macroeconomic parameter. In order to construct an appropriate auto-regressive time series model,entire observations are compiled as a function of past observations (Andersson, 2007; Daga et al., 2004; Maity and Chatterjee, 2012). The lags of the stationeries series in the forecasting econometric model are called autoregressive terms. While, lags of the forecast errors are called moving average terms. A time series that needs to take difference to be made stationary is said to be an integrated version stationary series. The general form of autoregressive econometric (AR(p)) model is given as: Here, log(GDP) is natural logarithm of GDP;?0is

$$log(GDP)_t = \alpha_0 + \alpha_t\ (Year) + \alpha_1\ log\ (GDP)_{t-1} + \hat{u}_t \quad [(AR(1, 0, 0))]$$
$$log(GDP)_t = \alpha_0 + \alpha_t\ (Year) + \alpha_1\ log(GDP)_{t-1} + \alpha_2\ log(GDP)_{t-2} + \hat{u}_t[(AR(2, 0, 0))] \quad (2)$$

constantterm; ?t is estimated regression coefficient of time trend factor; ?1, ?2 and ?2 are the regression coefficient for corresponding lags of GDP; and t is error term in equation (2).

C. Moving Average [MA(p)]Econometric Model

In moving average model, predictor is considered as dependent variable. Error terms and its lags values used as explanatory variables. While, error terms can be estimated by autoregressive model or simple OLS estimation. The description of moving average model is defined as: Here

$$log(GDP)_t=\alpha_0 + \alpha_t(Year) + \beta_t\hat{u}_t[(MA(0, 0, 0))]$$
$$log(GDP)_t=\alpha_0 + \alpha_t(Year) + \beta_t\hat{u}_t + \beta_1\hat{u}_{t-1}\ [(MA(0, 0, 1))]$$
$$log(GDP)_t=\alpha_0 + \alpha_t(Year) + \beta_t\hat{u}_t + \beta_1\hat{u}_{t-1} + \beta_2\hat{u}_{t-2}\ [(MA(0, 0, 2))] \quad (3)$$

tis estimated error terms; t-1 and t-2 are first and second lags of error terms respectively in equation (3). Remaining variables are stated in equation (2).

D. Autoregressive and Moving Average [ARMA(p, d, q)]

ARMA model is mixture of AR and MA model. An autoregressive and moving average model includes several lags of predictor and error terms. The model is specified as: The descriptions of all the variables are stated in

$$log(GDP)_t=\alpha_0 + \alpha_t(Year)+ \alpha_1 log(GDP)_{t-1}+ \beta_t\hat{u}_t+ \beta_1\hat{u}_{t-1}[\text{ARMA}(1, 0, 1)]$$
$$log(GDP)_t=\alpha_0 + \alpha_t(Year)+ \alpha_1 log(GDP)_{t-1}+ \beta_t\hat{u}_t+ \beta_1\hat{u}_{t-1}+ \beta_2\hat{u}_{t-2}[\text{ARMA}(1, 0, 2)](4)$$

equation (1), (2), and (3).

IV. Formulation Of Multivariate Econometric Model

Multivariate econometric model is useful to investigate the influence of explanatory factors on output,thus it has more advantage than univariate econometric model. Regression coefficients of explanatory variables can be convenient to measure long-term GDP projection. This study is used a multivariate econometric model to assess the association of socioeconomic factors with GDP. The detail descriptions of all proposed models are given as:

A. Time Trend Factor Model (TTF)

It assumes that GDP is function of credit deposit ratio, working population growth, urban growth, literacy rate, consumer price index, infrastructural development index, and climate variability index (Dao, 2012). The present study is used original and square term of most variables to reduce the existence of heteroskedasticity. It observed the relationship between GDP and aforementioned variables. Econometric formulation for this relation described as: Here, GDP is gross domestic product; CDR is credit

$$(GDP)_t=\alpha_0+\alpha_t(Year)+\theta_1(CDR)+\theta_2(CDR)^{\wedge 2}+\theta_3(WPGR)+\theta_4(WPGR)^{\wedge 2}+\theta_5(UGR)+\theta_6(UGR)^{\wedge 2}+\theta_7(LR)+\theta_8(LR)^{\wedge 2}+\theta_9(WPI)+\theta_{10}(IDI)+\theta_{11}(IDI)^{\wedge 2}+\theta_{12}(CVI_t-CVI_{t-1})+\theta_{13}(CVI_t-CVI_{t-1})^{\wedge 2}+\hat{u}_t(5)$$

deposit ratio; WPGR is working population growth; UGR is urban growth; LR is literacy rate; WPI is whole price index; IDI is infrastructural development index; and CVI is climate variability index. ?0 is constant term and?1 is regression coefficient for time trend factor. ?1 ?13 are the estimated regression coefficients for corresponding explanatory variables; and t is the error term in equation (5).

B. Autoregressive (AR) Regression Model

This model is includedfirst and second lags of GDP,and other factors. The general formulation of both the models are specified as: Here, ?1 and?2are the estimated regression coefficients of first and second lags of GDP, respectively in equation (6).

$$(GDP)_t=\alpha_0+\alpha_t(Year)+\beta_1(GDP)_{t-1}+\theta_1(CDR)+\theta_2(CDR)^{\wedge 2}+\theta_3(WPGR)+\theta_4(WPGR)^{\wedge 2}+\theta_5(UGR)+\theta_6(UGR)^{\wedge 2}+\theta_7(LR)+\theta_8(LR)^{\wedge 2}+\theta_9(WPI)+\theta_{10}(IDI)+\theta_{11}(IDI)^{\wedge 2}+\theta_{12}(CVI_t-CVI_{t-1})+\theta_{13}(CVI_t-CVI_{t-1})^{\wedge 2}+\hat{u}_t[AR(1)]$$
$$(GDP)_t=\alpha_0+\alpha_t(Year)+\beta_1(GDP)_{t-1}+\beta_1(GDP)_{t-2}+\theta_1(CDR)+\theta_2(CDR)^{\wedge 2}+\theta_3(WPGR)+\theta_4(WPGR)^{\wedge 2}+\theta_5(UGR)+\theta_6(UGR)^{\wedge 2}+\theta_7(LR)+\theta_8(LR)^{\wedge 2}+\theta_9(WPI)+\theta_{10}(IDI)+\theta_{11}(IDI)^{\wedge 2}+\theta_{12}(CVI_t-CVI_{t-1})+\theta_{13}(CVI_t-CVI_{t-1})^{\wedge 2}+u_t[AR(2)] \quad (6$$

C. Moving Average [MA(p)] Model

In moving average model, error term is considered as independent variables, whereas, error term can also be estimated by equation (5) or (6). The econometric formulation of this model would be as:

$$(GDP)_t=\alpha_0+\alpha_t(Year)+£_1u_t+\theta_1(CDR)+\theta_2(CDR)^{\wedge 2}+\theta_3(WPGR)+\theta_4(WPGR)^{\wedge 2}+\theta_5(UGR)+\theta_6(UGR)^{\wedge 2}+\theta_7(LR)+\theta_8(LR)^{\wedge 2}+\theta_9(WPI)+\theta_{10}(IDI)+\theta_{11}(IDI)^{\wedge 2}+\theta_{12}(CVI_t-CVI_{t-1})+\theta_{13}(CVI_t-CVI_{t-1})^{\wedge 2}[MA(0)]$$
$$(GDP)_t=\alpha_0+\alpha_t(Year)+£_1u_t+£_1u_{t-1}+\theta_1(CDR)+\theta_2(CDR)\wedge 2+\theta_3(WPGR)+\theta_4(WPGR)\wedge 2+\theta_5(UGR)+\theta_6(UGR)\wedge 2+\theta_7(LR)+\theta_8(LR)\wedge 2+\theta_9(WPI+\theta_{10}(IDI)+\theta_{11}(IDI)\wedge 2+\theta_{12}(CVI_t-CVI_{t-1})+\theta_{13}(CVI_t-CVI_{t-1})\wedge 2[MA(1)]$$
$$(GDP)_t=\alpha_0+\alpha_t(Year)+£_1u_t+£_1u_{t-1}+£_2u_{t-2}+\theta_1(CDR)+\theta_2(CDR)\wedge 2+\theta_3(WPGR)+\theta_4(WPGR)\wedge 2+\theta_5(UGR)+\theta_6(UGR)\wedge 2+\theta_7(LR)+\theta_8(LR)\wedge 2+\theta_9(WPI)+\theta_{10}(IDI)+\theta_{11}(IDI)\wedge 2+\theta_{12}(CVI_t-CVI_{t-1})+\theta_{13}(CVI_t-CVI_{t-1})\wedge 2[MA(2)](7)$$

Here, ut, ut-1 and ut-2 are various lags of error terms; and t,1 and 2 are the estimated regression coefficients of associated lags of error term.

D. Autoregressive and Moving Average Model [ARMA(p, d, q)]

An autoregressive and moving average model comprisesvarious lags of predictor and error term as an independent variables. The formulation of this model would be as:

$$(GDP)_t=\alpha_0+\alpha_t(Year)+\beta_1(GDP)_{t-1}+£_tu_t+£_1u_{t-1}+\theta_1(CDR)+\theta_2(CDR)\wedge 2+\theta_3(WPGR)+\theta_4(WPGR)\wedge 2+\theta_5(UGR)+\theta_6(UGR)\wedge 2+\theta_7(LR)+\theta_8(LR)\wedge 2+\theta_9(WPI)+\theta_{10}(IDI)+\theta_{11}(IDI)\wedge 2+\theta_{12}(CVI_t-CVI_{t-1})+\theta_{13}(CVI_t-CVI_{t-1})\wedge 2[ARMA(1)]$$
$$(GDP)_t=\alpha_0+\alpha_t(Year)+\beta_1(GDP)_{t-1}+\beta_2(GDP)_{t-2}+£_tu_t+£_1u_{t-1}+£_1u_{t-2}+\theta1(CDR)+\theta_2(CDR)\wedge 2+\theta_3(WPGR)+\theta_4(WPGR)\wedge 2+\theta_5(UGR)+\theta_6(UGR)\wedge 2+\theta_7(LR)+\theta_8(LR)\wedge 2+\theta_9(WPI)+\theta_{10}(IDI)+\theta_{11}(IDI)\wedge 2+\theta_{12}(CVI_t-CVI_{t-1})+\theta_{13}(CVI_t-CVI_{t-1})\wedge 2[ARMA(2)](8)$$

E. Identification and Selection of an Appropriate Model

A time series is a set of observations usually ordered in equally spaced intervals (Cordeiro and Neves, 2009). It can be considered stationary if its statistical properties (i.e., mean and variance) are constant over period of time

(Gu et al., 2012). These are the basic assumptionsin a time series to estimate future projection. Even though, non-stationary of time series data would increase spurious regression and misleading in statistical inferences (Gu et al., 2012). Trend stationary process and difference stationary process are two processes for time series analysis (Gu et al., 2012). Augmented Dickey-Fuller (ADF) unit root test is applied to check whether time series data is stationary or not (Dega et al., 2004; Cordeiro and Neves, 2009; Gu et al., 2012; Carlomagno et al., 2013). The existence of autocorrelation in error term is recognized by Durbin-Watson d-statistics, Dubin's Alternative test and Brush-Godfrey L-M test.The autocorrelation and partial autocorrelation function also used in order to identify the existenceof autocorrelation. Variance Inflation Factor (VIF) is estimated to recognize the presence of multicollinearity between explanatory variables. Heteroskedasticity: Cameron and Trivedi decomposition of IM-test, and Breusch-Pagan/Cook-Weisberg test are applied to identify whether heteroskedasticity exists or not in time series. Ramsay RESET Test: It suggests that whether functional form of a model is correctly well-specified or not. As estimated F-value under this testare statistically insignificant. Thus, functional form of ARMA(2) models are correctly specified. Diagnostic Checking: As determinants of GDP, assumes that current year's GDP is likely to be correlated with last year's GDP. Therefore, lags of GDP for at least one year must be included on the right-hand side in regression analysis. Akaike Information Criterion (AIC) (Cordeiro and Neves, 2009), and Schwarz Information Criteria (SIC) or Bayesian Information Criterion (BIC) are used to decide how many lags to be used in automatically lag structure of auto-regressive model (Caraiani, 2010; Carlomagno et al., 2013; Bessonovs, 2014). The rule of thumb is to choose a model which has the lowest value of SIC and AIC, and high adjusted R-square value. AIC and BIC are also the popular measures for comparing maximum likelihood models. This study is used several econometric models to forecast the GDP projection, thus GDP projected results are compared using mean forecast error (MFE) (Cordeiro and Neves, 2009), root mean square forecast error (RMSFE)(Carlomagno et al., 2013).

V. EMPIRICAL RESULTS AND DISCUSSION

A. Empirical Findings Based on Univariate Model

Figure: 1 presents the fitted GDP and actual GDP in-of-sample. The figure shows that fitted values are extensively coincides with actual GDP. Hence, it provides significant evidence that regression coefficients of explanatory variables can be used for future GDP projection.Figure: 2 shows the projected GDP out-of-sample based on TF, AR(1), AR(2), ARMA(1) and ARMA(2) models during 2015-2050. The projected results based on univariate model demonstrate that Gujarat's GDP is likely to be increased by INR48,093,236 to 66,387,416 Million by 2050. Projected GDP growth based on time trend factor model indicates that GDP growth has tendency to be increased during 2020-30, 2030-2040 and 2040-2050.

Projected results also imply that GDP growth is expected to be increased from 11.35% to 12.50% by 2050 (Figure: 3). It also provides confirmation that GPD growth has a tendency to be increased in coming decades. Further, it is expected that GDP growth would be reached by 8.81% to 9.29% during 2016-2020. It means that GDP growth would grow during 2016-2050. However, GDP growth is measures at constant prices with base year 2004-05. So, any variation in base year would directly influence the GPD growth.

B. Empirical Findings Based on Multivariate Model

Table: 2 presents the empirical results based on multivariate econometric model which estimates the impact of explanatory variables on GDP. It includes several models like TTF, AR(1), AR(2), MA(0), MA(1), MA(1), ARMA(1) and ARMA(2) to select a reliable model. Cross comparison of all the models, provedthat ARMA(2) produce better results compared to others. As ARMA(2) model has a lowest values of BIC/SIC and AIC. Ramsey RESET statistics also emphasized that ARMA(2) model is correctly well-specified. Furthermore, lowest values of MFE and RMSFEprovide a statistical evidence that ARMA(2) model performed well and produce better results. Estimated Chi2 value is also statistically significant at 1% significance level. Therefore, it is reasonable to accept that ARMA(2) model is best fit model. Estimated regression coefficients of ARMA(2) model can be used for GDP projection. Estimated R2-value shows that 100% variation in GDP can be capture by undertaken variables. Time trend factor has a positive and statistically significant effect on GDP. It implies that application of modern technology would be useful to increaseGDP. First and second lags of GDP significantly associated with current GDP. This shows that past values of GDP can be used to predict future GDP.

The regression coefficients of credit deposit ratio and working population growth with GDP are positive and statistically significant. It means that both the factor would be useful to increase GDP. Quadratic term of credit deposit ratio and working population growth are negatively associated with GDP. Hence, these estimates give confirmation that credit deposit ratio and working population growth has a non-linear relationship with GDP. It is also illustrated that credit deposit ratio and working population growth have a U-shaped relationship with GDP. This can be interpreted that credit is most significant financial factor to increase GDP. Credit availability in domestic market plays a significant role to increase GDP (Adu et al., 2013). The positive association of working population growth with GDP can be understood that working population produce more goods and services that contributes GDP. Regression coefficient of urban growth and literacy rate are negatively associated with GDP. Dao (2012)'s also found negative relationship between urban growth and GDP. Further, urban growth and literacy rate have a non-linear relationship with GDP. Whole price index has a negative and statistically significant impact on GDP. Infrastructural development index (IDI) and

TABLE 1
EMPIRICAL RESULTS BASED ON UNIVARIATE *ARIMA* MODEL

Model's Name	*TTF*		*AR(1)*		*AR(2)*		*MA(0)*	
No. of Obs.	34		33		32		33	
R^2	0.9807		0.9880		0.9891		0.9922	
Adj. R^2	0.9801		0.9872		0.9879		0.9917	
Mean VIF	1.00		48.79		68.63		1.00	
AIC	-116.5816		-128.0594		-126.2131		-142.4756	
BIC/SIC	-113.5289		-123.5699		-120.3501		-137.9861	
Variables	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*
Year	0.0299	0.000	0.0116	0.011	0.0092	0.056	0.0301	0.000
$(GDP)_{t-1}$	-	-	0.6263	0.000	0.39238	0.033	-	-
$(GDP)_{t-2}$	-	-	-	-	0.3279	0.072	-	-
u_t	-	-	-	-	-	-	1.000	0.000
Con. Coef.	5.5926	0.000	-20.872	0.010	-16.6232	0.055	-54.0624	0.000
B-P/C-W test	0.11		6.49		5.84*		0.00	
IM-test	6.13		24.00*		21.81		14.66***	
Ramsey RESET test	10.26*		3.45**		1.47		12.16*	
D's A test	18.276*		4.568**		0.607		17.125*	
B-G LM test	12.610*		4.491**		0.704		12.252*	
MFE	26859.3643		-68071.9001		-127256		16097.3662	
RMSFE	181759.7537		87257.6190		159775.5915		120617.7405	

Source: Author's Estimation. **Note:-***VIF*: Variance Inflation Factor; *AIC*: Akaike's Information Criterion; *BIC/SIC*: Bayesian's or Bayesian's Information Criterion; *B-P/C-W test*: Breusch-Pagan/Cook-Weisberg test; *D's A test:* Durbin's alternative test; *B-G LM test*: Breusch-Godfrey LM test; *MFE*: Mean Forecast Error; *RMSFE*: Root Mean Square Forecast Error; *, ** and *** indicates that coefficients are statistically significant at 1%, 5% and 10% significance level, respectively.

TABLE 1
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Model's Name	*MA(1)*		*MA(2)*		*ARMA(1)*		*ARMA(2)*	
No. of Obs.	32		31		32		31	
R^2	0.9971		0.9988		1.0000		1.0000	
Adj. R^2	0.9968		0.9987		1.0000		1.0000	
Mean VIF	1.04		1.11		65.03		131.62	
AIC	-168.3638		-190.9327		-902.7084		-882.4489	
BIC/SIC	-162.5009		-183.7628		-896.8455		-875.279	
Variables	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*
Year	0.03033	0.000	0.03052	0.000	0.0116019	0.000	0.0116017	0.000
$(GDP)_{t-1}$	-	-	-	-	0.6263132	0.000	0.6263179	0.000
u_t	1.12389	0.000	1.00134	0.000	1.000001	0.000	1.000001	0.000
u_{t-1}	0.64592	0.000	0.69650	0.000	2.62e-06	0.119	-2.80e-06	0.213
u_{t-2}	-	-	0.39836	0.000	-	-	-4.69e-06	0.003
Con. Coef.	-54.4772	0.000	-54.8444	0.000	-20.8718	0.000	-20.87154	0.000
B-P/C-W test	0.00		0.02		1.54		3.63***	
IM-test	24.44**		29.04***		7.02		17.52	
Ramsey RESET test	10.68*		11.26*		0.55		0.05	
D's A test	14.284*		12.273*		1.624		2.586***	
B-G LM test	11.072*		10.207*		1.881		3.016***	
MFE	8463.9933		4736.5408		-261		0.22733	
RMSFE	74762.5264		48656.1907		315.1614		1.4613	

Source: Author's Estimation. **Note:**Refer Table: 1.

climate variability index (CVI) have a negative influence on GDP. While, quadratic terms of IDI and CVI are positively associated with GDP. Estimates imply that IDI and CVI have a non-linear relationship with GDP. Results show that up to a certain extent in climate variability and investment in infrastructural development would be positive impact on GDP but beyond this it would be negative influence on GDP. Figure: 4 provides the fitted GDP that is estimated based on regression coefficients of corresponding variables for in-of-sample. It infer that estimated fitted values are extensively coincides with actual GDP. Hence, regression coefficients of explanatory variables can be used for future GDP projection. Ramsey RESET test provides statistically insignificant results for AR(1), AR(2), ARMA(1) and ARMA(2) models, therefore, these models produce relatively better results than others

Figure: 5 presents the expected trend in GDP based on TTF, AR(1), AR(2), ARMA(1) and ARMA(2) models. Estimates trend based on multivariate model shows that GDP has an increasing trend and it is expected to reach from INR87,55,119 Million to 91,95,090 Million by 2015. Other models also indicate that GDP has an increasing trend during 2012-2050 (Figure: 6). Hence, it indicates

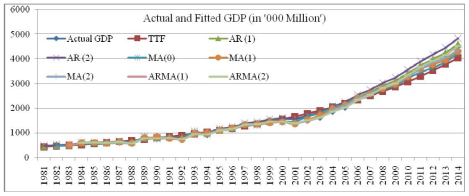

Fig. 1. Actual GDP and fitted GDP based on univariate model during 1981-2014. Source: Author's Estimation.

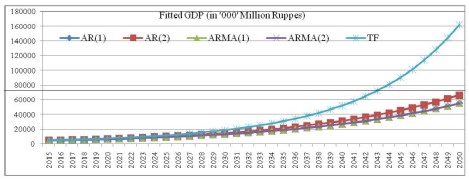

Fig. 2. Estimated projected GDP based on univariate model during 2015-2050. Source: Author's Estimation.

that GDP growth would be growing stage during 2020-30, 2030-2040 and 2040-2050. Projected results based on multivariate model show that GDP growth is expected to be increased by 8% by 2050 (Figure: 7). Univariate and multivariate model indicates that GDP and its growth have an increasing trend during 2015-2050. Therefore, there must not be worried for this. Estimates also infer that GDP growth would be positive at increasing trend during 2016-2020.

VI. Conclusion And Policy Guidelines

The present study estimates the long-term GDP projection of Gujarat during 2015-2050. It used past information of GDP, and socioeconomic factors as explanatory variables during 1981-2011. It employed a Box-Jenkins (B-J) methodology using univariate and multivariate econometric models. Empirical and statistical results of the study proved that ARMA(2) econometric model is performed well and produce better results than other models. Here, it recommended that ARMA(2) model would be useful to existing researcher to forecast amacroeconomic variables. Estimatesindicate that GDP of Gujarat has a stationary trend. It implies that there is high tendency to be increasedin GDP. Estimates indicate that most explanatory factors are found stationary (except climate variability index), thus it is reasonable to accept that there would be stationary trend in the pattern of these variables in near future.Estimates specify that Gujarat is a stable economy and past values of explanatory variables may be useful for GDP forecasting. Projected results based on univariate model imply that Gujarat's GDP is likely to be increased by INR48,093,236 to 66,387,416 Million. GDP growth is expected to be increased by 11.35% to 12.50% by 2050. Projected results based on univariate model demonstrate that GDP growth would be 8.81% to 9.29% during 2016-2020. However, estimates based on multivariate model also shows that GDP has increasing trend and it is

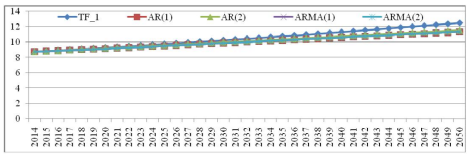

Fig. 3. Estimated projected GDP based on univariate model during 2015-2050. Source: Author's Estimation.

expected to reach by INR87,55,119 Million to 91,95,090 Million and GDP growth is expected to be reached by 7.54% to 8% by 2050. Industrial development would be useful to create new employment opportunities for peoples. Consequently, economic participation of people would be beneficial to increase economic growth and development. Policy makers also need to consider all the negative consequence of overwhelming industrialization to sustain the property of scarce natural resource and to maintain environmental sustain ability. As agriculture and service sectors has a significant contribution in national GDP of the country.So, here it cannot be neglected the importance of agriculture and service sectors in Gujarat. Hence, it is argued that balance investment in agricultural, industry and service sectors would be conducive to maintain sustainable development which would be helpful to achieve projected GDP in Gujarat. As overwhelming urban and population growth create several problems (i.e. environmental degradation, water unavailability and land degradation) in economy. So, it emphasized that policy makersand developmental thinkers are required to implement effective policies to manage urbanization and population growth in India. In addition, climate change would bring serious threat for domestic development polices and GDP. Hence, policy makers are also needed to implement mitigation and adaptation policies to cope with climate change in agricultural and allied sector. This study is assessed the impact of explanatory variables on SGDP and estimate long-term GDP projection of Gujarat. It employed univariate and multivariate econometric model under Box-Jenkins (B-J) methodology. This is first empirical exercise as a research context, which estimates the long-term GDP projection at state level in India. The study simultaneously used a univariate and multivariate model to check the reliability of both models. Nevertheless, given the paucity of time and availability of data, the present study could not include some other important estimations. Therefore, the study acknowledges following limitations: most researchers argued that user can forecast macro-economic variables like sales, production, GDP, and business and economic series more than (n/2) time periods. Where (n) is number of data points or number of information for past years. Few studies demonstrates that projection may be for no longer than (2) years, especially in case of rapidly changing economic activities. In long-run countries grow according to trends in all factors of production such as human asset, capital asset, physical asset, and natural resources. Hence, it is rational to assume that some aspects of the past patterns will

TABLE 2
EMPIRICAL RESULTS BASED ON MULTIVARIATE ARIMA MODEL

Model's Name	*TTF*		*AR(1)*		*AR(2)*		*MA(0)*	
No. of Obs.	30		30		29		30	
R^2	0.9967		0.9971		0.9976		1.0000	
Mean VIF	27691.73		72802.62		72802.62		25844.53	
AIC	765.1162		763.3179		763.3179		187.2579	
BIC/SIC	786.1342		785.737		785.737		209.6771	
Variables	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*
Year	141082.9	0.087	207453.4	0.012	268685.2	0.001	141082.5	0.000
$(GDP)_{t-1}$	-	-	-0.52926	0.043	-0.61523	0.008	-	-
$(GDP)_{t-2}$	-	-	-	-	-0.12101	0.570	-	-
u_t	-	-	-	-	-	-	1.0001	0.000
CDR	6081.65	0.710	11434.94	0.399	15573.21	0.249	6081.561	0.000
CDR^2	-36.442	0.717	-69.8230	0.409	-91.6753	0.262	-36.4401	0.000
WPGR	3.27e+07	0.001	5.42e+07	0.000	7.21e+07	0.000	3.27e+07	0.000
WPGR^2	-7814518	0.001	-1.30e+07	0.000	-1.73e+07	0.000	-7814311	0.000
UGR	-2209163	0.024	-4218874	0.001	-5755761	0.009	-2209060	0.000
UGR^2	423588.1	0.078	851949	0.005	1199110	0.025	423560	0.000
LR	-1875102	0.000	-3028323	0.000	-3851296	0.000	-1875063	0.000
LR^2	14327.01	0.000	23061.95	0.000	28968.43	0.000	14326.71	0.000
WPI	-9430.60	0.312	-7311.07	0.465	-5776.31	0.568	-9429.65	0.000
IDI	-146458	0.794	-359980	0.496	-230250	0.658	-146418	0.000
IDI^2	20777.13	0.952	152111	0.644	78068.12	0.806	20743.78	0.000
DCVI	-25888.5	0.630	-32800.8	0.535	-40329.3	0.504	-25890.4	0.000
DCVI^2	44633.8	0.717	-8477.81	0.943	6702.734	0.958	44640.71	0.000
Con. Coef.	-2.51e+08	0.120	-3.65e+08	0.020	-4.76e+08	0.002	-2.51e+08	0.000
B-P/C-W test	1.05		0.46		0.46		0.36	
Ramsey RESET test	0.74		1.42		1.42		3.89**	
D's A test	3.806***		4.270**		4.270**		4.234**	
B-G LM test	6.412**		7.417*		7.417*		7.371*	
MFE	-0.043333		5029.816666		150894.5000		-0.129999	
RMSFE	50665.36372		270467.798		49380.43808		3.183237	

Source: Author's Estimation. **Note:** Refer Table: 1.

continue in the future. This study could not include the effects of government regulation and policies in financial market, subsequently on GDP also; however, both the variables have a significant influence on GDP. It also could not consist of information on natural disasters (e.g., floods, drought, and earthquakes) which have a negative and significant impact on all sectors of the economy and GDP also. It also did not include information on international export and import of goods and services or any international policy under World Trade Organization and other international organization (i.e., World Bank and Asian Development Bank). It also assumes that there is a perfect competition in the domestic and international market. All the economic activities are adjusted as per demand and supply law in product market. The study also could not capture the prediction of economic crisis, which has negative and significant influence on GDP in short-run. This also raised several questions about the capability of the researchers and economists to accurate prediction of future GDP. Hence, it is very decisive challenge for economists and researchers to develop an appropriate forecasting technique which must be included stated variables.

VII. Acknowledgment

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References

[1] Adu G., Marbuah G. and Mensah J.T., "Financial development and economic growth in Ghana: Does the measure of financial development matter? Review of Development Finance, 2013, 3(1):192-203.
[2] Bessonovs A.,"Suite of statistical models forecasting Latvian GDP",Procedia-Social and Behavioral Sciences, 2014, 110(1), pp.1094-1105.
[3] Caraiani P.,"Forecasting Romanian GDP using a BVAR model", Romanian Journal of Economic Forecasting, 2010, 13(4), pp.76-87.
[4] Carlomagno G., Garca-Suaza A., Lobello S., Sanchez M. and Sant'Anna P., "Econometric Game 2013: Forecasting Spanish GDP in a Rich Data Environment", AENORM, 2013, 21(79), pp.15-19.
[5] Cordeiro C. and Neves M.M.,"Forecasting time serieswith boot.expos procedure", REVSTAT - Statistical Journal, 2009, 7(2), pp. 135-149
[6] Daga U.R., Das R. and Maheshwari B., "Estimation, analysis and projection of India's GDP: A time series model", MPRA Paper No. 22830, 2004.
[7] Dao M.Q., Population and economic growth in developing countries", International Journal of Academic Research in Business and Social Sciences, 2012, 2(1), pp. 6-17.
[8] Gu P., Wang X. and Chen, "Research on GDP forecast and its relationship with energy consumption", Advances in Applied Economics and Finance, 2012, 2(4), pp. 442-448.
[9] Maity B. and Chatterjee B., Forecasting GDP growth rates of India: An empirical study. International Journal of Economics and Management Sciences, 2012, 1(9), pp. 52-58.

TABLE 2
CONTI...

Model's Name	*MA(1)*		*MA(2)*		*ARMA(1)*		*ARMA(2)*	
No. of Obs.	29		28		29		28	
R^2	1.0000		1.0000		1.0000		1.0000	
Mean VIF	25844.53		25844.53		133391.06		266665.76	
AIC	187.2579		187.2579		178.0962		159.8243	
BIC/SIC	209.6771		209.6771		202.7075		186.4684	
Variables	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*	*Reg. Coef.*	*P>|t|*
Year	141083.2	0.000	141080	0.000	141092.5	0.000	141092.5	0.000
$(GDP)_{t-1}$	-	-	-	-	-0.00006	0.038	-0.0001	0.077
$(GDP)_{t-2}$	-	-	-	-	-	-	-0.0001	0.059
u_t	1.00001	0.000	1.0000	0.000	1.00000	0.000	1.0000	0.000
u_{t-1}	-0.00002	0.577	-0.00004	0.441	0.00002	0.585	0.0001	0.474
u_{t-2}	-	-	-0.00003	0.506	-	-	0.0001	0.421
CDR	6081.579	0.000	6081.013	0.000	6082.61	0.000	6083.3	0.000
CDR^2	-36.4403	0.000	-36.4371	0.000	-36.4459	0.000	-36.450	0.000
WPGR	3.27e+07	0.000	3.27e+07	0.000	3.27e+07	0.000	3.28e+07	0.000
WPGR^2	-7814249	0.000	-7813942	0.000	-7814913	0.000	-7815462	0.000
UGR	-2209031	0.000	-2208937	0.000	-2209289	0.000	-2209561	0.000
UGR^2	423552.1	0.000	423529.4	0.000	423610.2	0.000	423677.2	0.000
LR	-1875050	0.000	-1875000	0.000	-1875194	0.000	-1875322	0.000
LR^2	14326.61	0.000	14326.27	0.000	14327.68	0.000	14328.67	0.000
WPI	-9429.58	0.000	-9429.93	0.000	-9429.73	0.000	-9429.81	0.000
IDI	-146427	0.000	-146434	0.000	-146438	0.000	-146426	0.000
IDI^2	20748.58	0.000	20748.6	0.000	20754.94	0.000	20754.71	0.000
DCVI	-25891.1	0.000	-25893.3	0.000	-25890.2	0.000	-25890.9	0.000
DCVI^2	44641.54	0.000	44643.64	0.000	44639.43	0.000	44639.68	0.000
Con. Coef.	-2.51e+08	0.000	-2.51e+08	0.000	-2.51e+08	0.000	-2.51e+08	0.000
B-P/C-W test	0.36		0.36		0.00		0.49	
IM-test								
Ramsey RESET test	3.89**		3.89**		3.74***		0.79	
D's A test	4.234**		4.234**		4.940**		6.693*	
B-G LM test	7.371*		7.371*		9.588**		13.686*	
MFE	-0.1300		-0.1300		-0.1030		-0.0540	
RMSFE	3.1832		3.1832		2.7926		2.0827	

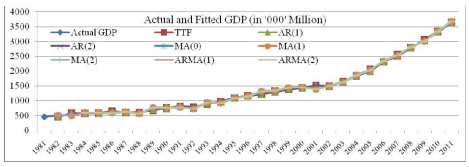

Fig. 4. Actual GDP and fitted GDP based on multivariate model during 1981-2011. Source: Author's Estimation

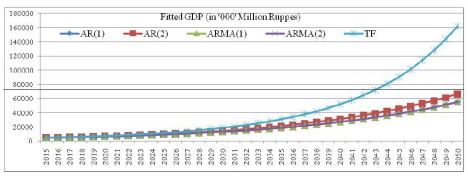

Fig. 6. Estimated projected GDP based on univariate model during 2015-2050. Source: Author's Estimation.

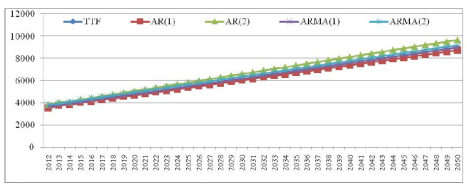

Fig. 5. Projected GDP based on multivariate model during 2012-2050. Source: Author's Estimation.

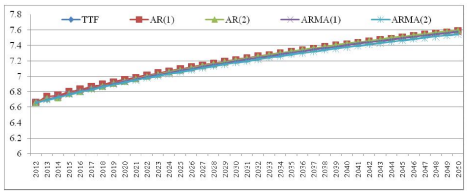

Fig. 7. Projected GDP growth (in %) based on multivariate model during 2015-2050. Source: Author's Estimation.