

## Economy Analysis for Bijie District about the Twelfth Five-Year Plan—Fixed Assets Investment and Production Soaring Forecasting

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**Abstract.** With the time-series model ARIMA and the CD production function we made fixed assets investment (FAI) forecasting analysis of Bijie Recycle Economy Test District for the 12th Five-Year Plan Period. FAI of Bijie at Guizhou Province will have capacity between 700 to 900-billion yuan, amount to 105 to 135-billion US dollar. And GDP development speed may get between 120% to 130% at current prices in the soaring process of the western part of China.

**Keywords:** FAI; ARIMA; CD production; 12th five-year plan; Bijie District

### 1. Introduction

Bijie Recycle Economy Test District is located at the northwest of Guizhou Province, and southwest of PR China. Present Chinese President Hu Jintao was the Leader of Guizhou in 1988 and at that time he decided to construct the District as Development and Poverty Alleviation, Ecological Construction Test Region. Scientist Qian Weichang was the first Chair of the Expert Advisor Group of the Region and now economist Li Yining is present Chair of the Group. Bijie Administration governs the District comprised 7 counties, Bijie City and an industrial estate. The District has 26853 square kilometers land area and has about 7.5 million people of Han, Yi, Miao, Hui, Bai, Buyi, Gelao, etc, more than thirty nationalities. For the fixed assets investment (FAI) forecasting analysis of the District about the twelfth five-year, from 2011 to 2015, economy plann we used the time-series model ARIMA, Autoregressive Integrated Moving Average, and the Cobb-Douglas prouction function. And the data were derived from the Statistics Bulletins of the National Economic and Social Development of Bijie District [4].

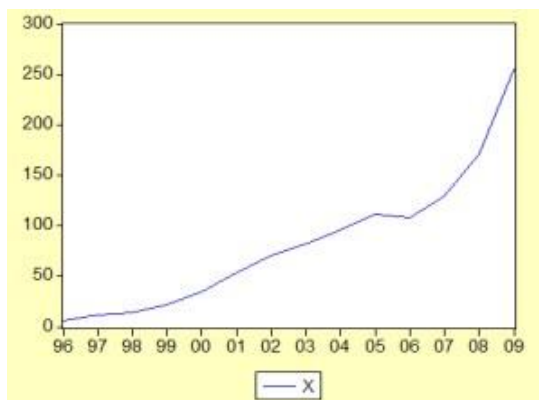


Fig. 1: FAI tendency chart from 1996 to 2009

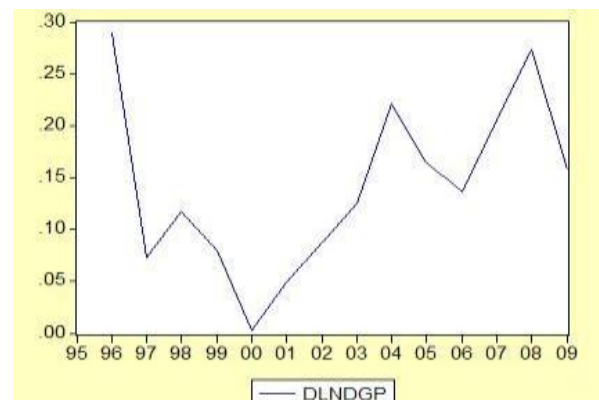


Fig. 2: FAI after taking logarithm and first difference, 96-09

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TABLE I. UNIT ROOT TEST RESULTS

Null Hypothesis: DLNX has a unit root  
 Exogenous: Constant  
 Lag Length: 0 (Automatic based on SIC, MAXLAG=2)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.972248	0.0662
Test critical values: 1% level	-4.121990	
5% level	-3.144920	
10% level	-2.713751	

TABLE II. PARAMETERS ESTIMATION OF ARIMA(1,1,2)

Sample (adjusted): 1998 2009  
 Included observations: 12 after adjustments  
 Failure to improve SSR after 27 iterations  
 Backcast: 1996 1997

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.273074	0.055786	4.895034	0.0012
AR(1)	-0.402935	0.142044	-2.836688	0.0219
MA(1)	1.325478	0.297813	4.450705	0.0021
MA(2)	0.994977	0.418680	2.376463	0.0448

R-squared	0.612098	Mean dependent var	0.257319
Adjusted R-squared	0.466635	S.D. dependent var	0.150698
S.E. of regression	0.110058	Akaike info criterion	-1.314425
Sum squared resid	0.096901	Schwarz criterion	-1.152789
Log likelihood	11.88655	F-statistic	4.207930
Durbin-Watson stat	1.927476	Prob(F-statistic)	0.046224

## 2. FAI Forecasting by Time Serial Model Arima

Using the data of 1996-2009 firstly we got the FAI tendency chart Fig. 1 by Eviews5.0. From Fig. 1 we know the FAI data of Bijie District had exponent tendency and the data were not stationary. After taking the logarithm we transformed the exponent to the linear tendency data, then dealing with first order difference we got the stationary data chart, Fig. 2. Results of unit root test were listed on TAB. I by that we reject the null hypothesis of existing unit root at 0.1 level and accept the hypothesis of the stationary sequence. So we can discuss the sequence in an ARMA. Fig. 3 shows the autocorrelation and partial autocorrelation of the sequence. From Fig. 3 we know the partial autocorrelation and the autocorrelation were contained in the intervals with radius in  $2/\sqrt{n}, 1/\sqrt{1+2\sum p_i^2}$  for every order n. We choose ARIMA(1,1,2) after trying a lot of models.

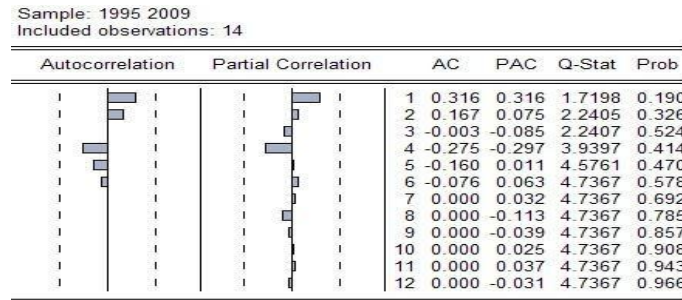


Fig. 3: Autocorrelation and partial autocorrelation

TABLE III. FAI FORECASTING(1996-2015) UNIT: HUNDREN MILLION YUAN

	Whole FAI	Logarithm	1st difference
2009	256.78	5.548219687	0.408429229
2010	338.0085409	5.823071164	0.273071164
2011	429.0023471	6.06146239	0.273075075
2012	563.7077193	6.334535889	0.273073499
2013	740.7106202	6.607610023	0.273074134
2014	973.2917674	6.880683901	0.273073878
2015	1278.902903	7.153757882	0.273073981
2011-2015	3985.615357		

At TAB. II R-squared equals 0.612098 and DW 1.927476. The model was stationary and was not self-correlative. AMIRA(1,1,2) is superior to the others. Simultaneously the coefficients of AR(1), MA(1),

and MA(2) have passed the significant tests. By Eviews5.0 we have the forecasting results of FAI from 2011 to 2015 which showed at TAB. III. The results are not at constant prices but at current prices. But FAI will be much more than the result 398.5615357 billion yuan in TAB. III since the speed of development of Bijie in the 12<sup>th</sup> five-year plan period will be about 120% to 130%, more than about 121% of 11<sup>th</sup> plan period at current prices. FAI should be at least 700-billion yuan (more than 00-billion dollar) at current prices in the 12<sup>th</sup> Plan<sup>[5]</sup>.

### 3. FAI Forecasting with Cobb-Douglas Function

#### 3.1. Forecasting for the Quantity of Employment

According to the employment rate of Guizhou Province and the population of Bijie District we estimated the employment quantity of the District from 1995 to 2009. The quantity has linear relation with the number of years. The linear regression test results are shown in TAB. IV. and the model is as following

$$Y = -28713.99 + 14.52555T, T = 1995, 1996, \dots, 2015 \quad (1)$$

The employment time series forecast model test results are shown in TAB. V and the model was as following :

$$Y = 11.38940 + 0.948339u_{t-10} \quad (2)$$

The forecast results of the employment are shown in TAB. VI with 10-thousand as unit.

#### 3.2. GDP Forecasting with Development Speed of 11th Plan

From 2007 to 2009 GDP[4] of Bijie District had From 2007 to 2009 GDP[4] of Bijie District had development speed about 124.05% at current prices.

$$\sqrt[2]{\frac{a_{2009}}{a_{2007}}} = \sqrt[2]{\frac{500.1}{325}} \times 100\% \approx 124.05\%$$

And from 2005 to 2010 GDP development speed was about 121.1%. By the two speeds we forecasted GDP in 2015 in TAB. VII which is close to in [5].

#### 3.3. Forecasting Model with Scale Being Increasing

The logarithm form of Cobb-Douglas production function is

$$\ln Y = \beta_0 + \beta_1 \ln L + \beta_2 \ln K \quad (3)$$

Using Eviews5.0 we have LS estimation of the coefficients of (3) shown in TAB.VIII. from which we know the two

TABLE IV. LINEAR REGRESSION TEST RESULTS OF EMPLOYMENT QUALITY

Sample: 1995 2009 Included observations: 15				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-28713.99	1189.386	-24.14186	0.0000
T	14.52555	0.594098	24.44977	0.0000
R-squared	0.978716	Mean dependent var	366.1581	
Adjusted R-squared	0.977079	S.D. dependent var	65.66277	
S.E. of regression	9.941155	Akaike info criterion	7.554809	
Sum squared resid	1284.745	Schwarz criterion	7.649216	
Log likelihood	-54.66107	F-statistic	597.7912	
Durbin-Watson stat	0.818890	Prob(F-statistic)	0.000000	

TABLE V. TIME SERIAL TEST RESULTS OF EMPLOYMENT QUALITY

Backcast: 1986 1995				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.38940	1.888429	6.031151	0.0001
MA(10)	0.948339	0.055913	16.96087	0.0000
R-squared	0.847709	Mean dependent var	13.28929	
Adjusted R-squared	0.835018	S.D. dependent var	8.904053	
S.E. of regression	3.616649	Akaike info criterion	5.540536	
Sum squared resid	156.9618	Schwarz criterion	5.631830	
Log likelihood	-36.78375	F-statistic	66.79636	
Durbin-Watson stat	1.666491	Prob(F-statistic)	0.000003	

TABLE VI. EMPLOYMENT QUANTITY FORECASTING OF THE DISTRICT

year	Employment: Linear model	Employment: MA(10)
2010	482.3655(10-thousand)	478.56(10-thousand)
2011	496.891	490.748
2012	511.4166	502.9463
2013	525.9421	514.4026
2014	540.4677	528.1402
2015	554.9933	539.6833

coefficients were significant and the constant was not sig.. Finally we choose the following model in which returns to scale be increasing ( $\alpha + \beta > 1$ ):

$$\ln \widehat{GDP} = 0.71845 \ln K + 0.359039 \ln L \quad (4)$$

Restored (4) to

$$\widehat{GDP} = K^{0.71845} L^{0.359039} \quad (\alpha + \beta > 1) \quad (5)$$

### 3.4. Forecast Model of Constant Returns to Scale

Suppose we have  $\alpha + \beta = 1$  when the Cobb-Douglas production function has constant returns to scale (CRTS). Then it can be transformed to:

$$\ln Y = \alpha + (1 - \beta) \ln L + \beta \ln K + u \quad (6)$$

That is

$$\ln Y / L = \alpha + \beta \ln K / L + u \quad (7)$$

We have LS estimation results for production of CRTS in TAB. IX from the data set of  $Y / L$  and  $K / L$ . The coefficients are both significant by TAB. IX. The model is

$$\ln \widehat{GDP} / L = 0.506658 + 0.747862 \ln K / L \quad (8)$$

which might be changed as

$$\widehat{GDP} = 1.659735 K^{0.747862} L^{0.25214} \quad (\alpha + \beta = 1) \quad (9)$$

We used some forecasting data of employment quantity and GDP with some original data to get above (5) and (9).

### 3.5. FAI Forecast with CD Production and Analysis

In TAB. X we got the FAI forecasting results with Cobb- Douglas production function when GDP development speed would be 124.05% and 130% with employment quantity forecasted by linear model (1) and time serial model

TABLE VII. GDP FORECASTING : UNIT OF 100-MILLION YUAN

	Speed of 124.05%	Speed of 121.1%
2010	620.37405	605.12
2011	769.574009	732.20
2012	954.6565582	885.96
2013	1184.25146	1072.01
2014	1469.063937	1297.13
2015	1822.373813	1569.53

TABLE VIII. LEAST SQUARE RESULTS OF CD PRODUCTION FUNCTION (1)

Sample: 1995 2009  
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNK	0.718450	0.075122	9.563797	0.0000
LNL	0.359039	0.054090	6.637742	0.0000
R-squared	0.929869	Mean dependent var	5.122571	
Adjusted R-squared	0.924474	S.D. dependent var	0.583797	
S.E. of regression	0.160439	Akaike info criterion	-0.698239	
Sum squared resid	0.334629	Schwarz criterion	-0.603833	
Log likelihood	7.236795	Durbin-Watson stat	0.286213	

TABLE IX. LEAST SQUARE ESTIMATION RESULTS OF CRTS FUNCTION (5)

Sample: 1995 2009  
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.506658	0.145015	3.493838	0.0040
LNP	0.747862	0.081790	9.143665	0.0000
R-squared	0.865434	Mean dependent var	-0.765093	
Adjusted R-squared	0.855082	S.D. dependent var	0.417562	
S.E. of regression	0.158958	Akaike info criterion	-0.716793	
Sum squared resid	0.328478	Schwarz criterion	-0.622386	
Log likelihood	7.375949	F-statistic	83.60661	
Durbin-Watson stat	0.288721	Prob(F-statistic)	0.000001	

MA(10). Respectively FAI forecasting values are 448.9658 and 613.447 etc. billion yuan at current prices.

China will strive to develop its western part which includes Bijie District in the 12<sup>th</sup> economy development plan. And Guizhou has an industrial 12<sup>th</sup> plan to build the Province into a strong industrial one. People have expected with CPI to develop its economy at a development speed of between 120% to 130%, though made the speed of 112% except CPI carefully. In the 12<sup>th</sup> plan period Bijie District will have a very important industry cluster speeding process. From 2011 to 2015 if Bijie has the economy development speed of 130% its FAI will be even more than 600 billion yuan at current prices as predicted in TAB. X.

The development of western part such like Guizhou Province including Bijie District were lagged seriously when the economy of the southeastern part of China soared in the last 30 years. Present GDP of Bijie District were still very low so that a speed between 120% to 130% or more in the next five-year plan period will be suitable for the developing District. Like the speed of 11<sup>th</sup> plan period, from 2005 to 2010, was about 121% at current prices.

Guizhou Province including Bijie District has developed critical conditions for the economy soaring. Such like the traffic projects of international airports, super highway and high speed rail way, international financial projects and organs would have been carried out. Now people in Guizhou including Bijie District are attracting investment all-out. Actually FAI between 700 to 900 billion yuan at current prices in 12<sup>th</sup> plan period will be quite possible in Bijie District if capital raising is smooth and enough since the District has so many construction and industrial projects which need lots of investments. For example only the high speed railway will need to be invested about 100 billion yuan and super high way and other traffic highway will need

TABLE X. FAI FORECASTING WITH CD PRODUCTION FUNCTION

year	GDP at speed of 124.05%	Linear Forecast Employ	Forecasting FAI	
			$\alpha + \beta > 1$	$\alpha + \beta = 1$
2011	769.574009	496.891	467.6242	452.9815
2012	954.656582	511.4166	622.1847	598.4313
2013	1184.25146	525.9421	828.1651	790.7994
2014	1469.063937	540.4677	1102.758	1045.274
2015	1822.373813	554.9933	1468.926	1381.973
2011-15	6199.92		4489.658	4269.459
year	GDP at speed of 124.05%	MA(10) Forecast Employ	Forecasting FAI	
			$\alpha + \beta > 1$	$\alpha + \beta = 1$
2011	769.574009	490.748	470.5404	454.8854
2012	954.656582	502.9463	627.3994	601.8104
2013	1184.25146	514.4026	837.3978	796.7364
2014	1469.063937	528.1402	1115.547	1063.437
2015	1822.373813	539.6833	1489.605	1395.068
2011-15	6199.92		4540.489	4301.937
year	GDP at speed of 130%	MA(10) Forecast Employ	Forecasting FAI	
			$\alpha + \beta > 1$	$\alpha + \beta = 1$
2011	845.169	490.748	536.09	515.60
2012	1098.72	502.9463	762.96	726.24
2013	1428.336	514.4026	1086.96	1023.62
2014	1856.836	528.1402	1545.57	1440.92

2015	2413.887	539.6833	2202.89	2301.58
2011-15			6134.47	5737.97
year	GDP at speed of 130%	Linear Forecast Employ	Forecasting FAI	
			$\alpha + \beta > 1$	$\alpha + \beta = 1$
2011	845.169	496.891	532.77	513.44
2012	1098.72	511.4166	756.62	722.16
2013	1428.336	525.9421	1074.97	1016.00
2014	1856.836	540.4677	1527.85	1429.76
2015	2413.887	554.9933	2172.30	2012.51
2011-15			6064.52	5693.87

about 70 billion yuan. The sum total 170 billion yuan is more than 25 billion US dollar. After the traffic projects are completed, some has been done by now, the passengers and goods needs only about 4 hours to get Guangzhou and other international commercial harbor cities.

#### 4. Adjusting Industrial Structure

In 12<sup>th</sup> plan period Bijie District plans to have 250 billion yuan FAI for industrials totally and to get more than 180 billion yuan of gross industrial output. The District has projects of 160 billion yuan output to expand five mainstay industrials: coal, electric power, chemical industrial, equipment manufacture industrial, liquor and tobacco including in farming and light industry. Five industrial clusters, each will have more than 10 billion output, will be formed: power energy sources, equipment industry, chemical industry, light industry, building and new materials industry. Among the five industry clusters energy sources has been planed to have 10 billion yuan output.

In 2015 Coal industry of Bijie District has been expected to have between 100 to 120 million ton coal output, about one thirty-eighth of the planed coal consumption of China. The total coal industrial output value planed to be 70 billion yuan, more than 10 billion US dollar. Meanwhile Total installed power capacity of 14 million kilowatts and 30 billion yuan output value of power also be expected. Most of the power is come from coal power. The coal- chemical and phosphorus chemical industries were also need coal output in the District. So about half industrial output value will come from coal, coal power and coal chemical industry. Actually half of the industrial output value will depend on coal energy source in 12<sup>th</sup> plan period.

For economy balance of the industries people in Bijie District plan to control and restrict the development of mining industry, coal energy industry and coal related industry such that to transform and adjust the industrial structure. This is very important for sustainable development of the economy. So in the 12<sup>th</sup> plan period Bijie District will develop Ten Industries including food industry and drug, textile and clothes, metallurgy, tourism goods and new industry besides others we mention before. The Ten Industries are eager for lots of FAI.

#### 5. FAI Increasing in Environment Protection, Water Conservancy and Livelihood

Besides the FAI for the industrials Bijie District will have lots of investment in environment protection, water conservancy and livelihood in the 12<sup>th</sup> planning projects.

For example, the production value of industries of Bijie mainly comes from coal, coal power and coal chemical related industrials even after adjust the industrial structure since Bijie District is full of coal source. In the 12<sup>th</sup> plan period the coal production will come at 100-million ton in Bijie District. So People in Bijie plan to have enough investment to protect coal production land area from the geological disaster, collapse and soil erosion such that to accept the experience of resource economy transformation from Ruhr in German, Houston in US, Kitakyushu in Japan, some northern province which had 20-thousand square kilometer land area, about one-eighth of its land area, became mining up region in the coal production and mining production. To protect precious soil source people in Guizhou including Bijie plan to invest enough funding in conducting reclamation after the completion of mining operation. Qianxi, a county in Bijie District has had the experience measures of the reclamation analyzed in [7].

Another important investment field would be the water conservancy. Guizhou is a province of beautiful Karst topography and its abundant water source may leak in vain. In 12<sup>th</sup> plan period China plans to invest 4000-billion yuan for water conservancy. Bijie District also plans to increase corresponding investment.

Other livelihood, such like social security, education, hospital, city construction, etc. will have increasing FAI in the 12<sup>th</sup> plan also. Economist Li Yining, professor of Beijing University, advised that in the urbanization construction process, we may adopt the advanced experience of the developed countries or regions to take marketization operational pattern to found public utilities investment funds which should be rolling development. He also pointed minitype enterprises should be supported vigorously to expand employment.

## 6. Discussion

In the 12<sup>th</sup> plan period Bijie District will have soaring processes of economy and investment chances. Finance will be smooth for the District and the FAI will be at about 700- billion yuan, 105-billion US dollar, or more. GDP will have a development speed of 120% to 130% or more. Environment protection, water conservancy and livelihood such like social security, education, medical system, etc. will also have huge investment funds besides industrials.

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