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## APPENDIX I

### FORECASTING GAS AND CONDENSATE PRICES-TIME SERIES

#### APPROACH

The Time-Series model which is developed by Box-Jenkin<sup>12</sup> was selected for estimating Gas and Condensate price. In building forecasting models, the general Autoregressive Integrated Moving Average (ARIMA) model of order p, d, q is considered. The ARIMA process is defined by the equation

$$\phi(B)(1-B)^d Z_t = \theta_0 + \theta(B) a_t$$

where

$$\phi(B) = 1 - \phi_1 B - \phi_2 B^2 - \phi_3 B^3 - \dots - \phi_p B^p$$

$$\theta(B) = 1 - \theta_1 B - \theta_2 B^2 - \theta_3 B^3 - \dots - \theta_q B^q$$

$Z_t$  is gas (condensate) price at time t.

d is the degree of differencing, B denotes the backward shift operator, defined by  $B^i Z_t = Z_{t-i}$ , and  $a_t$  is white noise randomly drawing from a fixed probability distribution,  $\phi(B)$  is the weight parameter of autoregressive operator and  $\theta(B)$  is the weight parameter of moving average operator.

#### Step 1 Data preparation

Gas and Condensate price data of Erawan Field in Baht / MMBTU were collected quarterly from the Royalty Payment Filing. There are 54 observations of Gas Price and 55 observations of Condensate Price. Figure 4.1 and 4.2 show the plot of quarterly Erawan Gas Price and quarterly condensate price.

## Step 2 Identification of the ARIMA model

To identify the ARIMA model plots of autocorrelation and partial autocorrelation of  $Z$ ,  $\nabla Z$  and  $\nabla^2 Z$  are obtained.

$$\begin{aligned} \text{where } Z_t &= Z_t \\ \nabla Z_t &= Z_t - Z_{t-1} \\ \nabla^2 Z_t &= (1 - B)_2 Z_t, \end{aligned}$$

The autocorrelation can be calculated as follows:

$$\begin{aligned} r_k &= \frac{C_k}{C_0}, \quad C_0 = \frac{1}{N} \sum_{t=1}^{N-k} (Z_t - \bar{Z})^2 \\ \text{where } C_k &= \frac{1}{N} \sum_{t=1}^{N-k} (Z_t - \bar{Z})(Z_{t+k} - \bar{Z}) \\ \text{such that } k &\leq \frac{N}{4} \quad k = 0, 1, 2, \dots, k \\ \text{and } \bar{Z} &= \frac{1}{N} \sum_{t=1}^N Z_t \end{aligned}$$

The partial autocorrelation can be calculated as follows:

$$\begin{aligned} r_1 &\text{ for } l = 1 \\ \hat{\phi}_{ll} &= \frac{r_l - \sum_{j=1}^{l-1} \hat{\phi}_{l-1,j} r_{l-j}}{1 - \sum_{j=1}^{l-1} \hat{\phi}_{l-1,j} r_j} \quad \text{for } l = 2, 3, \dots, l \\ \text{where } \hat{\phi}_{lj} &= \hat{\phi}_{l-1,j} - \hat{\phi}_{ll} \hat{\phi}_{l-1,1,j}, \quad j = 1, 2, \dots, l-1 \end{aligned}$$

The results of calculating autocorrelation and partial autocorrelation of gas and condensate price as shown in Table 1.1a and 1.2a and plots are as shown in Figure 1.1a – 1.1f and 1.2a – 1.2f

From the above figures, the autocorrelation function of Gas Price Series has a cut off after lag 1 (only  $\hat{\phi}_{11}$  nonzero) suggest the model of ARIMA (1, d, o) and the

roughly exponential fall-off in the correlation for the zero difference, suggest the model is AR (1, 0, 0) and the general equation is as follow:

$$(1 - \phi B) Z_t = a_t$$

For condensate price, the autocorrelation and partial autocorrelation have pattern in the same as those of Gas Price , the model of this Condensate Price series is also AR (1, 0, 0).

### Step 3 Estimation Autoregressive parameter

After the identification stage, the autoregressive parameter ( $\phi$ ) was estimated. The method of unconditional likelihood function was used because of its advantages in estimating parameters than the conditional likelihood function method. Using the unconditional likelihood (or the sum of squares function or least squares estimates), the parameter ( $\phi$ ) was initial estimated. For our first-order Autoregressive , AR (1, 0, 0), initial estimates for  $\phi_1$  can be obtained by replacing the theoretical autocorrelation  $\rho_k$  by the estimated autocorrelations  $r_k$  in Yule-Walker equation. Then ,  $\phi_1 = r_1$  (lag1 autocorrelations), Initial estimate parameters ( $\phi$ ) are 0.7 for Gas Price Model and 0.9 for Condensate Price Model.

The unconditional sum of squares function is given by

$$S(\phi) = \sum_{t=1}^n [ a_t | \phi, \bar{Z}_t ]^2$$

Where  $\bar{Z}_t = \bar{Z}_1, \bar{Z}_2, \dots, \bar{Z}_n$

$n$  = total number of observations

$[ a_t | \phi, \bar{Z}_t ]$  = the expectation of  $a_t$  conditional on  $\phi$  and  $\bar{Z}_t$

For an AR (1,0,0) we have

$$(1 - \phi B) \bar{Z}_t = a_t$$

and we can write,  $(1 - \phi F) \bar{Z}_t = e_t$

where  $e_t$  is a sequence of independently distributed random (backward process)

variable having zero and variance  $\delta_{e^2} = \delta_a^2$

$$\text{and} \quad F \bar{Z}_t = \bar{Z}_{t+1}$$

$$\text{therefore} \quad [a_t] = [\bar{Z}_t] - \phi [\bar{Z}_{t-1}] \quad \text{-(A)}$$

$$\text{and} \quad [e_t] = [\bar{Z}_t] - \phi [\bar{Z}_{t-1}] \quad \text{-(B)}$$

These two equations were used to evaluate  $S(\phi)$  with varying  $\phi$  in the range that cover initial estimate parameter. In these cases, for gas price,  $S(\phi)$  was calculated with 6 values of  $\phi$  ( $\phi = 0.65, 0.68, 0.69, 0.70, 0.72, 0.75$ ) and for condensate price,  $S(\phi)$  was calculated with 8 values of  $\phi$  ( $\phi = 0.80, 0.83, 0.85, 0.88, 0.89, 0.90, 0.91$  and  $0.92$ ).

The  $\phi$  value that gave the smallest value of  $S(\phi)$  was chosen to be the required parameter. After comparison, The  $\phi = 0.69$  is the required parameter for gas price and  $\phi = 0.9$  is the required parameter for condensate price.

Then, Gas Price model is:  $(1 - 0.69B) Z_t = a_t$

and Condensate Price model is:  $(1 - 0.9B) Z_t = a_t$

#### Step 4 Forecasting Gas and Condensate Price

Standard deviation was used to check the model by forecasting  $Z_t$  (data value) at any point of time and compare with actual data as shown in Figure 1.1g and 1.2g.

Then the gas and condensate price from the year 1997 can be estimated.

Table 1.1a Autocorrelations and Partial Autocorrelations of Erawan Gas Price

		Autocorrelations														
54 observations																
Z	lag1-15	0.7035	0.5015	0.4008	0.3471	0.1784	0.1098	0.0810	0.0995	-0.0506	-0.1059	-0.1015	-0.0419	-0.2096	-0.2692	-0.2206
VZ	lag1-15	-0.1602	-0.1551	-0.0704	0.2274	-0.1902	-0.0942	-0.0876	0.3307	-0.1743	-0.1206	-0.0917	0.4200	-0.2146	-0.1984	-0.0383
V2Z	lag1-15	-0.5047	-0.0334	-0.0917	0.3089	-0.2167	0.0352	-0.1806	0.4006	-0.2382	0.0081	-0.2095	0.4976	-0.2810	-0.0635	-0.0290
		Partial Autocorrelations														
Z	lag1-15	0.7035	0.0131	0.0860	0.0642	-0.2178	0.0626	0.0024	0.0828	-0.2606	0.0132	0.0186	0.0906	-0.3274	-0.0211	0.0872
VZ	lag1-15	-0.1602	-0.1855	-0.1377	0.1705	-0.1643	-0.1096	-0.1662	0.2213	-0.0970	-0.1135	-0.1660	0.2766	-0.0918	-0.1977	-0.1236
V2Z	lag1-15	-0.5047	-0.3866	-0.4894	-0.0911	-0.1387	-0.0842	-0.4065	-0.0530	-0.0385	-0.0021	-0.4170	-0.0243	0.0696	-0.0239	-0.0521

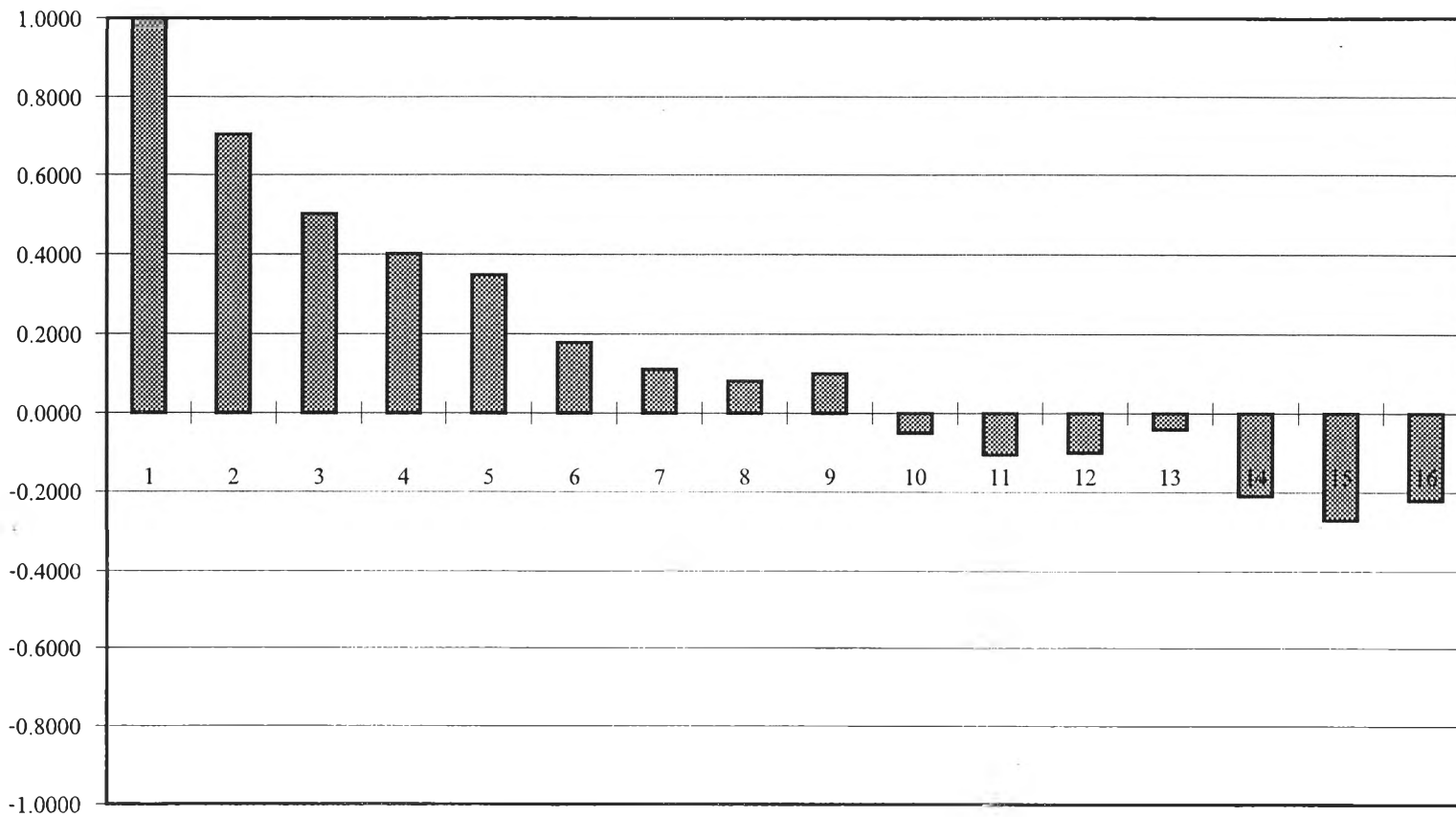


Figure 1.1a Autocorrelation Function of Z of Erawan Gas Price



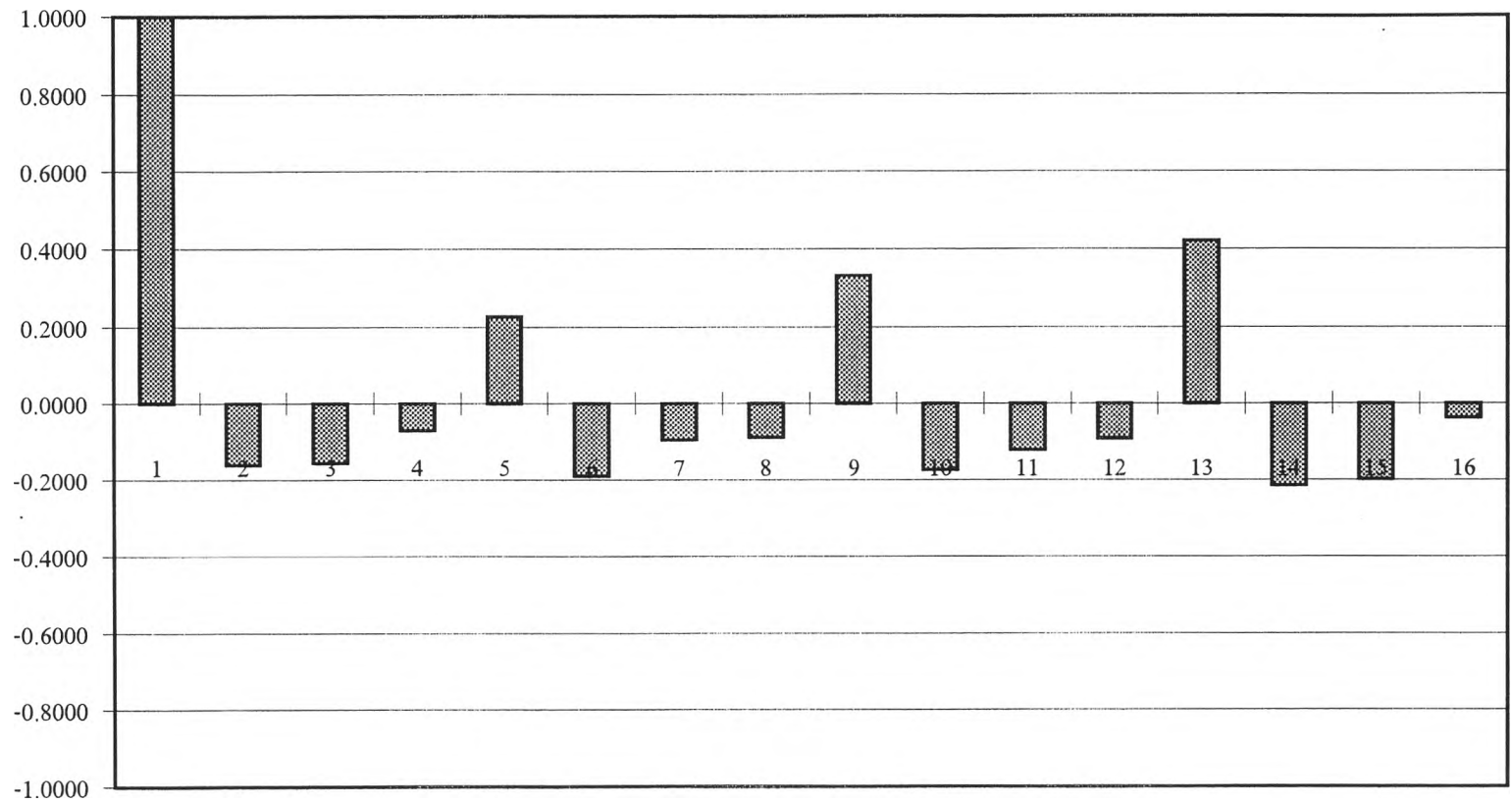


Figure 1.1b Autocorrelation Function of VZ of Erawan Gas Price

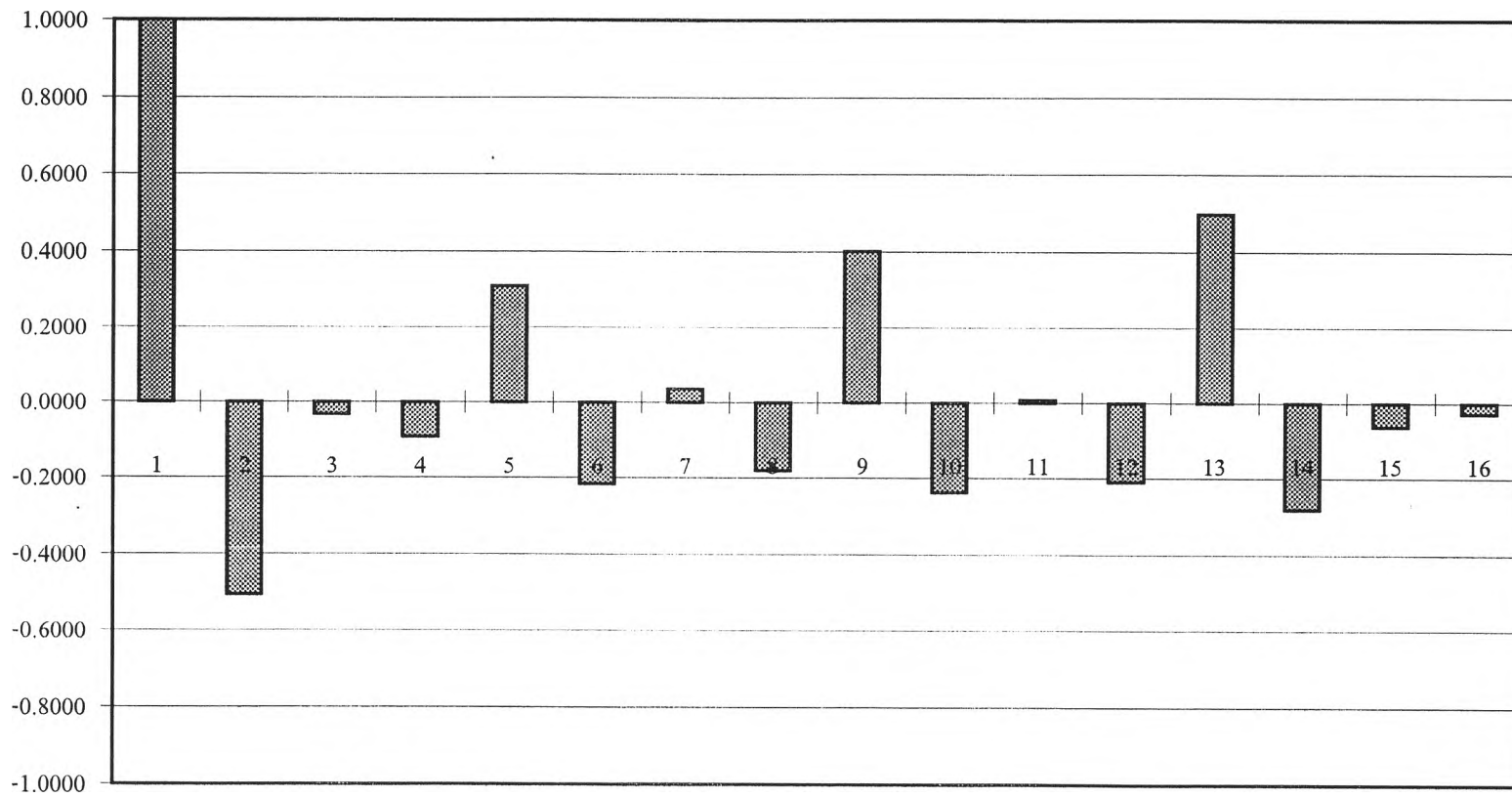


Figure 1.1c Autocorrelation Function of V2Z of Erawan Gas Price

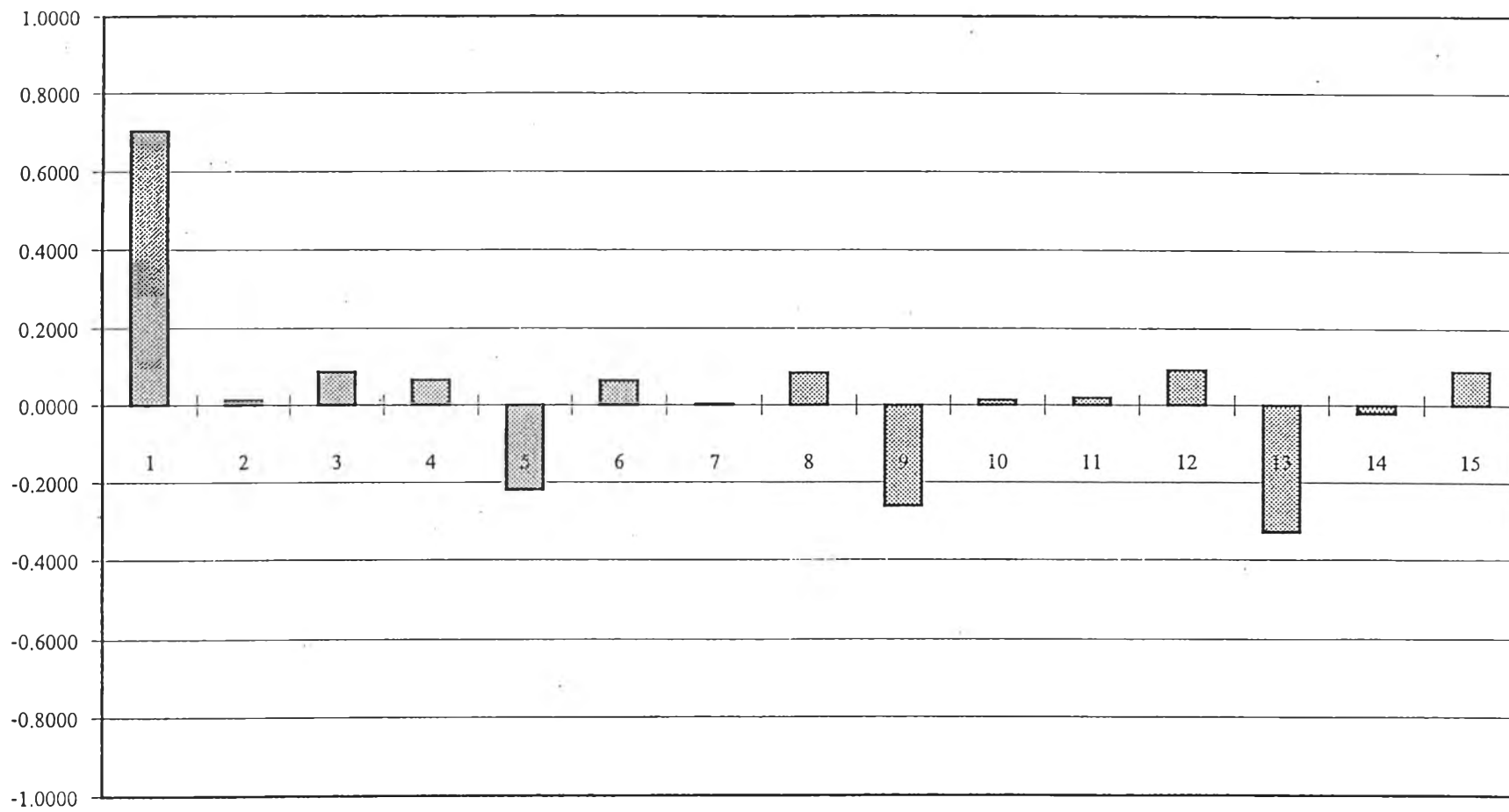


Figure 1.1d Partial Autocorrelation Function of Z of Erawan Gas Price

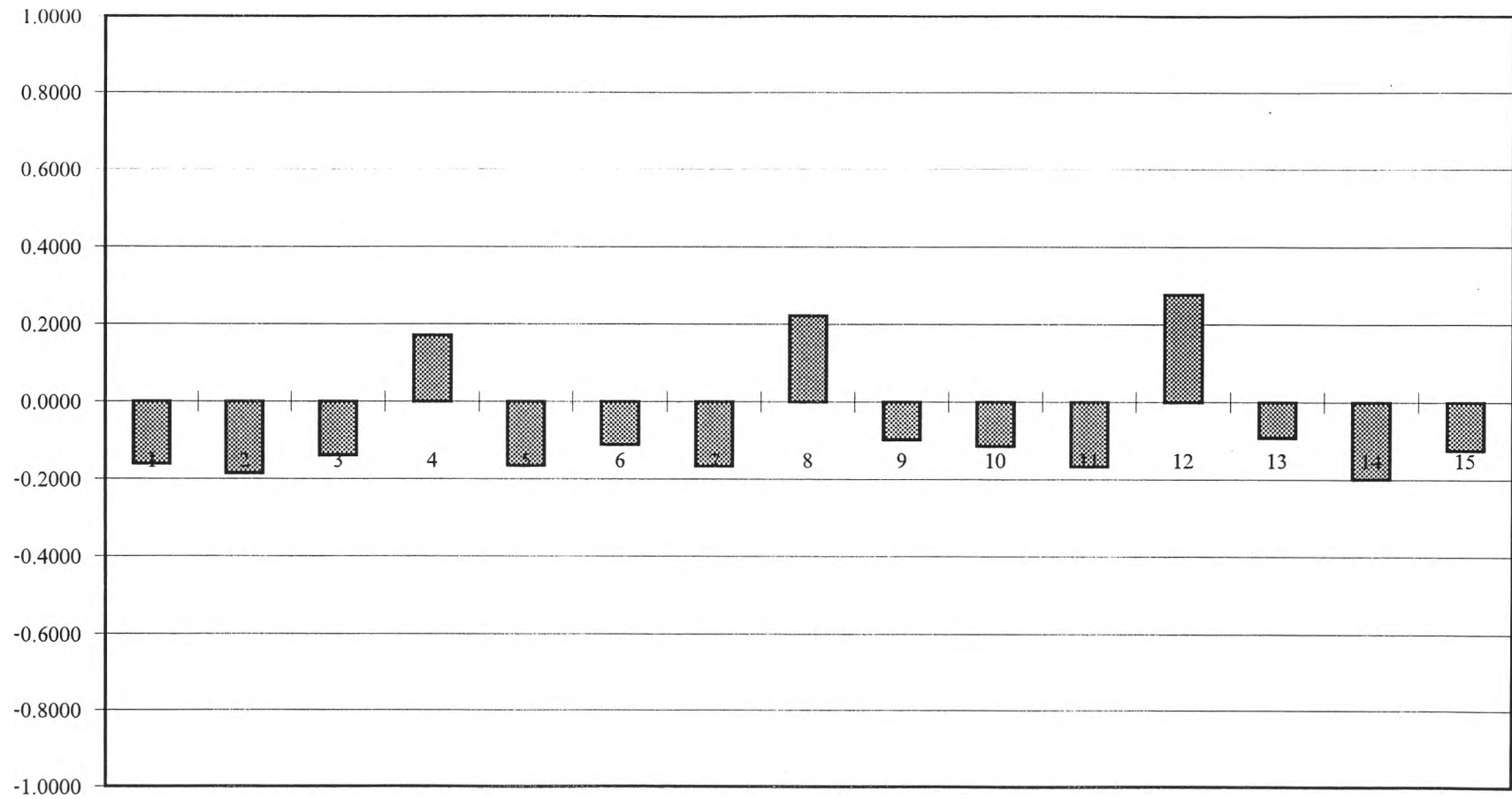


Figure 1.1e Partial Autocorrelation Function of VZ of Erawan Gas Price

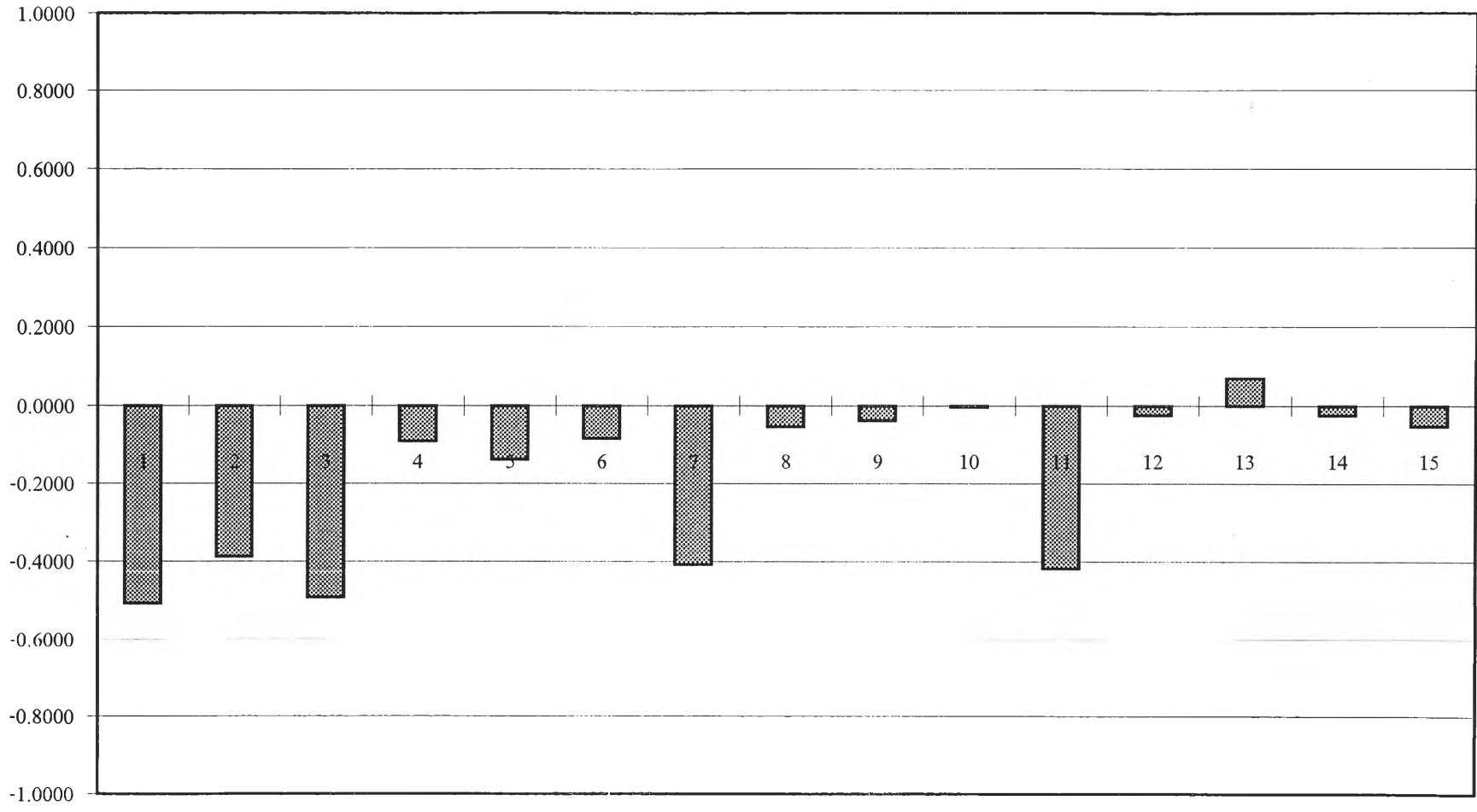


Figure 1.1f Partial Autocorrelation Function of V2Z of Erawan Gas Price

Table 1.1b Estimate Parameter of Model AR(1,0,0) of Erawan Gas Price

t	(at) <sup>2</sup>	( at)	0.70(Zt-1)	(Zt)	0.70(Zt+1)	(et)
	1.71243					
t	(at) <sup>2</sup>	( at)	0.68(Zt-1)	(Zt)	0.68(Zt+1)	(et)
	1.71295					
t	(at) <sup>2</sup>	( at)	0.72(Zt-1)	(Zt)	0.72(Zt+1)	(et)
	1.71442					
t	(at) <sup>2</sup>	( at)	0.75(Zt-1)	(Zt)	0.75(Zt+1)	(et)
	1.72					
t	(at) <sup>2</sup>	( at)	0.65(Zt-1)	(Zt)	0.65(Zt+1)	(et)
	1.72					
t	(at) <sup>2</sup>	( at)	0.69(Zt-1)	(Zt)	0.69(Zt+1)	(et)
	1.71236					

Since (at)<sup>2</sup> of O = 0.69 is the least , then parameter of this AR model is 0

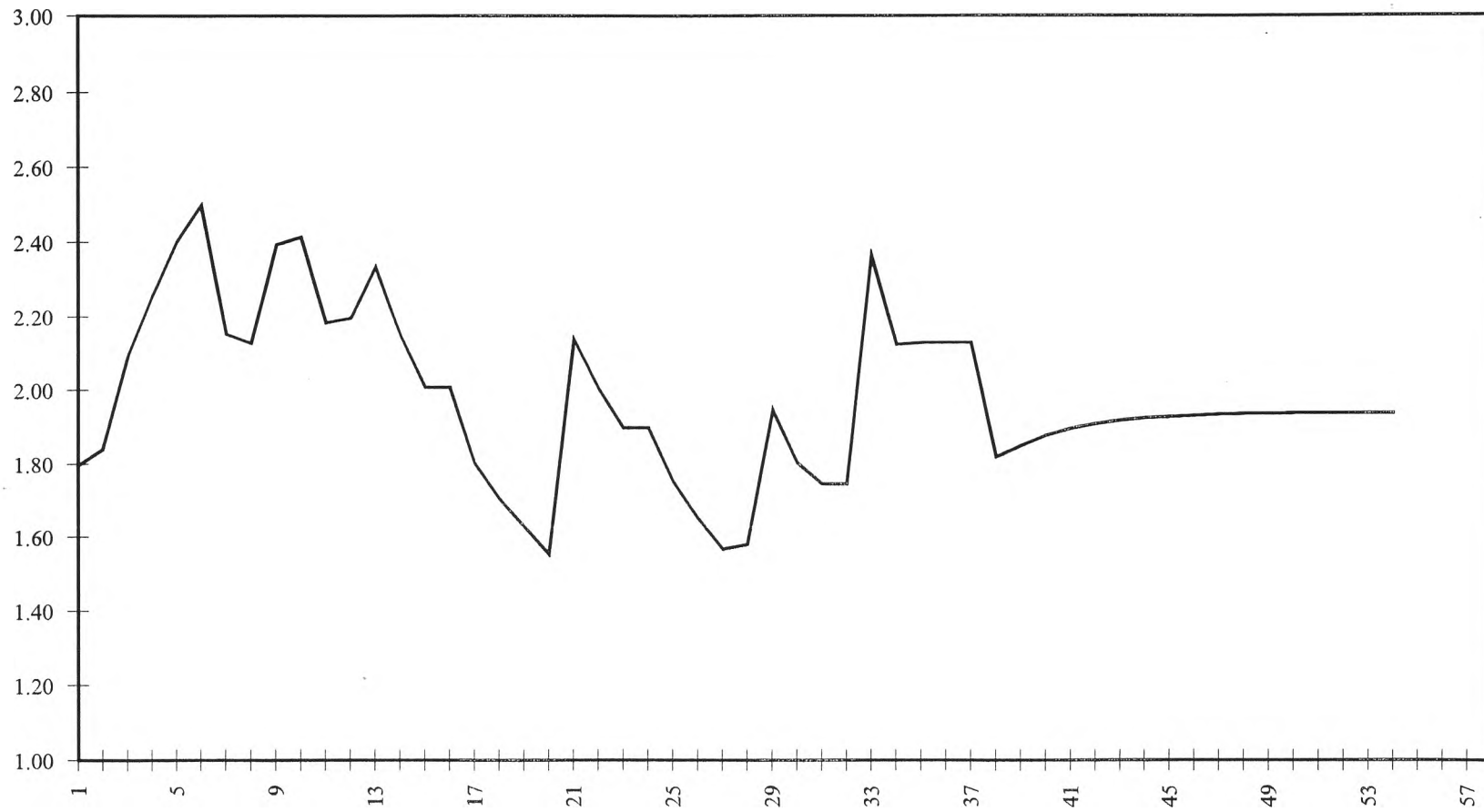


Figure 1.1g Forecasting Erawan Gas Prices at any point of time

Table 1.2a Autocorrelations and Partial Autocorrelations of Erawan Condensate Price

		Autocorrelations														
55 Observations																
Z	lag 1-15	0.8344	0.6712	0.5782	0.4842	0.3777	0.2883	0.1949	0.0814	0.0066	-0.0608	-0.1825	-0.2645	-0.2335	-0.1954	-0.1761
VZ	lag 1-15	0.0212	-0.2695	0.0301	0.0618	-0.0605	-0.0826	0.1394	-0.1452	0.0293	0.2318	-0.1404	-0.1159	-0.0037	0.0017	0.0249
V2Z	lag 1-17	-0.3441	-0.3082	0.1349	0.0899	-0.0502	-0.1330	0.2649	-0.2372	-0.0205	0.3058	-0.2021	-0.0490	0.0541	-0.0104	0.0205
		Partial Autocorrelations														
Z	lag 1-15	0.8344	-0.0827	0.1354	-0.0675	-0.0648	-0.0195	-0.0946	-0.1285	0.0276	-0.0858	-0.2333	0.0253	0.2219	0.0397	0.0398
VZ	lag 1-15	0.0212	-0.2701	0.0465	-0.0146	-0.0451	-0.0725	0.1249	-0.2126	0.1446	0.1341	-0.1423	0.0104	-0.0736	-0.0902	0.1216
V2Z	lag 1-17	-0.3441	-0.4839	-0.2799	-0.1806	-0.1198	-0.2619	0.1008	-0.2557	-0.1769	0.1281	-0.0609	0.0423	0.0462	-0.1729	0.0337



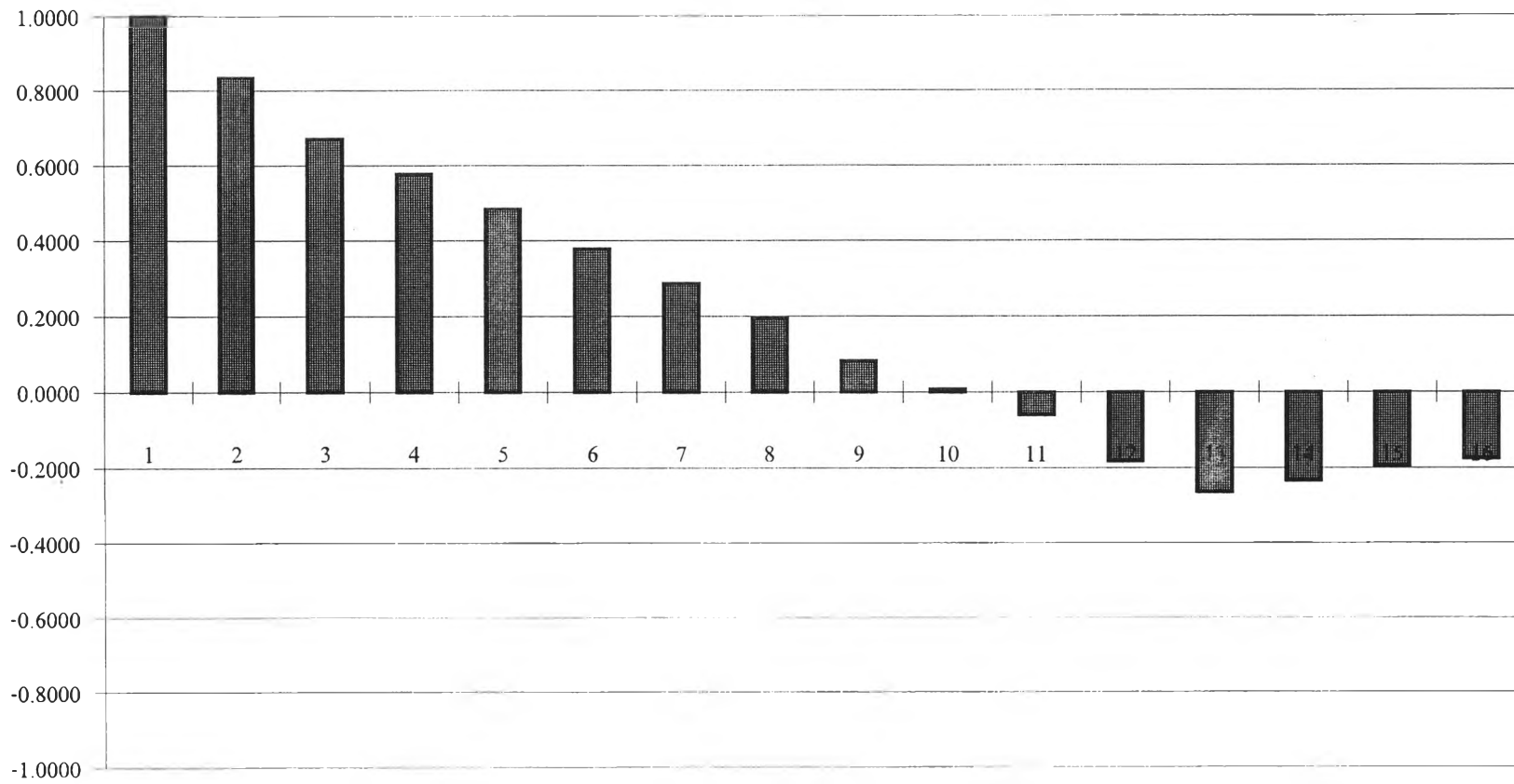


Figure 1.2a Autocorrelation Function of Z of Erawan Condensate Price

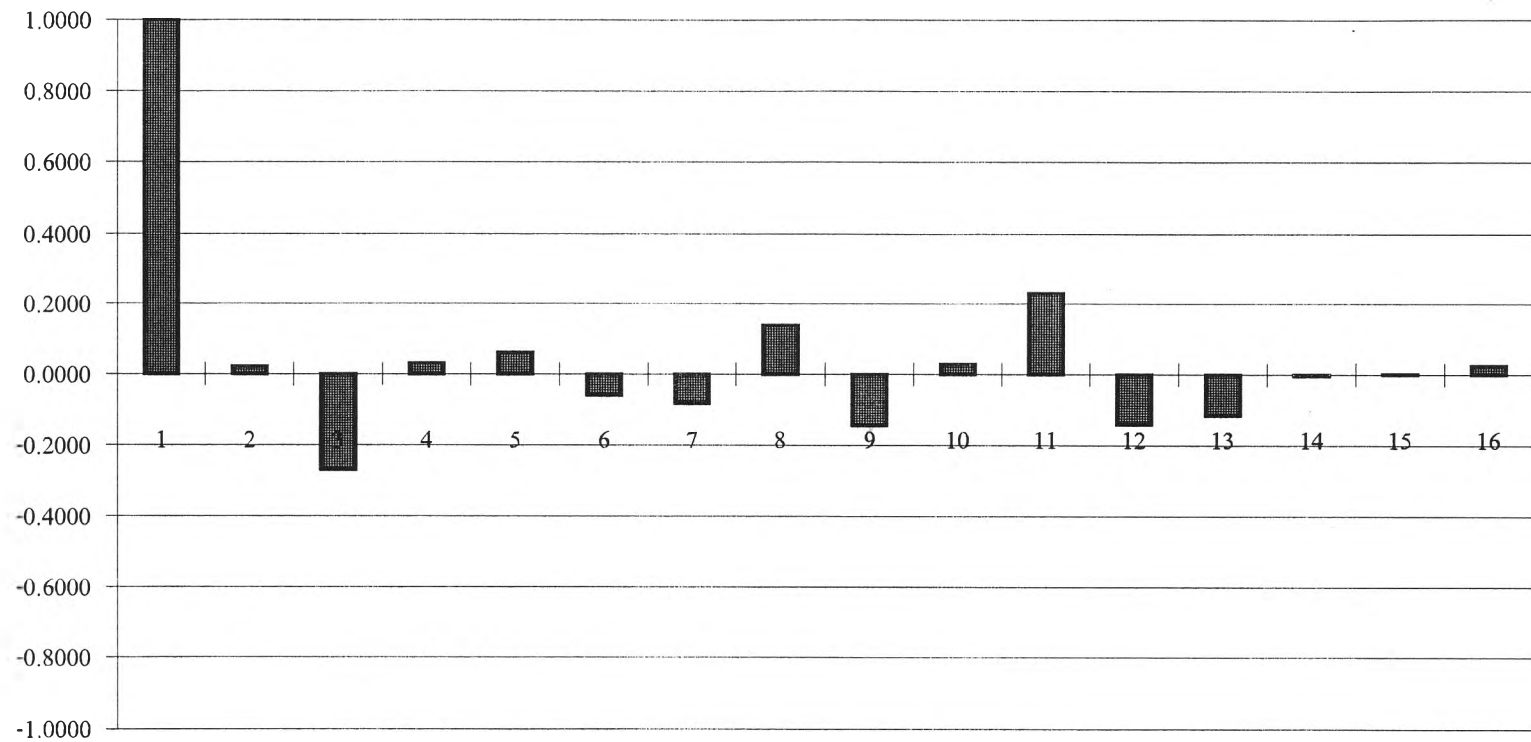


Figure 1.2b Autocorrelation Function of VZ of Erawan Condensate Price

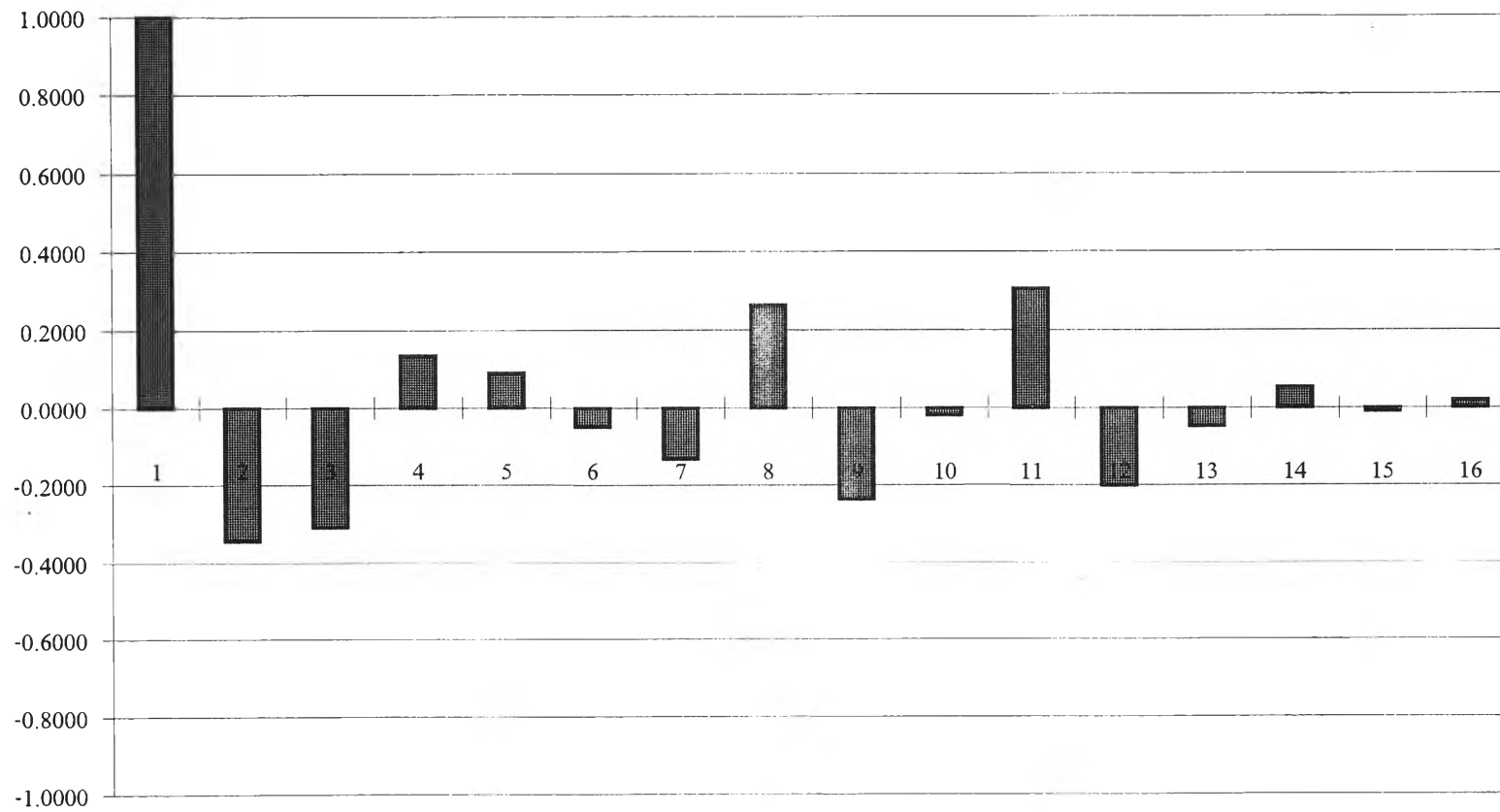


Figure 1.2c Autocorrelation Function of V2Z of Erawan Condensate Price

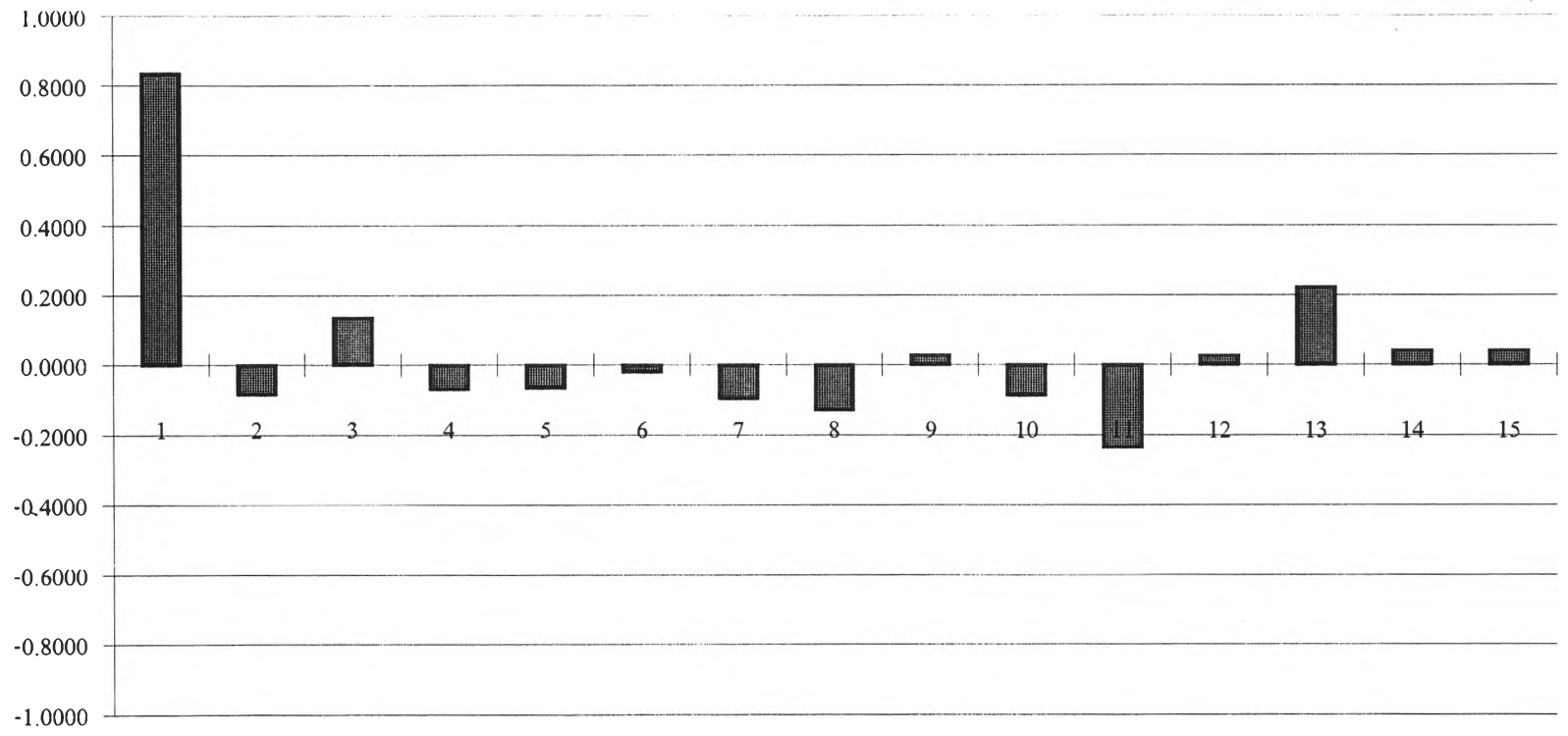


Figure 1.2d Partial Autocorrelation Function of Z of Erawan Condensate Price

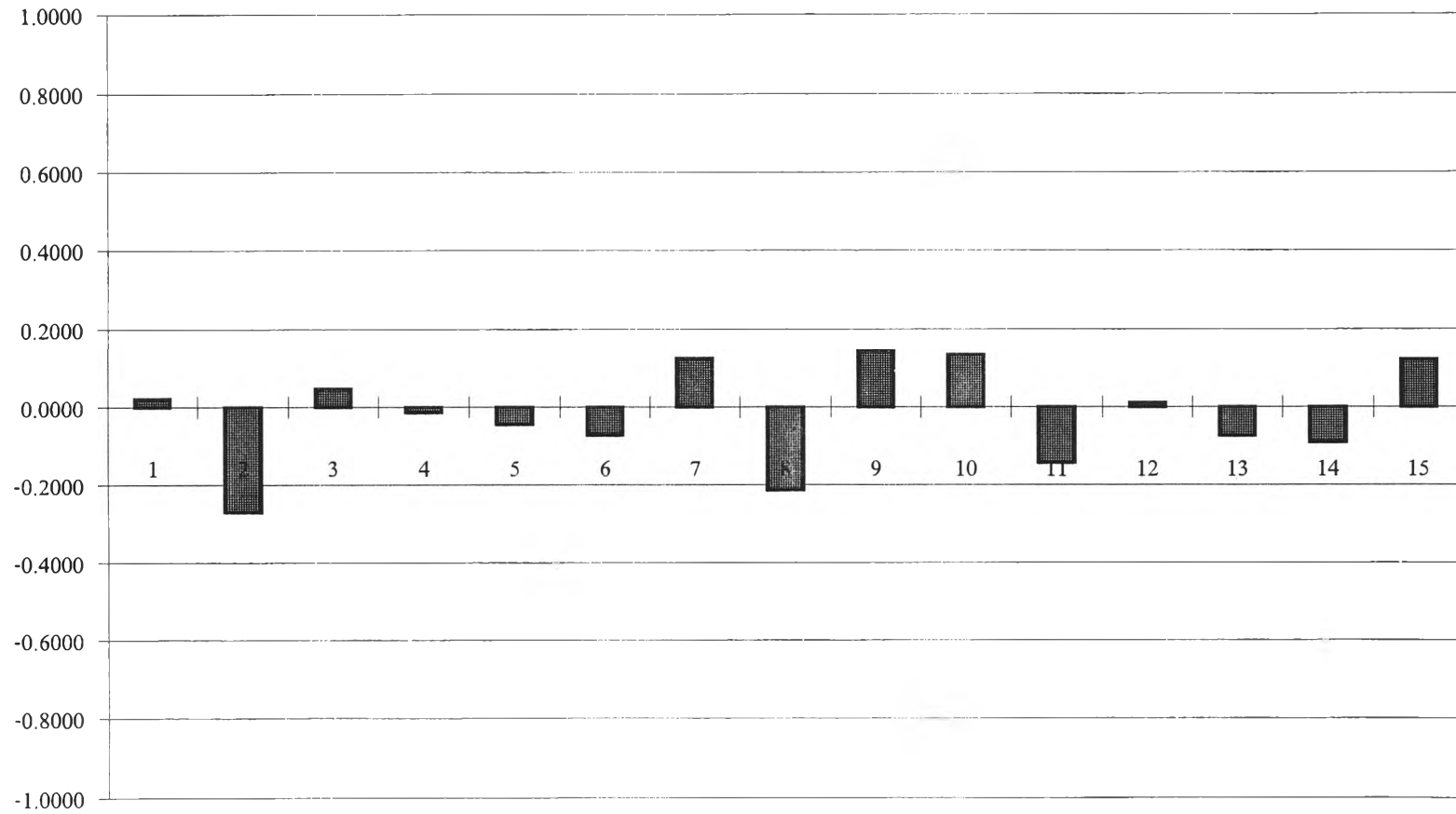


Figure 1.2e Partial Autocorrelation Function of VZ of Erawan Condensate Price

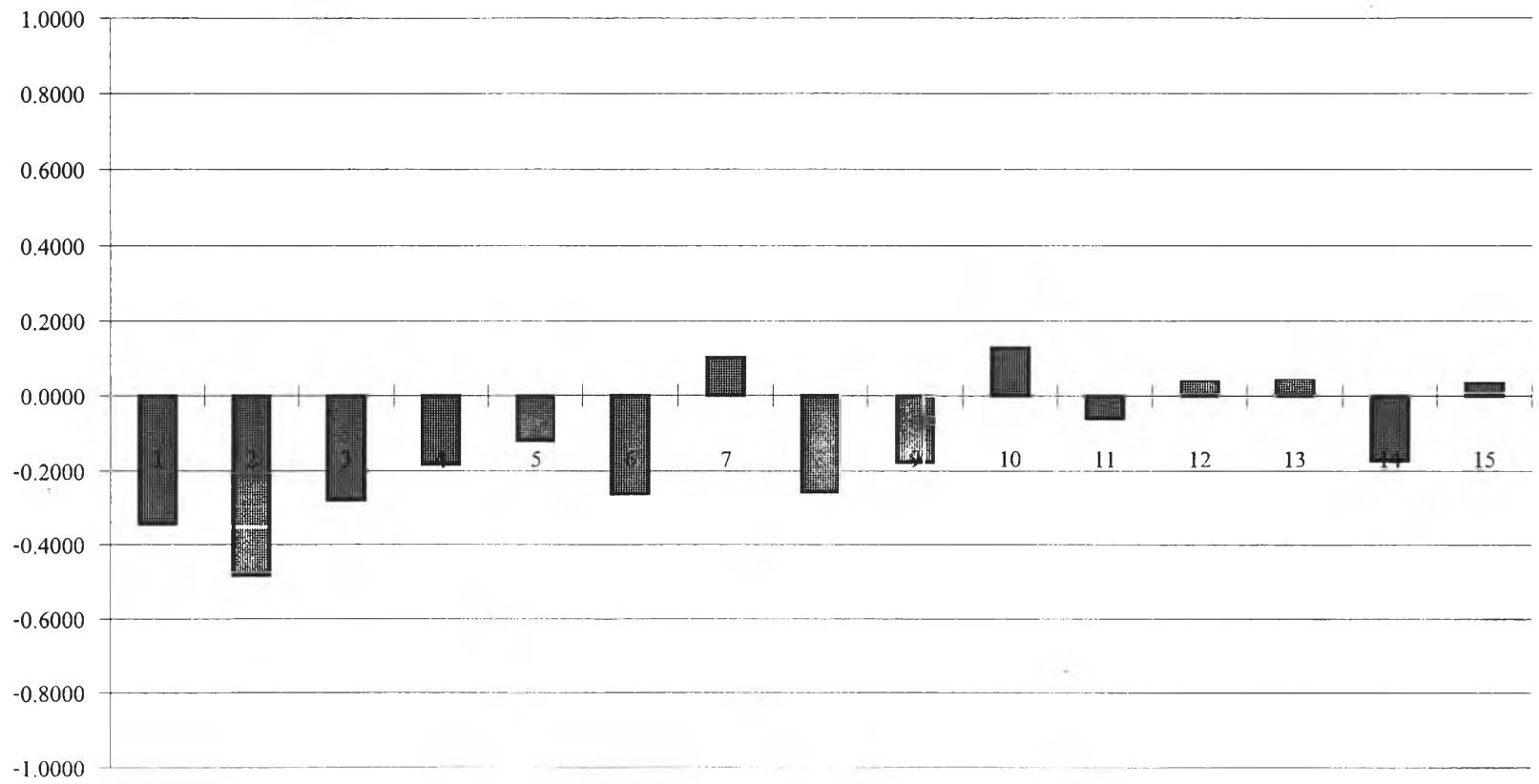


Figure 1.2f Partial Autocorrelation Function of V2Z of Erawan Condensate Price

Table 1.2b Estimate Parameter of Model AR(1,0,0) of Erawan Condensate Price

t	(at) <sup>2</sup>	( at)	0.83(Zt-1)	(Zt)	0.83(Zt+1)	(et)
	292.84					
t	(at) <sup>2</sup>	( at)	0.85(Zt-1)	(Zt)	0.85(Zt+1)	(et)
	290.17					
t	(at) <sup>2</sup>	( at)	0.8(Zt-1)	(Zt)	0.8(Zt+1)	(et)
	298.49					
t	(at) <sup>2</sup>	( at)	0.88(Zt-1)	(Zt)	0.88(Zt+1)	(et)
	287.78					
t	(at) <sup>2</sup>	( at)	0.92(Zt-1)	(Zt)	0.92(Zt+1)	(et)
	287.48					
t	(at) <sup>2</sup>	( at)	0.89(Zt-1)	(Zt)	0.89(Zt+1)	(et)
	287.41					
t	(at) <sup>2</sup>	( at)	0.9(Zt-1)	(Zt)	0.9(Zt+1)	(et)
	287.23					
t	(at) <sup>2</sup>	( at)	0.91(Zt-1)	(Zt)	0.91(Zt+1)	(et)
	287.26					

Since (at)<sup>2</sup> of O = 0.9 is the least , the parameter of this AR = 0.9

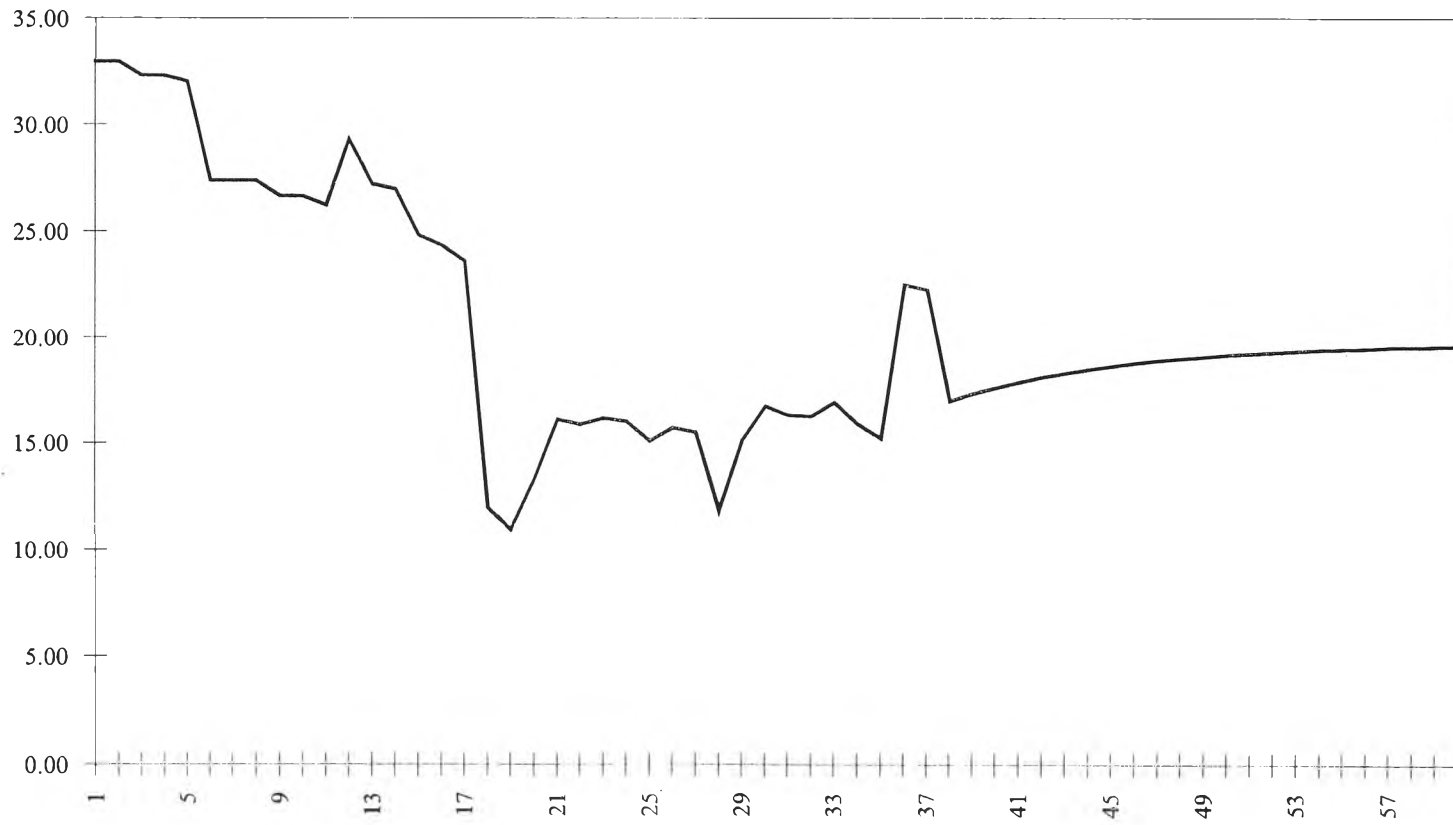


Figure 1.2g Forecasting Erawan Condensate Prices at any point of time



## APPENDIX II

Example of Spreadsheet

**COMBINATION CASE .5TCF+.5TCF (There are 2 blocks and 1field for each block)**

**NO ESCALATION**

GAS PRICE(USD/MMCF)							2035.92	2035.91	2035.90	2035.90	2035.90	2035.90
CONDY PRICE(USD/bbl)							18.83	18.76	18.72	18.69	18.67	18.66
.5TCF Sunk (MMUSD)	4.00	12.00	8.65	12.00	20.00	84.00	71.00	21.00	21.00	21.00	18.00	15.00
.5TCF Sunk (MMUSD)	4.00		12.00	8.65		12.00	20.00	84.00	71.00	21.00	21.00	21.00
.5TCF Operating (MMUSD)							13.35	14.89	15.73	16.57	15.57	14.75
.5TCF Operating (MMUSD)									13.35	14.89	15.73	16.57
.5TCF FINANCING					122.50	-12.25	-12.25	-29.75	-28.00	-26.25	-24.50	-22.75
.5TCF FINANCING							122.50	-12.25	-12.25	-29.75	-28.00	-26.25

**3% ESCALATION**

GAS PRICE(USD/MMCF)							2569.93	2647.03	2726.44	2808.23	2892.48	2979.25
CONDY PRICE(USD/bbl)							25.24	26.00	26.78	27.59	28.41	29.27
.5TCF Sunk (MMUSD)	4.00	12.36	9.18	13.11	22.51	97.38	84.78	25.83	26.60	27.40	24.19	20.76
.5TCF Sunk (MMUSD)	4.00		12.73	9.45		13.51	23.88	103.31	89.94	27.40	28.22	29.07
.5TCF Operating (MMUSD)							15.94	18.31	19.92	21.62	20.92	20.41
.5TCF Operating (MMUSD)									15.94	18.31	19.92	21.62
.5TCF FINANCING					143.27	-14.33	-14.33	-34.79	-32.75	-30.70	-28.65	-26.61
.5TCF FINANCING							151.99	-15.20	-15.20	-36.91	-34.74	-32.57

5% ESCALATION

GAS PRICE(USD/MMCF)							2884.25	3028.47	3179.89	3338.89	3505.83	3681.12
CONDY PRICE(USD/bbl)							28.33	29.75	31.24	32.80	34.44	36.16
.5TCF Sunk (MMUSD)	4.00	12.60	9.54	13.89	24.31	107.21	95.15	29.55	31.03	32.58	29.32	25.66
.5TCF Sunk (MMUSD)	4.00		13.23	10.01		14.59	26.80	118.20	104.90	32.58	34.21	35.92
.5TCF Operating (MMUSD)							17.89	20.95	23.24	25.70	25.36	25.22
.5TCF Operating (MMUSD)									17.89	20.95	23.24	25.70
.5TCF FINANCING					158.67	-15.87	-15.87	-38.53	-36.27	-34.00	-31.73	-29.47
.5TCF FINANCING							174.93	-17.49	-17.49	-42.48	-39.98	-37.48

NO GOVERNMENT TAKE

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
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PRODUCTION

GAS (.5TCFBlock1-MMSCF)							39,420	43,800	43,800	43,800	43,800	39,420
GAS (.5TCFBlock2-MMSCF)									39,420	43,800	43,800	43,800
GAS 2Blocks (MMSCF)							39,420	43,800	83,220	87,600	87,600	83,220
CONDY (.5TCFBlock1-MMbbl)							1.58	1.75	1.75	1.75	1.75	1.58
CONDY (.5TCFBlock2-MMbbl)									1.58	1.75	1.75	1.75
CONDY 2Blocks (MMbbl)							1.58	1.75	3.33	3.50	3.50	3.33

PRICE

GAS PRICE(USD/MMCF)							2,035.92	2,035.91	2,035.90	2,035.90	2,035.90	2,035.90
CONDY PRICE(USD/bbl)							18.83	18.76	18.72	18.69	18.67	18.66

EXPENSE (MMUSD)

Sunk 2Blocks(MMUSD)	8.00	12.00	20.65	20.65	20.00	96.00	91.00	105.00	92.00	42.00	39.00	36.00
Operating 2Blocks(MMUSD)							13.35	14.89	29.08	31.46	31.30	31.32
TOTAL EXP(.5TCFBlock1)	4.00	12.00	8.65	12.00	20.00	84.00	84.35	35.89	36.73	37.57	33.57	29.75
TOTAL EXP(.5TCFBlock2)	4.00	0.00	12.00	8.65	0.00	12.00	20.00	84.00	84.35	35.89	36.73	37.57
TOTAL EXP(2Blocks)	8.00	12.00	20.65	20.65	20.00	96.00	104.35	119.89	121.08	73.46	70.30	67.32
DEPRECIATION OF SUNK COST							53.66	74.66	93.06	101.46	109.26	62.80
Ded. Exp.(MMUSD)							67.01	89.55	122.14	132.92	140.56	94.12

REVENUE.5TCFBLOCK1(MMUSD)							109.95	122.05	121.97	121.92	121.88	109.67
REVENUE.5TCFBLOCK2(MMUSD)									109.77	121.92	121.88	121.86
TOTAL REVENUE(MMUSD)							109.95	122.05	231.74	243.83	243.76	231.53

Cost Recovery (%)	20.00											
K CONSTANT	150,000											
CUMULATIVE EXPENSES	8.00	20.00	40.65	61.30	81.30	177.30	281.65	401.54	522.61	596.07	666.36	733.68
NET CASH FLOW	-8.00	-12.00	-20.65	-20.65	-20.00	-96.00	5.60	2.16	110.66	170.38	173.47	164.22
FINANCING					122.50	-12.25	110.25	-42.00	-40.25	-56.00	-52.50	-49.00
NET CASH FLOW/FINANCING	-8.00	-12.00	-20.65	-20.65	102.50	-108.25	115.85	-39.84	70.41	114.38	120.97	115.22
CUM> CASH FLOW	-8.00	-20.00	-40.65	-61.30	41.20	-67.05	48.80	8.96	79.38	193.75	314.72	429.94
IRR %	30.79%											
IRR/FINANCING %	44.45%											
NPV@25.00%	55.26											
NPV@30.00%	29.34											

THAILAND III

Year	1	2	3	4	5	6	7	8	9	10	11	12
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Gross Revenues(.5TCFBlock1)							109.95	122.05	121.97	121.92	121.88	109.67
Gross Revenues(.5TCFBlock2)									109.77	121.92	121.88	121.86
Gross Revenues(2Blocks)							109.95	122.05	231.74	243.83	243.76	231.53

**.5TCFBlock1**

Adj. Rev. (MMUSD)							91.09	98.20	95.37	92.70	90.15	78.96
Adj. Rev. (MMBAHT)							2,485.66	2,696.64	2,635.23	2,577.08	2,521.77	2,222.11
A (BAHT/METER)							11,481	11,189	9,926	10,247	10,168	9,220
Pet. Profit (Loss)	-4.00	-12.00	-8.65	-12.00	-20.00	-84.00	15.28	74.39	73.49	72.62	76.59	69.70
Net Pet. Profit(after carry loss)	-4.00	-16.00	-24.65	-36.65	-56.65	-140.65	-125.37	-50.98	22.51	72.62	76.59	69.70

**.5TCFBlock2**

Adj. Rev. (MMUSD)									85.84	92.70	90.15	87.73
Adj. Rev. (MMBAHT)									2,371.71	2,577.08	2,521.77	2,469.01
A (BAHT/METER)									10,955	10,693	9,498	9,817
Pet. Profit (Loss)	-4.00	0.00	-12.00	-8.65	0.00	-12.00	-20.00	-84.00	15.16	74.30	73.43	72.58
Net Pet. Profit(after carry loss)	-4.00	-4.00	-16.00	-24.65	-24.65	-36.65	-56.65	-140.65	-125.49	-51.19	22.25	72.58

**.5+.5TCFBlock(NON-RING)**

Adj. Rev. (MMUSD)							91.09	98.20	181.21	185.39	180.30	166.68
Adj. Rev. (MMBAHT)							2,485.66	2,696.64	5,006.94	5,154.16	5,043.54	4,691.11
A (BAHT/METER)							6,782	6,897	10,388	10,465	9,822	9,525
Pet. Profit (Loss)	-8.00	-12.00	-20.65	-20.65	-20.00	-96.00	-4.72	-9.61	88.65	146.92	150.03	142.28
Net Pet. Profit(after carry loss)	-8.00	-20.00	-40.65	-61.30	-81.30	-177.30	-182.02	-191.63	-102.97	43.94	150.03	142.28

Deductible Exp.	67.01	89.55	122.14	132.92	140.56	94.12
Royalty(.5TCFBlock1)	10.32	11.77	11.75	11.73	11.72	10.23
Royalty(.5TCFBlock2)			10.26	11.73	11.72	11.71
Royalty(2Blocks)	10.32	11.77	22.01	23.46	23.44	21.94
SRB(.5TCFBlock1)	0.00	0.00	4.95	16.70	17.62	13.24
SRB(.5TCFBlock2)			0.00	0.00	4.45	15.24
SRB(2BlockS)	0.00	0.00	4.95	16.70	22.07	28.48
<i>SRB(.5+.5TCFBlock)(NON-RING)</i>	0.00	0.00	0.00	10.55	31.51	28.46
<i>TOTAL EXPENSE(RING)</i>	77.33	101.32	149.10	173.08	186.06	144.54
<i>TOTAL EXPENSE(NON-RING)</i>	77.33	101.32	144.15	166.92	195.50	144.51
Profit (Loss)	32.62	20.73	82.64	70.75	57.70	86.99
Net Profit (after carry loss)	32.62	20.73	82.64	70.75	57.70	86.99
Income Tax (RING)	16.31	10.36	41.32	35.38	28.85	43.50
<i>Profit (Loss)</i>	32.62	20.73	87.59	76.91	48.26	87.02
<i>Net Profit (after carry loss)</i>	32.62	20.73	87.59	76.91	48.26	87.02
<i>Income Tax (NON-RING)</i>	16.31	10.36	43.80	38.45	24.13	43.51

CONCESSIONAIRES(RING):

Net Profit(after tax)							16.31	10.37	41.32	35.37	28.85	43.49
Cost Recovery							67.01	89.55	122.14	132.92	140.56	94.12
Cashflow (RING)	-8.00	-12.00	-20.65	-20.65	-20.00	-96.00	-21.03	-19.97	42.38	94.83	99.11	70.29
% of Revenues							-19.12	-16.36	18.29	38.89	40.66	30.36
Cashflow (NON-RING)	-8.00	-12.00	-20.65	-20.65	-20.00	-96.00	-21.03	-19.97	44.85	97.92	94.39	70.31
FINANCING					122.50	-12.25	110.25	-42.00	-40.25	-56.00	-52.50	-49.00
Cashflow (RING)/FINANCING	-8.00	-12.00	-20.65	-20.65	102.50	-108.25	89.22	-61.97	2.13	38.83	46.61	21.29
PAYOUT PERIOD	-8.00	-20.00	-40.65	-61.30	41.20	-67.05	22.17	-39.80	-37.66	1.17	47.78	69.08
Cashflow(NON-RING)/FINANCING	-8.00	-12.00	-20.65	-20.65	102.50	-108.25	89.22	-61.97	4.60	41.92	41.89	21.31
IRR %	16.59%											
IRR/FINANCING %	23.77%											
IRR(NON-RING)%	16.67%											
IRR(NON-RING)/FINANCING %	23.94%											

GOVERNMENT:

Cashflow							26.63	22.13	68.28	75.54	74.36	93.92
% of Revenues							24.22	18.13	29.47	30.98	30.50	40.57
CUMULATIVE CASHFLOW							27	49	117	193	267	361



SRB CALCULATION

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	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
CUM. METER DRILLED(.5TCFBLOCK1)							66,500	91,000	115,500	101,500	98,000	91,000
CUM. METER DRILLED(.5TCFBLOCK2)									66,500	91,000	115,500	101,500
<i>TOTAL CUM.METER(.5+.5TCF)</i>							66,500	91,000	182,000	192,500	213,500	192,500
CPI	124.06	127.71	131.35	135.00	138.64	142.29	145.93	149.58	153.22	156.87	160.51	164.15
WPI	117.15	120.03	122.91	125.78	128.66	131.54	134.42	137.29	140.17	143.05	145.93	148.81
EXCHANGE RATE	26.26	26.43	26.60	26.77	26.95	27.12	27.29	27.46	27.63	27.80	27.97	28.14
(BAHT/US\$)												
REVENUE ADJ. FACTOR	1.0000	0.9674	0.9366	0.9074	0.8797	0.8535	0.8284	0.8046	0.7820	0.7603	0.7397	0.7199
AT YEAR 1 (1997)												
I =	26.2616											
C =	124.06											
W =	117.15											

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Special Benefit Rate (.5TCFBlock1)							27.84	26.62	21.36	22.70	22.37	18.42
SRB Rate							28.00	27.00	22.00	23.00	23.00	19.00
Special Benefit Rate (.5TCFBlock2)									25.64	24.56	19.58	20.90
SRB Rate									26.00	25.00	20.00	21.00

Special Benefit Rate (.5+.5TCF)	8.26	8.74	23.28	23.61	20.92	19.69
SRB Rate	9.00	9.00	24.00	24.00	21.00	20.00

SLIDING SCALE ROYALTY

CALCULATION(.5TCFBlock1)

EQI.GAS PROD. (MMBBL)	4.14	4.60	4.60	4.60	4.60	4.14
TOTAL PRODUCTION(MBBL)	5,717	6,352	6,352	6,352	6,352	5,717
*** HTV = 1050						
ROYALTY						
SLIDING SCALE						
5 %	0.68	0.68	0.67	0.67	0.67	0.67
6.25 %	1.27	1.27	1.26	1.26	1.26	1.26
10 %	3.39	3.38	3.37	3.36	3.36	3.36
12.5 %	4.98	6.45	6.44	6.43	6.42	4.94
15 %	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	10.32	11.77	11.75	11.73	11.72	10.23

SLIDING SCALE ROYALTY

CALCULATION(.5TCFBlock2)

EQUI.GAS PROD. (MMBBL)									4.14	4.60	4.60	4.60
TOTAL PRODUCTION(MBBL)									5,717	6,352	6,352	6,352
ROYALTY												
SLIDING SCALE												
5 %									0.67	0.67	0.67	0.67
6.25 %									1.26	1.26	1.26	1.26
10 %									3.37	3.36	3.36	3.36
12.5 %									4.95	6.43	6.42	6.42
15 %									0.00	0.00	0.00	0.00
TOTAL									10.26	11.73	11.72	11.71

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	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
DEPRECIATION OF												
SUNK&DEV. COST	8.00	12.00	20.65	20.65	20.00	96.00	91.00	105.00	92.00	42.00	39.00	36.00
CALCULATION												
1							53.66	53.66	53.66	53.66	53.66	
2								21.00	21.00	21.00	21.00	21.00
3									18.40	18.40	18.40	18.40

4										8.40	8.40	8.40
5											7.80	7.80
6												7.20
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												

TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	53.66	74.66	93.06	101.46	109.26	62.80
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## APPENDIX III

### OPERATING COST ESTIMATION

Operating Costs used in the study (Fixed operating cost = 4% of development cost and Variable operating cost = US\$160/MMCF) are estimated by using existing data of the fields which are producing gas in the Gulf of Thailand as follows.

#### Fixed Operating Cost

1. Data on development costs of Erawan (1.85 TCF), Satun (1.4 TCF), Platong (0.33 TCF) and Baanpot (0.12 TCF) are collected.
2. Different percentages of these development costs from 3% to 20% are calculated. The results are as in Table 3a.
3. The MMUS\$ of different percentage of development cost for field size of 1.85 TCF, 1.4 TCF, 0.33 TCF, and 0.12 TCF are as shown in Figure 3a. From this figure, 4% of Development cost is chosen to be the fixed operating cost in estimating the operating cost of the study.

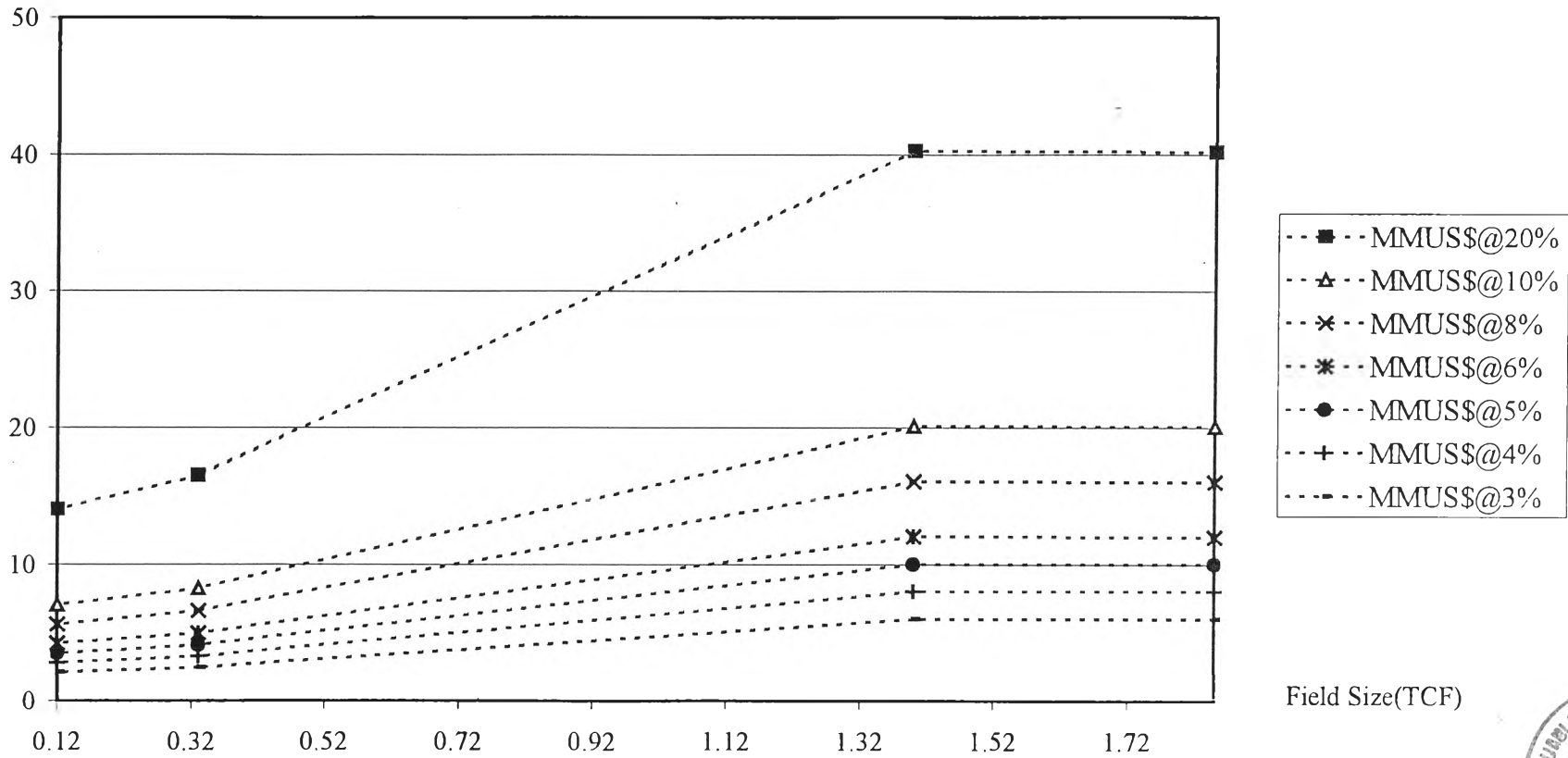
#### Variable Operating Cost

1. Data on total Operating costs of the above fields are collected.
2. Subtract the total operating cost with 4% of development costs, and then calculate the variable operating costs per unit of production.
3. Then, average these variable operating costs and the result will be the variable operating cost in estimating the operating cost of the study (US\$160/MMCF).

Table 3a Development cost, Operating cost, and different percentages of  
development cost of fields in the gulf

	(Unit : MMUS\$)			
	Erawan	Baanpot	Satun	Platong
Reserve(TCF)	1.85	0.12	1.40	0.33
Development Cost	201.10	70.50	201.40	82.70
Total Operating Cost	353.00	24.00	187.00	54.00
20%Development Cost	40.22	14.10	40.28	16.54
10%Development Cost	20.11	7.05	20.14	8.27
8%Development Cost	16.09	5.64	16.11	6.62
6%Development Cost	12.07	4.23	12.08	4.96
5%Development Cost	10.06	3.53	10.07	4.14
4%Development Cost	8.04	2.82	8.06	3.31
3%Development Cost	6.03	2.12	6.04	2.48

MMU\$\$



Field Size(TCF)



Figure 3a MMU\$\$ of different percentages of development cost for different field sizes

## APPENDIX IV

### Summary of Results



Table 4.1a Internal Rate of Return for Single field Project : Base Case

Escalation	Field Size	Thailand III		No Government Take	
		W/O Loan	With Loan	W/O Loan	With Loan
NO	0.5 TCF	16.51	24.15	32.06	49.03
	1.0 TCF	17.53	32.66	38.37	67.82
	1.5 TCF	18.73	41.47	42.77	79.84
	2.0 TCF	19.07	54.49	45.66	92.79
3%	0.5 TCF	18.77	29.79	39.69	60.24
	1.0 TCF	19.46	41.10	45.68	79.52
	1.5 TCF	20.84	52.65	50.27	92.00
	2.0 TCF	20.91	68.12	53.36	105.66
5%	0.5 TCF	19.29	31.96	42.40	64.74
	1.0 TCF	20.12	45.29	48.51	84.87
	1.5 TCF	21.20	57.56	53.19	97.78
	2.0 TCF	20.92	74.69	56.34	112.04

Table 4.2b Internal Rate of Return for Single field Project : Increase Cost 25%

Escalation	Field Size	Thailand III		No Government Take	
		W/O Loan	With Loan	W/O Loan	With Loan
NO	.5TCF	12.47	15.39	24.86	38.47
	1TCF	13.64	20.66	30.37	56.43
	1.5TCF	14.90	27.30	34.46	68.80
	2TCF	15.17	36.38	36.82	82.02
3%	.5TCF	14.85	20.98	32.09	50.45
	1TCF	15.48	27.94	37.24	69.05
	1.5TCF	16.86	38.21	41.47	81.83
	2TCF	16.94	53.95	44.00	95.83
5%	.5TCF	15.33	22.58	34.65	55.02
	1TCF	16.10	31.31	39.91	74.60
	1.5TCF	17.27	43.04	44.22	87.83
	2TCF	17.06	62.18	46.79	102.50

Table 4.1c Internal Rate of Return for Single field Project : Decrease Cost 25%

Escalation	Field Size	Thailand III		No Government Take	
		W/O Loan	With Loan	W/O Loan	With Loan
NO	.5TCF	22.28	35.16	41.93	60.99
	1TCF	23.11	46.31	49.47	80.53
	1.5TCF	24.26	55.68	54.42	92.38
	2TCF	24.70	68.52	58.10	105.13
3%	.5TCF	24.33	40.39	50.03	71.67
	1TCF	25.15	54.30	57.34	91.65
	1.5TCF	26.44	65.10	62.52	104.00
	2TCF	26.50	79.27	66.46	117.41
5%	.5TCF	24.91	42.92	52.94	76.14
	1TCF	25.83	58.38	60.39	96.89
	1.5TCF	26.75	69.67	65.68	109.64
	2TCF	26.47	85.14	69.69	123.59

Table 4.2.1 Internal Rate of Return for Two Block Project (.5TCF+.5TCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	16.59	23.77	16.67	23.94	14.93	20.82
		25 % Up	12.61	15.61	12.66	15.75	11.36	13.02
		25 % Down	22.22	33.51	22.29	33.68	19.96	30.39
	3%		18.53	28.44	18.57	28.62	16.92	26.14
	5%		19.12	30.64	19.20	30.93	17.59	28.42
6 Years	NO		15.58	20.31	16.20	21.41	14.78	19.19

Table 4.2.2 Internal Rate of Return for Two Block Project ( 1TCF+5TCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	17.61	29.30	18.07	30.52	16.33	27.29
		25 % Up	13.70	19.59	14.01	20.47	12.60	17.11
		25 % Down	23.18	40.40	23.78	41.74	21.64	38.87
	3%		19.63	35.91	19.90	36.88	18.51	34.76
	5%		20.27	39.07	20.64	40.27	18.81	37.36
6 Years	NO		16.92	25.74	18.33	28.74	16.39	25.33

Table 4.2.3 Internal Rate of Return for Two Block Project ( 1TCF+1TCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	18.18	33.22	18.29	33.68	16.89	31.35
		25 % Up	14.27	22.74	14.35	23.08	13.13	20.07
		25 % Down	23.73	44.36	23.93	45.06	22.33	43.27
	3%		20.21	40.85	20.41	41.74	18.98	39.68
	5%		20.83	44.49	21.03	45.50	19.18	42.94
6 Years	NO		17.19	27.03	18.45	29.72	16.71	26.82

Table 4.2.4 Internal Rate of Return for Two Block Project ( 1.5TCF+.5TCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	18.16	33.05	18.68	34.55	17.19	31.91
		25 % Up	14.29	22.29	14.74	23.67	13.45	20.50
		25 % Down	13.67	44.92	24.28	46.38	22.53	44.22
	3%		20.22	40.89	20.60	42.24	19.20	40.06
	5%		20.67	44.25	21.25	46.09	19.33	43.04
6 Years	NO		17.61	29.38	19.05	32.67	17.21	29.36

Table 4.2.5 Internal Rate of Return for Two Block Project ( 2TCF+.5TCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	18.47	38.86	18.85	40.20	17.62	38.14
		25 % Up	14.56	25.72	14.91	27.10	13.83	24.24
		25 % Down	24.05	51.81	24.56	53.42	23.09	51.78
	3%		20.34	48.20	20.96	50.30	19.41	47.91
	5%		20.52	52.33	21.42	55.00	19.51	52.41
6 Years	NO		18.01	34.74	19.17	37.65	17.70	35.07



Table 4.2.6 Internal Rate of Return for Two Block Project ( 1.5TCF+ITCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	18.60	36.99	18.76	37.81	17.58	35.97
		25 % Up	14.73	25.49	14.84	26.08	13.80	23.54
		25 % Down	24.12	48.74	24.40	49.82	22.99	48.27
	3%		20.68	45.77	20.89	46.91	19.53	44.99
	5%		21.12	49.64	21.47	51.16	19.60	48.69
6 Years	NO		17.80	30.54	19.07	33.54	17.46	30.78

Table 4.2.7 Internal Rate of Return for Two Block Project ( 2TCF+1TCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	18.85	43.05	19.05	44.30	18.03	42.87
		25 % Up	14.92	29.44	15.05	30.33	14.15	28.07
		25 % Down	24.43	55.52	24.79	57.01	23.51	55.68
	3%		20.74	53.19	21.11	54.84	19.64	52.91
	5%		20.94	57.83	21.47	59.91	19.83	58.20
6 Years	NO		18.16	35.82	19.24	38.63	17.94	36.45

Table 4.2.8 Internal Rate of Return for Two Block Project ( 1.5TCF+1.5TCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	19.12	39.95	19.21	40.59	18.18	39.12
		25 % Up	15.29	28.40	15.33	28.81	14.42	26.74
		25 % Down	24.60	51.37	24.84	52.36	23.59	51.06
	3%		21.24	49.21	21.43	50.31	19.99	48.36
	5%		21.58	53.22	21.82	54.55	20.13	52.65
6 Years	NO		18.17	31.61	19.26	34.24	17.85	31.88

Table 4.2.9 Internal Rate of Return for Two Block Project ( 2TCF+1.5TCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	19.30	46.11	19.51	47.31	18.48	45.89
		25 % Up	15.41	32.78	15.52	33.66	14.65	31.54
		25 % Down	24.85	58.04	25.24	59.51	23.94	58.17
	3%		21.24	56.60	21.54	58.05	19.97	56.15
	5%		21.37	61.38	21.68	63.06	20.40	62.00
6 Years	NO		18.48	36.77	19.46	39.39	18.25	37.42

Table 4.2.10 Internal Rate of Return for Two Block Project ( 2TCF+2TCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	19.51	49.85	19.66	50.85	18.67	49.63
		25 % Up	15.58	36.67	15.67	37.58	14.82	35.66
		25 % Down	25.10	61.19	25.44	62.55	24.19	61.37
	3%		21.37	60.58	21.57	61.91	20.11	60.56
	5%		21.42	65.71	21.56	67.25	20.68	66.68
6 Years	NO		18.62	37.78	19.49	40.24	18.40	38.48

Table 4.3.1 Internal Rate of Return for Two Block Project (.5TCF+.5TCF)+.5TCF

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	18.49	31.64	19.50	34.10	17.69	31.13
		25 % Up	14.48	21.83	15.34	24.26	13.80	20.83
		25 % Down	24.13	42.40	25.37	44.90	23.23	42.37
	3%		20.47	38.25	21.34	40.70	19.81	38.51
	5%		21.07	41.33	22.06	44.15	20.11	41.35
6 Years	NO		17.89	28.07	20.00	32.37	17.79	28.77

Table 4.3.2 Internal Rate of Return for Two Block Project 2TCF+(.5TCF+.5TCF)

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	19.43	44.51	19.78	45.77	18.68	44.27
		25 % Up	15.50	31.60	15.76	32.75	14.80	30.55
		25 % Down	21.52	56.43	25.55	57.97	24.20	56.56
	3%		21.34	54.44	21.81	55.92	20.23	53.94
	5%		21.52	58.96	22.05	60.71	20.53	59.18
6 Years	NO		18.72	36.53	19.61	39.02	18.31	36.89

Table 4.3.3 Internal Rate of Return for Two Block Project ( 1TCF+1TCF)+1TCF

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	20.42	48.64	21.33	51.69	20.05	50.13
		25 % Up	16.34	36.80	17.10	38.41	16.02	38.41
		25 % Down	26.25	59.80	27.55	63.10	25.94	61.45
	3%		21.99	57.53	23.35	61.63	21.64	59.84
	5%		22.43	62.71	23.45	66.37	22.14	65.46
6 Years	NO		19.93	41.83	21.64	45.70	20.23	43.64



Table 4.3.4 Internal Rate of Return for Two Block Project (1TCF+1TCF)+2TCF

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (2K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	19.46	51.27	19.59	51.02	18.04	47.80
		25 % Up	15.42	38.16	15.45	38.06	14.16	33.41
		25 % Down	25.29	62.59	25.54	62.21	23.56	59.15
	3%		20.67	60.47	21.01	60.53	19.16	57.67
	5%		20.76	65.97	20.99	65.82	19.87	64.19
6 Years	NO		20.25	43.35	21.76	47.01	20.51	45.19

Table 4.4.1 Internal Rate of Return for Three Block Project .5TCF+.5TCF+.5TCF

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (3K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	16.33	22.34	16.46	22.63	14.09	18.70
		25 % Up	12.47	15.06	12.56	15.26	10.69	11.52
		25 % Down	21.69	30.86	21.94	31.33	18.87	27.33
	3%		18.29	26.63	18.47	27.14	16.27	24.03
	5%		18.92	28.66	19.16	29.38	16.66	25.75
6 Years	NO		14.64	17.63	15.55	19.06	13.67	16.35

Table 4.4.2 Internal Rate of Return for Three Block Project 1TCF+1TCF+1TCF

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (3K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	17.79	29.79	17.97	30.47	16.10	27.58
		25 % Up	13.97	20.82	14.12	21.33	12.47	17.58
		25 % Down	23.12	39.43	23.62	40.72	21.34	38.18
	3%		19.72	36.10	20.04	37.35	18.06	34.75
	5%		20.37	39.18	20.76	40.75	18.34	37.74
6 Years	NO		16.39	22.64	17.86	25.41	15.49	21.80

Table 4.4.3 Internal Rate of Return for Three Block Project 1.5TCF+1.5TCF+1.5TCF

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (3K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	19.02	35.81	19.33	37.13	17.92	35.36
		25 % Up	15.28	26.37	15.46	27.27	14.19	24.79
		25 % Down	24.31	45.57	24.89	47.25	23.22	45.64
	3%		21.13	43.50	21.54	45.28	19.46	42.81
	5%		21.43	46.68	21.97	48.99	20.14	47.17
6 Years	NO		17.65	26.52	19.29	29.89	17.04	26.40

Table 4.4.4 Internal Rate of Return for Three Block Project 2TCF+2TCF+2TCF

Lag Time of Field Development	Escalation	Cost Effect	Thailand III					
			Ring		Non-Ring (3K)		Non-Ring (1K)	
			W/O Loan	With Loan	W/O Loan	With Loan	W/O Loan	With Loan
2 Years	NO	Base Case	19.45	43.08	19.80	44.89	18.48	43.42
		25 % Up	15.60	32.33	15.79	33.81	14.64	31.64
		25 % Down	24.87	53.12	25.58	55.30	23.90	53.75
	3%		21.30	51.83	21.81	54.23	19.81	52.51
	5%		21.38	55.86	21.85	58.74	20.77	57.97
6 Years	NO		17.97	30.30	19.61	34.02	17.68	30.84



## VITAE

Boonbandan Yuvanasiri was born on October 31, 1956 in Prachinburi province, Thailand. She received her B.Sc. in Chemistry from the Faculty of Science, Chulalongkorn University in 1979. She has been a graduate student in the master degree program in petroleum engineering of the Department of Mining and Petroleum Engineering, Chulalongkorn University since 1994. Currently, She is government officer of the Department of Mineral Resources.