

# Transition to Centralized Unit Commitment

## An Econometric Analysis of Colombia's Experience<sup>1</sup>

(TECHNICAL SUPPLEMENT)

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## Introduction

This document is a technical supplement to Riascos et al (2015). See that document for an introduction.

## Construction of startup costs

Before 2009, startup costs were not reported by generators. To overcome this difficulty we used reported startup costs after 2009 and fuel prices to estimate start-up costs before 2009. To do so we first calculated the most common operating fuel type by plant (next table).

Generator	Start-up Fuel
TERMOCARTAGENA 1	Gas
TERMOCARTAGENA 2	Gas
TERMOCARTAGENA 3	Gas
MERILECTRICA 1	Gas
PAIPA 1	Coal
PAIPA 2	Coal
PAIPA 3	Coal
PAIPA 4	Coal
PROELECTRICA 1	Gas
PROELECTRICA 2	Gas
TERMOBARRANQUILLA 3	Gas
TERMOBARRANQUILLA 4	Gas
TEBSA TOTAL	Gas
TERMOCANDELARIA 1	Gas
TERMOCANDELARIA 2	Gas
TERMODORADA 1	Gas
TERMOEMCALI 1	Gas
TERMOFLORES 1	Gas
TERMO FLORES 4	Gas
GUAJIRA 1G	Gas and Coal
GUAJIRA 2G	Gas and Coal
TERMOCENTRO 1 CICLO COMBINADO	Gas
TASAJERO 1	Coal
TERMO SIERRAB	Gas

TERMOVALLE 1	Gas
TERMOYOPAL 2	Gas
ZIPAEMG 2	Coal
ZIPAEMG 3	Coal
ZIPAEMG 4	Coal
ZIPAEMG 5	Coal

For each thermal plant we have a six-month frequency series of fuel costs (in US dollars). Each plant, except for GUAJIRA 1 and GUAJIRA 2, uses either coal or gas as its main fuel. GUAJIRA 1 and 2 is the only plant that can use both types of fuel.

Fuel prices are reported as US dollars per Thermal Units (USD/MBTU). Coal and gas prices may differ across plants because of transportation costs and other economic factors. Start-up costs are reported for every thermal generator for the 2008-2012 period. Since fuel costs have a six month frequency we used a local regression model to construct a daily fuel cost data. For an appropriate fit of the LOESS model we use a smoothness parameter of  $\alpha = 0.3$ . With the LOESS fit we construct a new database with the price of fuel for each plant in a daily frequency. Before running the LOESS model we transformed prices and costs to local currency (COP) and used the Producer Price Index (IPP) to deflate both start-up costs and fuel costs. Since the IPP has a monthly frequency, we used a LOESS fit with  $\alpha = 0.1$  to convert it to a daily series.

Because the prediction horizon is large (daily start-up costs for the period 2006 - 2009) we want to use a simple model that avoids high variance and over fits the data. The econometric specification we used was a linear model of the form:

$$StartUpCost_{gt} = \beta_{g0} + \beta_g^T FuelCost_{gt} + \varepsilon_{gt}$$

Depending on the generator,  $FuelCost_{gt}$  represents gas or coal fuel cost. In the case of GUAJIRA 1 and 2,  $FuelCost_{gt}$  is a vector with gas and coal fuel costs as its components.

This model is fitted using minimization of the squared error subject to the positivity of the vector  $\beta_g^T$ . This problem can be formulated as a convex optimization problem and can be solved numerically. Whenever  $\beta_g^T$  is strictly positive, we will obtain the OLS solution.

The next table show the results.<sup>2</sup>For 12 generators the restriction on the coefficients  $\beta_g^T$  was binding. The next table reports the results of all other plants.

<b>Generator</b>	<b>R2</b>	<b>Generator</b>	<b>R2</b>
TERMOBARRANQUILLA.3	0.57	TASAJERO.1	0.08
TERMOBARRANQUILLA.4	0.54	TERMOCENTRO.1	0.05
TERMOCARTAGENA.1	0.51	TERMOSIERRAB	0.08
TERMOCARTAGENA.2	0.61	TERMOVALLE.1	0.41
TERMOCARTAGENA.3	0.56	ZIPAEMG.2	0.03
TERMODORADA.1	0.36	ZIPAEMG.3	0.10
TERMOFLORES.1	0.14	ZIPAEMG.4	0.07
GUAJIRA.1	0.44	ZIPAEMG.5	0.13
GUAJIRA.2	0.35	TERMO.FLORES.4	0.05

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<sup>2</sup> The complete database can be found at: <http://www.alvaroriasco.com/research/data/>

## General specification output decision model

The following are the estimation results for the general output decisions model, using as instrumental variables water resources in rivers (*"Aportes Hídricos"*) and ignoring the period of Government intervention.

Summary of model for all Plants			
Plants	Average of Coefficients	Average of Std. Errors	# of Significant Coeff. (5%)
(Intercept)	4,007,679	3,983,698	28
Pcmpos	223,576	75,903	30
Pcm	221,546	155,733	7
pcm_2	-276	3,668	3
pcm_3	-30	102	3
pcm_4	0	1	1
pcm_5	0	0	3
pcmminus1	13,062	110,846	2
pcmminus1_2	3,418	1,846	7
pcmminus1_3	61	79	6
pcmminus1_4	-2	1	9
pcmminus1_5	0	0	9
pcmplus1	366,594	136,291	7
pcmplus1_2	1,139	3,664	3
pcmplus1_3	-140	98	5
pcmplus1_4	2	1	5
pcmplus1_5	0	0	5
meanpcm	-3,920,131	973,028	23
meanpcm_2	184,369	53,346	19
meanpcm_3	20,619	5,423	19
meanpcm_4	-762	152	23
meanpcm_5	6	1	17
meanpcmminus24	-2,640,696	775,370	18
meanpcmminus24_2	-466,474	94,388	17
meanpcmminus24_3	-2,171	3,767	23
meanpcmminus24_4	752	185	19
meanpcmminus24_5	-8	2	23
meanpcmplus24	4,169,466	1,208,527	25
meanpcmplus24_2	293,945	69,111	24
meanpcmplus24_3	-9,264	2,455	19
meanpcmplus24_4	-503	123	18
meanpcmplus24_5	8	1	21
Niño	-10,534,695	3,410,290	18
Nina	-4,373,193	2,434,354	27

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Significant Coeff. (5%)</b>
factor(month)2	673,779	1,899,903	22
factor(month)3	1,455,971	1,728,539	23
factor(month)4	2,025,759	2,881,525	22
factor(month)5	3,142,409	4,207,668	19
factor(month)6	3,698,756	4,796,780	26
factor(month)7	1,571,778	4,156,210	21
factor(month)8	-8,870,423	5,752,356	26
factor(month)9	-3,561,142	4,117,038	28
factor(month)10	-8,995,412	3,716,836	22
factor(month)11	-462,391	4,001,576	25
factor(month)12	3,999,440	3,362,153	23
factor(wday)Sunday	3,687,658	2,455,495	21
factor(wday)Monday	-4,249,396	4,210,083	23
factor(wday)Tuesday	-612,219	4,130,158	23
factor(wday)Wednesday	4,465,163	2,739,774	25
factor(wday)Saturday	9,892,300	4,103,528	16
factor(wday)Friday	3,261,587	2,447,297	19

**Estimation results when controlling with water resources in rather than using it as an instrument**

Summary of model for all Plants

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
(Intercept)	3,540,277	136,346	39
pcmpos	1,489,977	90,796	34
aportesh	0.001	0.004	37
pcm	-18,234	3,687	30
pcm_2	-214	66	19
pcm_3	5	1	22
pcm_4	0	0	18
pcm_5	0	0	16
pcmminus1	1,468	2,997	14
pcmminus1_2	-11	59	17
pcmminus1_3	-1	1	11
pcmminus1_4	0	0	12
pcmminus1_5	0	0	9
pcmplus1	4,063	3,000	22
pcmplus1_2	63	59	21
pcmplus1_3	-2	1	17

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
pcmplus1_4	0	0	14
pcmplus1_5	0	0	13
meanpcm	81,416	6,180	34
meanpcm_2	1,054	279	33
meanpcm_3	-98	16	29
meanpcm_4	1	0	25
meanpcm_5	0	0	27
meanpcmminus24	-24,939	5,044	32
meanpcmminus24_2	-276	247	36
meanpcmminus24_3	74	15	29
meanpcmminus24_4	-2	0	34
meanpcmminus24_5	0	0	30
meanpcmplus24	-33,744	5,004	34
meanpcmplus24_2	-457	247	29
meanpcmplus24_3	74	15	29
meanpcmplus24_4	-2	0	30
meanpcmplus24_5	0	0	32
nino	26,366	76,803	40
nina	38,287	50,973	40
factor(hour)1	-176,838	128,925	5
factor(hour)2	-272,675	129,020	11
factor(hour)3	-284,633	129,186	12
factor(hour)4	-97,688	129,558	9
factor(hour)5	358,485	129,477	16
factor(hour)6	529,176	129,383	16
factor(hour)7	748,314	129,727	22
factor(hour)8	1,089,925	129,978	24
factor(hour)9	1,250,403	130,329	21
factor(hour)10	1,396,710	130,730	22
factor(hour)11	1,510,338	130,723	23
factor(hour)12	1,430,550	130,557	21
factor(hour)13	1,337,770	130,377	21
factor(hour)14	1,340,090	130,276	24
factor(hour)15	1,327,676	130,204	21
factor(hour)16	1,314,480	130,184	22
factor(hour)17	1,421,338	133,467	28
factor(hour)18	2,200,411	137,623	32
factor(hour)19	2,455,786	137,699	29
factor(hour)20	2,238,626	136,427	28
factor(hour)21	1,757,139	131,072	22
factor(hour)22	1,055,596	129,642	17
factor(hour)23	387,855	129,042	13



<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
factor(month)2	165,336	88,529	34
factor(month)3	103,830	88,885	39
factor(month)4	4,391	92,623	36
factor(month)5	35,505	104,136	40
factor(month)6	99,739	108,778	36
factor(month)7	139,628	103,307	38
factor(month)8	362,717	111,369	39
factor(month)9	390,913	103,554	43
factor(month)10	45,740	105,907	38
factor(month)11	390,842	107,467	41
factor(month)12	317,349	97,595	39
factor(wday)jueves	810,509	70,663	34
factor(wday)lunes	574,817	71,335	31
factor(wday)martes	783,742	71,125	37
factor(wday)mi?coles	800,219	70,859	38
factor(wday)s?ado	499,695	71,410	33
factor(wday)viernes	775,713	71,025	37

Summary of model for 29 Thermo Plants

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
(Intercept)	763,658	39,500	23
pcmpos	-35,151	24,246	19
aportesh	-.001	.0001	22
pcm	2,627	920	14
pcm_2	0	11	5
pcm_3	0	0	8
pcm_4	0	0	6
pcm_5	0	0	5
pcmminus1	1,462	697	9
pcmminus1_2	-10	9	11
pcmminus1_3	0	0	9
pcmminus1_4	0	0	11
pcmminus1_5	0	0	8
pcmplus1	1,470	697	11
pcmplus1_2	-3	9	13
pcmplus1_3	0	0	10
pcmplus1_4	0	0	9
pcmplus1_5	0	0	8
meanpcm	-1,683	1,179	17

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
meanpcm_2	40	29	19
meanpcm_3	-1	1	18
meanpcm_4	0	0	15
meanpcm_5	0	0	16
meanpcmminus24	8,149	902	20
meanpcmminus24_2	63	24	21
meanpcmminus24_3	-1	0	15
meanpcmminus24_4	0	0	20
meanpcmminus24_5	0	0	17
meanpcmplus24	-1,941	891	20
meanpcmplus24_2	77	24	20
meanpcmplus24_3	0	0	18
meanpcmplus24_4	0	0	21
meanpcmplus24_5	0	0	22
nino	346,172	20,634	25
nina	-43,348	13,866	24
factor(hour)1	-25,861	35,255	1
factor(hour)2	-34,113	35,334	5
factor(hour)3	-37,867	35,486	6
factor(hour)4	-31,067	35,812	7
factor(hour)5	-10,380	35,743	7
factor(hour)6	-6,140	35,665	6
factor(hour)7	10,150	35,942	8
factor(hour)8	33,808	36,119	8
factor(hour)9	43,863	36,355	7
factor(hour)10	55,704	36,615	6
factor(hour)11	67,087	36,566	7
factor(hour)12	56,122	36,467	7
factor(hour)13	53,814	36,359	7
factor(hour)14	66,650	36,276	8
factor(hour)15	74,344	36,229	6
factor(hour)16	83,374	36,250	8
factor(hour)17	124,914	38,060	13
factor(hour)18	222,473	39,800	17
factor(hour)19	234,225	39,552	14
factor(hour)20	192,221	39,092	12
factor(hour)21	138,595	36,736	8
factor(hour)22	91,549	35,814	5
factor(hour)23	45,679	35,360	3
factor(month)2	98,106	24,216	21
factor(month)3	337,558	24,318	27
factor(month)4	184,181	25,528	25

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
factor(month)5	227,888	28,406	25
factor(month)6	165,603	29,290	23
factor(month)7	133,236	28,408	23
factor(month)8	109,974	30,476	26
factor(month)9	222,103	28,349	26
factor(month)10	47,301	29,004	23
factor(month)11	-16,920	29,487	24
factor(month)12	-20,756	26,964	24
factor(wday)jueves	155,717	19,567	18
factor(wday)lunes	130,197	20,179	16
factor(wday)martes	161,397	19,836	22
factor(wday)mi?coles	163,476	19,697	22
factor(wday)s?ado	73,627	20,214	18
factor(wday)viernes	155,904	19,763	22

Summary of model for 17 Hydro Plants

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
(Intercept)	2,776,620	96,846	16
pcmpos	1,525,128	66,551	15
aportesh	.002	.0003	15
pcm	-20,860	2,766	16
pcm_2	-215	55	14
pcm_3	5	1	14
pcm_4	0	0	12
pcm_5	0	0	11
pcmminus1	6	2,300	5
pcmminus1_2	-1	50	6
pcmminus1_3	-1	1	2
pcmminus1_4	0	0	1
pcmminus1_5	0	0	1
pcmplus1	2,593	2,303	11
pcmplus1_2	66	50	8
pcmplus1_3	-2	1	7
pcmplus1_4	0	0	5
pcmplus1_5	0	0	5
meanpcm	83,099	5,001	17
meanpcm_2	1,014	250	14
meanpcm_3	-97	15	11
meanpcm_4	1	0	10

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
meanpcm_5	0	0	11
meanpcmminus24	-33,087	4,142	12
meanpcmminus24_2	-339	223	15
meanpcmminus24_3	75	14	14
meanpcmminus24_4	-2	0	14
meanpcmminus24_5	0	0	13
meanpcmplus24	-31,803	4,113	14
meanpcmplus24_2	-534	223	9
meanpcmplus24_3	74	14	11
meanpcmplus24_4	-2	0	9
meanpcmplus24_5	0	0	10
nino	-319,805	56,169	15
nina	81,635	37,108	16
factor(hour)1	-150,977	93,670	4
factor(hour)2	-238,561	93,686	6
factor(hour)3	-246,765	93,701	6
factor(hour)4	-66,621	93,746	2
factor(hour)5	368,865	93,734	9
factor(hour)6	535,315	93,718	10
factor(hour)7	738,164	93,784	14
factor(hour)8	1,056,117	93,859	16
factor(hour)9	1,206,540	93,975	14
factor(hour)10	1,341,006	94,115	16
factor(hour)11	1,443,251	94,156	16
factor(hour)12	1,374,428	94,090	14
factor(hour)13	1,283,956	94,017	14
factor(hour)14	1,273,439	93,999	16
factor(hour)15	1,253,333	93,976	15
factor(hour)16	1,231,107	93,935	14
factor(hour)17	1,296,424	95,407	15
factor(hour)18	1,977,938	97,823	15
factor(hour)19	2,221,561	98,147	15
factor(hour)20	2,046,405	97,335	16
factor(hour)21	1,618,543	94,335	14
factor(hour)22	964,047	93,828	12
factor(hour)23	342,176	93,682	10
factor(month)2	67,230	64,313	13
factor(month)3	-233,728	64,566	12
factor(month)4	-179,790	67,095	11
factor(month)5	-192,383	75,730	15
factor(month)6	-65,864	79,488	13
factor(month)7	6,392	74,899	15

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
factor(month)8	252,743	80,893	13
factor(month)9	168,810	75,205	17
factor(month)10	-1,561	76,902	15
factor(month)11	407,762	77,980	17
factor(month)12	338,105	70,632	15
factor(wday)jueves	654,792	51,096	16
factor(wday)lunes	444,621	51,156	15
factor(wday)martes	622,345	51,289	15
factor(wday)mi?coles	636,743	51,162	16
factor(wday)s?ado	426,068	51,196	15
factor(wday)viernes	619,809	51,261	15

**Welfare Implications of Production Inefficiencies when the output decision model is estimated using water resources in rivers as a covariate.**

Welfare Implications of Production Inefficiencies								
<b>Model</b>	<b>2006-0</b>	<b>2007-0</b>	<b>2008-0</b>	<b>2009-0</b>	<b>2009-1</b>	<b>2010-1</b>	<b>2011-1</b>	<b>2012-1</b>
<b>Actual Outcomes</b>								
Output	48.3	50.0	50.3	29.9	9.2	26.2	52.1	50.6
Total Variable Costs	4337	4934	4902	3214	1081	2394	4418	4986
<b>Counterfactual</b>								
Output	48.3	50.0	50.3	29.9	9.2	26.2	52.1	50.6
Total Variable Costs	4402	4858	4895	3235	1139	2531	4751	5058
Deadweight loss	-65	76	7	-21	-58	-137	-333	-72
DWL share	-1.50%	1.54%	0.14%	-0.65%	-5.37%	-5.72%	-7.54%	-1.44%

Notes: Output is measured in millions of MWh. Total Variable Costs and Deadweight loss are measured in \$COP Billions<sup>3</sup>.

<sup>3</sup> A Billion is 10<sup>9</sup>.

## Estimation of price model using a polynomial of degree 5 and 6

Adding one more degree to the polynomial in the price model does not improve the model. Fewer coefficients are significant.

### Degree 5

Summary of model for all Plants

Plants	Average of Coefficients	Average of Std. Errors	# of Coefs. Significant(5%)
(Intercept)	4,007,679	3,983,698	28
pcmpos	223,576	75,903	30
pcm	221,546	155,733	7
pcm_2	-276	3,668	3
pcm_3	-30	102	3
pcm_4	0	1	1
pcm_5	0	0	3
pcmminus1	13,062	110,846	2
pcmminus1_2	3,418	1,846	7
pcmminus1_3	61	79	6
pcmminus1_4	-2	1	9
pcmminus1_5	0	0	9
pcmplus1	366,594	136,291	7
pcmplus1_2	1,139	3,664	3
pcmplus1_3	-140	98	5
pcmplus1_4	2	1	5
pcmplus1_5	0	0	5
meanpcm	-3,920,131	973,028	23
meanpcm_2	184,369	53,346	19
meanpcm_3	20,619	5,423	19
meanpcm_4	-762	152	23
meanpcm_5	6	1	17
meanpcmminus24	-2,640,696	775,370	18
meanpcmminus24_2	-466,474	94,388	17
meanpcmminus24_3	-2,171	3,767	23
meanpcmminus24_4	752	185	19
meanpcmminus24_5	-8	2	23
meanpcmplus24	4,169,466	1,208,527	25
meanpcmplus24_2	293,945	69,111	24
meanpcmplus24_3	-9,264	2,455	19
meanpcmplus24_4	-503	123	18
meanpcmplus24_5	8	1	21

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
nino	-10,534,695	3,410,290	18
nina	-4,373,193	2,434,354	27
factor(month)2	673,779	1,899,903	22
factor(month)3	1,455,971	1,728,539	23
factor(month)4	2,025,759	2,881,525	22
factor(month)5	3,142,409	4,207,668	19
factor(month)6	3,698,756	4,796,780	26
factor(month)7	1,571,778	4,156,210	21
factor(month)8	-8,870,423	5,752,356	26
factor(month)9	-3,561,142	4,117,038	28
factor(month)10	-8,995,412	3,716,836	22
factor(month)11	-462,391	4,001,576	25
factor(month)12	3,999,440	3,362,153	23
factor(wday)jueves	3,687,658	2,455,495	21
factor(wday)lunes	-4,249,396	4,210,083	23
factor(wday)martes	-612,219	4,130,158	23
factor(wday)mi?coles	4,465,163	2,739,774	25
factor(wday)s?ado	9,892,300	4,103,528	16
factor(wday)viernes	3,261,587	2,447,297	19

Summary of model for 17 Hydro Plants

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
(Intercept)	6,274,160	2,110,902	14
pcmpos	177,494	52,842	14
pcm	219,432	134,046	7
pcm_2	-147	3,106	3
pcm_3	-30	96	3
pcm_4	0	1	1
pcm_5	0	0	3
pcmminus1	8,244	93,699	1
pcmminus1_2	3,419	1,349	7
pcmminus1_3	60	73	5
pcmminus1_4	-2	1	9
pcmminus1_5	0	0	9
pcmplus1	372,604	112,530	7
pcmplus1_2	910	3,000	3
pcmplus1_3	-142	90	5
pcmplus1_4	2	1	5
pcmplus1_5	0	0	5

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
meanpcm	-4,166,064	811,405	10
meanpcm_2	186,608	48,112	8
meanpcm_3	20,825	5,275	8
meanpcm_4	-767	150	11
meanpcm_5	6	1	8
meanpcmminus24	-2,570,368	687,972	10
meanpcmminus24_2	-454,765	88,375	9
meanpcmminus24_3	-2,184	3,678	9
meanpcmminus24_4	749	183	9
meanpcmminus24_5	-8	2	9
meanpcmplus24	4,638,543	959,966	10
meanpcmplus24_2	292,823	65,725	9
meanpcmplus24_3	-9,287	2,343	8
meanpcmplus24_4	-500	121	7
meanpcmplus24_5	8	1	5
nino	-9,061,277	2,549,190	7
nina	-3,801,596	1,082,116	9
factor(month)2	-1,078,806	872,550	9
factor(month)3	1,055,318	1,128,999	11
factor(month)4	-1,987,125	1,250,381	10
factor(month)5	-2,003,606	2,221,113	9
factor(month)6	-1,134,915	2,775,908	10
factor(month)7	-1,951,445	2,456,471	10
factor(month)8	-6,820,098	2,443,484	10
factor(month)9	-1,806,498	1,943,902	11
factor(month)10	-5,241,674	2,170,379	11
factor(month)11	920,002	1,539,088	7
factor(month)12	6,291,624	1,725,714	10
factor(wday)jueves	2,133,182	1,818,685	9
factor(wday)lunes	-117,000	1,724,764	7
factor(wday)martes	2,224,530	2,110,956	8
factor(wday)mi?coles	4,428,829	1,881,154	7
factor(wday)s?ado	5,037,533	2,168,961	8
factor(wday)viernes	2,174,832	1,928,379	8

Summary of model for 29 Thermo Plants

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
(Intercept)	-2,266,480	1,872,797	14
pcmpos	46,082	23,060	16



<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
pcm	2,114	21,687	0
pcm_2	-130	562	0
pcm_3	0	6	0
pcm_4	0	0	0
pcm_5	0	0	0
pcmminus1	4,817	17,147	1
pcmminus1_2	-1	496	0
pcmminus1_3	0	6	1
pcmminus1_4	0	0	0
pcmminus1_5	0	0	0
pcmplus1	-6,009	23,760	0
pcmplus1_2	229	664	0
pcmplus1_3	2	8	0
pcmplus1_4	0	0	0
pcmplus1_5	0	0	0
meanpcm	245,933	161,622	13
meanpcm_2	-2,239	5,233	11
meanpcm_3	-206	147	11
meanpcm_4	5	2	12
meanpcm_5	0	0	9
meanpcmminus24	-70,328	87,399	8
meanpcmminus24_2	-11,709	6,014	8
meanpcmminus24_3	12	89	14
meanpcmminus24_4	3	2	10
meanpcmminus24_5	0	0	14
meanpcmplus24	-469,076	248,561	15
meanpcmplus24_2	1,122	3,386	15
meanpcmplus24_3	23	112	11
meanpcmplus24_4	-3	1	11
meanpcmplus24_5	0	0	16
nino	-1,473,419	861,100	11
nina	-571,598	1,352,237	18
factor(month)2	1,752,584	1,027,352	13
factor(month)3	400,653	599,539	12
factor(month)4	4,012,884	1,631,144	12
factor(month)5	5,146,015	1,986,555	10
factor(month)6	4,833,671	2,020,873	16
factor(month)7	3,523,223	1,699,740	11
factor(month)8	-2,050,325	3,308,872	16
factor(month)9	-1,754,645	2,173,136	17
factor(month)10	-3,753,738	1,546,456	11
factor(month)11	-1,382,393	2,462,488	18

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
factor(month)12	-2,292,184	1,636,439	13
factor(wday)jueves	1,554,476	636,810	12
factor(wday)lunes	-4,132,396	2,485,319	16
factor(wday)martes	-2,836,749	2,019,203	15
factor(wday)mi?coles	36,333	858,620	18
factor(wday)s?ado	4,854,767	1,934,567	8
factor(wday)viernes	1,086,754	518,918	11

## Degree 6

### Summary of model for all Plants

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
(Intercept)	664,955,451	182,705,505	20
pcmpos	202,501	75,668	34
pcm	241,055	192,215	4
pcm_2	390	6,454	2
pcm_3	-18	155	5
pcm_4	0	3	3
pcm_5	0	0	4
pcm_6	0	0	1
pcmminus1	-22,908	132,885	1
pcmminus1_2	4,401	4,074	7
pcmminus1_3	63	101	5
pcmminus1_4	-3	2	5
pcmminus1_5	0	0	6
pcmminus1_6	0	0	3
pcmplus1	360,903	179,806	6
pcmplus1_2	6,200	6,589	3
pcmplus1_3	-121	161	3
pcmplus1_4	-1	3	4
pcmplus1_5	0	0	5
pcmplus1_6	0	0	2
meanpcm	-74,215,834	23,964,314	14
meanpcm_2	-9,122,937	2,576,870	10
meanpcm_3	985,354	267,573	14
meanpcm_4	21,661	6,243	9
meanpcm_5	-982	271	13
meanpcm_6	7	2	5

<b>Plants</b>	<b>Average of Coefficients</b>	<b>Average of Std. Errors</b>	<b># of Coefs. Significant(5%)</b>
meanpcmminus24	543,644,205	141,206,820	17
meanpcmminus24_2	-33,551,707	8,802,862	11
meanpcmminus24_3	-2,667,258	688,950	15
meanpcmminus24_4	182,254	47,524	17
meanpcmminus24_5	-3,384	886	12
meanpcmminus24_6	19	5	15
meanpcmplus24	-246,570,963	72,758,926	9
meanpcmplus24_2	11,363,311	3,530,566	12
meanpcmplus24_3	-856,238	249,238	15
meanpcmplus24_4	13,002	5,831	12
meanpcmplus24_5	88	95	14
meanpcmplus24_6	-1	1	7
nino	-48,133,540	23,124,926	21
nina	-156,416,260	49,669,823	21
factor(month)2	49,556,318	21,389,253	17
factor(month)3	-508,445,892	138,064,913	16
factor(month)4	-254,853,648	67,588,087	17
factor(month)5	-948,846,624	254,967,974	18
factor(month)6	-1,822,642,583	489,043,327	17
factor(month)7	-1,711,537,634	456,370,632	14
factor(month)8	157,442,215	51,410,818	16
factor(month)9	-909,308,476	236,655,727	15
factor(month)10	657,994,400	185,504,766	18
factor(month)11	-801,810,517	215,953,163	19
factor(month)12	253,541,178	82,750,822	13
factor(wday)jueves	218,265,722	62,395,530	9
factor(wday)lunes	-1,415,929,418	369,282,660	14
factor(wday)martes	558,140,082	146,311,960	10
factor(wday)mi?coles	965,240,233	253,385,800	14
factor(wday)s?ado	334,358,136	90,666,606	16
factor(wday)viernes	5,286,609	11,147,052	12