

## FINANCIAL PERFORMANCE ASSESSMENT OF ELECTRICITY COMPANIES: EVIDENCE FROM PORTUGAL

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# Summary



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## **1- Introduction**

## **2- Research Design/methodology**

## **3- Results**

## **4- Conclusions, Limitations and Future Research**



## □ Motivation

- Contribute to the assessment of electricity companies in a small country like Portugal.
- Given the importance of the electricity companies in any country's economic system, it is desirable to assess their financial performance.
- Furthermore, through this type of analysis it is possible to monitor the tariff deficit, particularly in the transmission, distribution or trade segments
- These issues are even more important since Portugal was largely affected by the financial global crisis and sovereign debt crisis.



## □ **Starting Point**

- Traditional Financial Indicators
- Panel Data methodology – GMM system method
- DEA method

## □ **Objective**

- This paper is aimed at assessing the financial performance of regulated companies operating in the Portuguese electricity market, in the period of 2010 to 2014, a period particularly impacted by the financial assistance provided to the Portuguese government.



## □ Contributions:

1. Offer new evidence of the determinants of financial efficiency performance of electric companies, using data on Portuguese regulated firms during 2010- 2014:
2. Analyze determinants of profitability/efficiency through two different methodologies, GMM system and DEA method.



## □ Database:

### ■ AMADEUS

- **Panel for 743 electric companies** (unbalanced panel for GMM system) for the period 2010 – 2014 which belong to the following NACE Rev. 2 codes: 351 - Electric power generation, transmission, distribution and trade.
- However, because of data availability we have ended up only using **213 firms (for DEA)** in 2010 and 2014, respectively (only firms with information regarding all inputs and outputs selected and with a positive ROE in both periods have been considered).

# Variables



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Variable	Description
$ROE_{it}$	Compares the equity invested to the net income of the company and it provides a measure to analyze the success of the investments
$LIQUID_{it}$	Is the liquidity given by the ratio between current assets and current liabilities of company i in period t
$LEVERAGE_{it}$	Is the financial leverage given by the ratio between total debt and total assets of company i in period t
$SIZE_{it}$	Is the logarithm of total assets of company i in period t
$CFTA_{it}$	Is the cash flow to total assets of company i in period t.
$DATA_{it}$	Is the value of depreciations and amortizations to total assets of company i in period t.
$GDP_t$	Is a macroeconomic variable and represents the real Gross Domestic Product growth in period t.
$CCI_{it}$	Is the Consumer Confidence Index for company i in period t



## □ The Model:

$$\square ROE_{it} = \beta_0 + \beta_1 LIQUID_{it} + \beta_2 LEVERAGE_{it} + \beta_3 SIZE_{it} + \beta_4 CFTA_{it} + \beta_5 DATA_{it} + \beta_6 GDP_t + \beta_7 CCI_{it} + \varepsilon_{it}$$

## □ Estimation Method: panel data methodology :

- panel data allows controlling for individual heterogeneity
- This point is crucial in our study because the profitability is very closely related to the specificity of each electric company
- This methodology accommodates the possible endogeneity between the dependent variable and some of the explanatory variables in the model by means of appropriate instruments



## Estimation results of the model-using GMM system

<i>Variable</i>	<i>Coefficient</i>	<i>STD. Error</i>	<i>Z</i>	<i>P value</i>
-const	-169.906	(65.166)	-2.61	0.009 ***
ROE <sub>it</sub>	0.057	(0.028)	2.08	0.037 **
LIQUID <sub>it</sub>	0.423	(0.171)	2.48	0.013 **
LEVERAGE <sub>it</sub>	38.713	(14.744)	2.63	0.009 ***
SIZE <sub>it</sub>	18.945	(7.881)	2.40	0.016 **
CFTA <sub>it</sub>	204.649	(21.822)	9.38	0.000 ***
DATA <sub>it</sub>	-187.964	(39.744)	-4.73	0.000 ***
GDP <sub>t</sub>	-2.427	(0.955)	-2.54	0.011 **
CCI <sub>it</sub>	0.202	(0.113)	1.79	0.073 *
Sargan			9.448 (8)	0.306
Wald			97.77 (8)	0.000
AR (1)			-1.009	0.3013
AR (2)			-0.638	0.524

The regressions are performed by using an unbalanced panel data composed by 743 companies and about 1860 observations. The remainder of the information needed to read this table is as follows: i) Heteroscedasticity consistent asymptotic standard error in parentheses. It should also be noted that: i) \*, \*\*, and \*\*\* indicates significance levels at 10%, 5% and 1% respectively; (ii) The Sargan test with a p value greater than 5% shows that the instruments are valid, and the values in parentheses of the test represent degrees of freedom; (iii) The Wald test has a p value less than 5% which means that the joint significance and the coefficients are significant distributed asymptotically as  $\chi^2$  under a null hypothesis without significance, with degrees of freedom in parentheses. The table shows that there is no second order correlation problems in the model, see AR (2).



## Descriptive statistics of data obtained in 2010

	ROE	CFTA	Leverage	DATA
<b>Mean</b>	44.869	0.156	0.752	0.063
<b>Standard deviation</b>	56.918	0.096	0.375	0.044
<b>Minimum</b>	0.400	0.001	0.042	0.000
<b>Maximum</b>	559.100	0.639	1.797	0.289

## Descriptive statistics of data obtained in 2014

	ROE	CFTA	Leverage	DATA
<b>Mean</b>	42.677	0.201	0.601	0.067
<b>Standard deviation</b>	56.816	0.131	0.327	0.048
<b>Minimum</b>	0.800	0.019	0.009	0.000
<b>Maximum</b>	737.900	0.719	1.626	0.319



- The GMM estimation method allowed us to select the intrinsic corporate variables that were then used to assess the financial performance of electric companies through the Slack Based Measure (SBM) DEA model.
- In this framework, the return on equity (ROE), the leverage and the cash flow to total assets (CFTA) were selected as outputs, while the values of depreciations and amortizations to total assets (DATA) have been regarded as inputs



- DEA is a nonparametric approach for **evaluating** the **relative efficiency** of DMUs;
- SBM DEA model is a non-radial and non-oriented model, since unlike radial models and the input (output)-oriented models it can provide a comprehensive efficiency assessment;
- SBM efficiency measure is immune to the units considered in the quantification of the inputs and outputs, i.e. it is "dimension free" or "units invariant."

The SBM suggested by Tone (2001) as the following form:

$$\text{Min } \lambda, \mathbf{s}^-, \mathbf{s}^+ \rho = \frac{1 - \frac{1}{m} \sum_{i=1}^m s_i^- / x_{io}}{1 + \frac{1}{s} \sum_{r=1}^s s_r^+ / y_{ro}}$$

s.t.

$$\mathbf{x}_o = X\lambda + \mathbf{s}^-,$$

$$\mathbf{y}_o = Y\lambda - \mathbf{s}^+,$$

$$\lambda \geq \mathbf{0}, \mathbf{s}^- \geq \mathbf{0}, \mathbf{s}^+ \geq \mathbf{0},$$

In order to account for variable returns to scale (VRS) it is only necessary to add the constraint  $\mathbf{e}^T \lambda = 1$  into model (1). This Problem can be converted into a LP by considering a positive scalar variable  $t$ :

$$\text{Min } t, \lambda, \mathbf{s}^-, \mathbf{s}^+ \tau = t - \frac{1}{m} \sum_{i=1}^m S_i^- / x_{io}$$

$$\text{s.t. } t + \frac{1}{s} \sum_{r=1}^s S_r^+ / y_{ro} = 1,$$

$$t\mathbf{x}_o = X\Lambda + \mathbf{S}^-,$$

$$t\mathbf{y}_o = Y\Lambda - \mathbf{S}^+,$$

$$\Lambda \geq \mathbf{0}, \mathbf{S}^- \geq \mathbf{0}, \mathbf{S}^+ \geq \mathbf{0}, t > 0$$

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Efficiency scores and rankings of electric firms in 2010



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DMU	Efficiency Score	Rank	DMU	Efficiency Score	Rank	DMU	Efficiency Score	Rank	DMU	Efficiency Score	Rank	DMU	Efficiency Score	Rank	DMU	Efficiency Score	Rank
11	0.003	178	150	0.052	34	1102	0.007	96	1151	0.047	37	1207	0.004	146	1256	0.000	210
13	1.000	1	151	0.004	141	1103	0.011	69	1152	0.004	168	1208	0.005	133	1257	0.005	115
14	0.005	120	152	0.006	107	1105	1.000	1	1153	0.009	86	1209	0.007	97	1258	0.004	163
15	0.004	154	153	0.045	40	1106	0.006	109	1154	0.006	110	1210	0.004	148	1259	0.005	126
17	0.002	184	154	0.060	30	1110	0.010	78	1155	0.069	29	1211	0.010	80	1261	0.005	121
18	0.003	174	159	0.010	81	1111	0.027	52	1156	0.009	87	1212	0.001	192	1263	0.003	172
19	1.000	1	160	0.014	63	1115	1.000	1	1161	0.406	15	1213	0.000	212	1264	0.004	152
110	0.003	169	161	0.052	35	1116	0.005	113	1162	0.034	49	1214	0.264	18	1265	0.001	194
111	0.006	106	162	0.108	25	1119	0.240	19	1163	0.014	61	1215	0.004	155	1266	0.001	205
112	0.016	58	165	1.000	1	1120	0.494	14	1164	0.007	100	1218	0.004	137	1267	0.001	195
113	0.047	38	166	0.008	94	1121	0.780	13	1165	0.013	65	1219	0.003	170	1268	0.001	193
115	0.005	134	167	0.016	59	1122	0.002	182	1166	0.009	88	1220	0.011	73	1269	0.050	36
116	0.054	32	168	0.018	57	1123	0.005	132	1167	0.003	177	1221	0.008	95	1272	0.004	149
117	0.008	93	169	0.006	105	1124	0.004	153	1171	0.020	56	1222	0.122	24	1273	0.000	211
118	0.004	164	170	0.004	138	1125	0.007	99	1175	0.004	167	1223	0.005	122	1274	0.005	124
119	0.215	20	171	0.070	28	1126	0.045	39	1176	0.001	198	1224	1.000	1	1275	0.000	207
120	0.004	158	174	0.037	48	1127	0.003	171	1177	0.005	118	1225	0.000	209	1276	0.004	140
121	0.056	31	175	0.014	62	1128	0.004	144	1179	0.010	82	1226	0.005	116	1277	0.004	147
122	0.044	41	176	0.006	112	1129	0.809	12	1180	0.108	26	1227	0.002	186	1278	0.005	136
123	0.011	76	177	0.002	189	1130	0.025	53	1181	0.005	114	1228	0.003	173	1280	0.004	160
124	0.038	46	179	0.034	50	1131	0.004	162	1183	0.005	130	1229	1.000	1	1281	0.005	125
125	0.002	185	180	0.005	119	1132	0.212	21	1184	0.004	142	1230	0.011	75	1282	0.003	180
127	0.364	16	181	0.008	90	1133	0.005	123	1186	0.014	60	1232	0.000	208	1283	1.000	1
128	0.005	129	182	0.005	127	1135	0.004	157	1188	0.002	187	1234	0.010	85	1286	0.042	42
129	0.008	92	183	0.001	200	1137	0.037	47	1189	0.004	166	1235	0.001	199	1287	0.001	197
131	1.000	1	184	0.010	84	1138	0.131	23	1191	0.002	188	1237	0.006	108	1288	0.004	143
132	0.054	33	186	0.039	44	1139	0.006	111	1192	0.038	45	1238	0.001	196	1289	0.002	181
134	0.004	139	187	0.012	67	1140	0.024	54	1193	0.008	89	1239	0.003	176	1292	0.004	159
137	0.100	27	188	0.011	72	1141	0.007	101	1194	0.006	104	1241	0.001	201			
138	1.000	1	191	0.031	51	1142	0.003	175	1196	0.011	74	1246	0.001	202			
139	0.005	117	193	0.021	55	1144	0.001	204	1198	0.004	150	1247	0.000	213			
140	0.004	151	194	0.012	66	1145	0.010	79	1200	0.005	131	1248	0.007	98			
141	0.011	70	195	0.004	165	1146	0.014	64	1201	0.134	22	1249	0.001	203			
143	0.007	102	197	0.004	156	1147	0.005	135	1202	0.361	17	1251	0.011	71			
145	0.010	77	198	0.002	183	1148	0.004	145	1203	0.002	190	1252	0.004	161			
148	0.007	103	199	0.008	91	1149	0.012	68	1204	0.003	179	1254	0.039	43			

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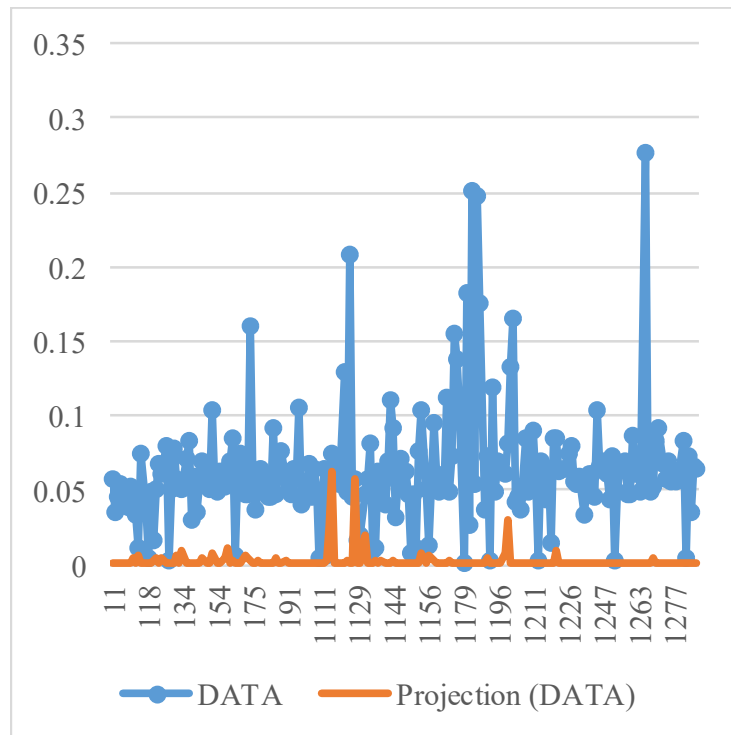
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14	0.002	161	152	0.006	93	1105	1.000	1	1153	0.001	172	1209	0.007	87	1258	0.003	132
15	0.001	181	153	0.003	138	1106	0.014	65	1154	0.044	35	1210	0.005	99	1259	0.001	188
17	0.001	193	154	0.044	38	1110	0.004	108	1155	0.004	117	1211	0.008	83	1261	0.009	81
18	0.003	130	159	1.000	1	1111	0.046	33	1156	0.010	72	1212	0.005	98	1263	0.004	110
19	0.362	16	160	0.061	24	1115	0.003	133	1161	0.001	173	1213	0.036	47	1264	0.004	120
110	0.000	201	161	0.044	39	1116	0.004	109	1162	0.003	135	1214	0.006	92	1265	0.054	26
111	0.007	89	162	0.031	49	1119	0.042	43	1163	0.006	95	1215	0.003	140	1266	0.015	64
112	0.173	19	165	1.000	1	1120	0.002	145	1164	0.008	86	1218	0.000	212	1267	0.043	41
113	0.024	57	166	0.011	70	1121	0.003	127	1165	0.023	59	1219	0.001	180	1268	0.053	27
115	0.001	175	167	0.044	36	1122	0.001	170	1166	0.009	80	1220	0.009	79	1269	0.001	197
116	0.001	182	168	1.000	1	1123	0.006	93	1167	0.150	22	1221	0.014	66	1272	0.009	78
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120	0.002	166	174	0.003	137	1127	0.047	30	1177	0.473	13	1225	0.000	208	1276	0.004	121
121	0.179	18	175	0.170	20	1128	0.002	147	1179	0.010	73	1226	0.003	142	1277	0.002	165
122	0.029	51	176	0.006	97	1129	0.003	139	1180	1.000	1	1227	0.005	107	1278	0.003	123
123	0.060	25	177	0.001	184	1130	0.009	82	1181	1.000	1	1228	0.002	160	1280	0.002	159
124	0.034	48	179	0.007	90	1131	0.000	204	1183	0.043	40	1229	0.000	206	1281	0.010	76
125	0.001	189	180	0.000	204	1132	0.005	102	1184	0.430	15	1230	0.011	71	1282	0.001	183
127	1.000	1	181	0.003	125	1133	0.004	122	1186	0.027	53	1232	0.001	195	1283	0.023	60
128	0.008	84	182	0.003	143	1135	0.004	118	1188	1.000	1	1234	0.002	154	1286	0.448	14
129	0.051	28	183	0.003	141	1137	0.019	62	1189	0.338	17	1235	0.003	131	1287	0.002	164
131	1.000	1	184	0.001	168	1138	0.002	163	1191	0.001	199	1237	0.005	103	1288	0.001	198
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137	0.038	45	188	0.000	211	1141	0.001	177	1194	0.013	67	1241	0.000	202			
138	0.001	169	191	0.028	52	1142	0.004	114	1196	0.013	68	1246	0.003	128			
139	0.018	63	193	0.042	44	1144	0.010	75	1198	0.004	119	1247	0.000	210			
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148	0.012	69	199	0.004	112	1149	0.002	153	1204	0.044	37	1254	0.004	116			
149	1.000	1	1100	0.029	50	1150	0.001	178	1206	0.001	194	1255	0.001	191			

Code:  
Efficient in both periods  
Efficient in 2014  
Efficient in 2010

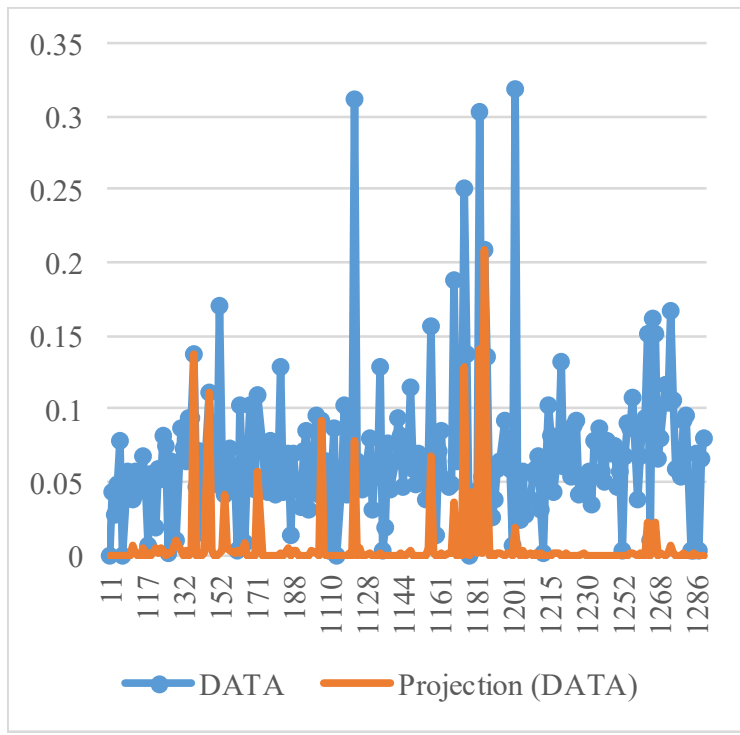
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a) 2010



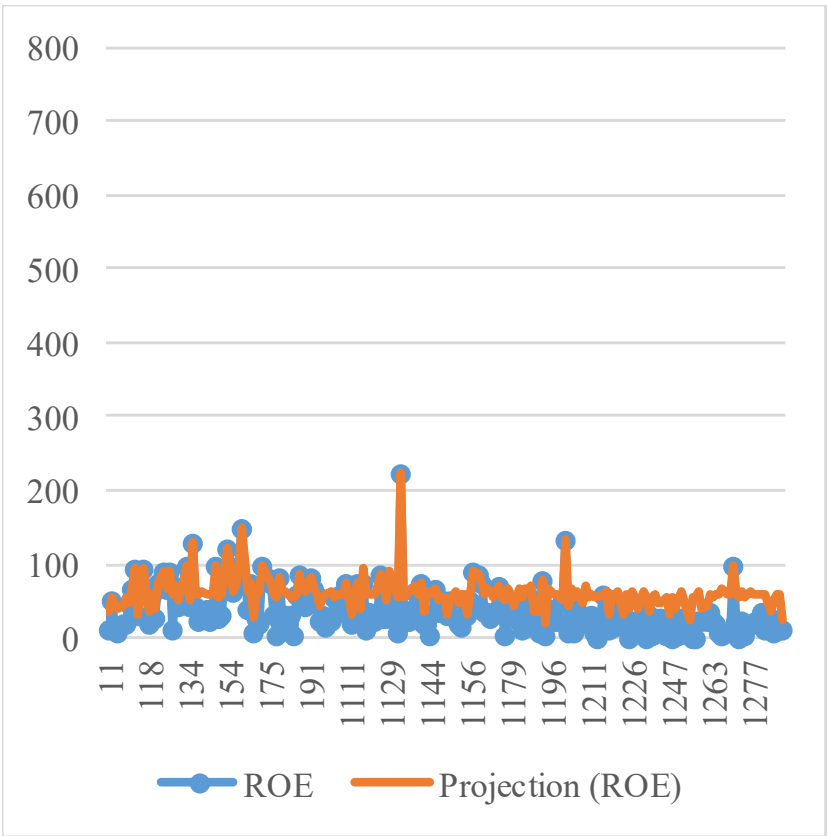
b) 2014



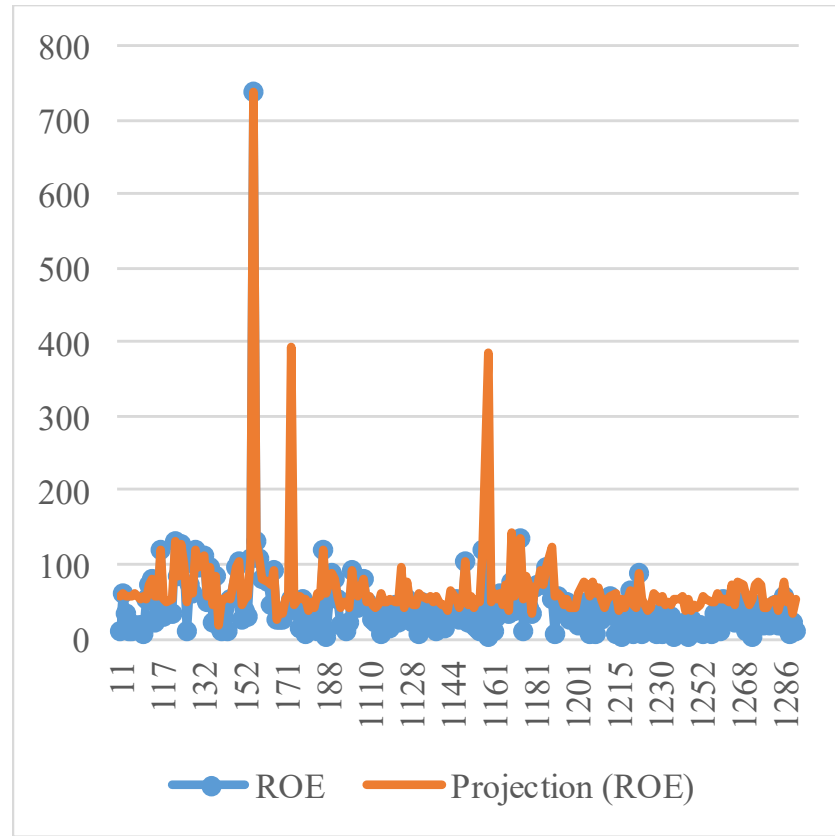
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a) 2010

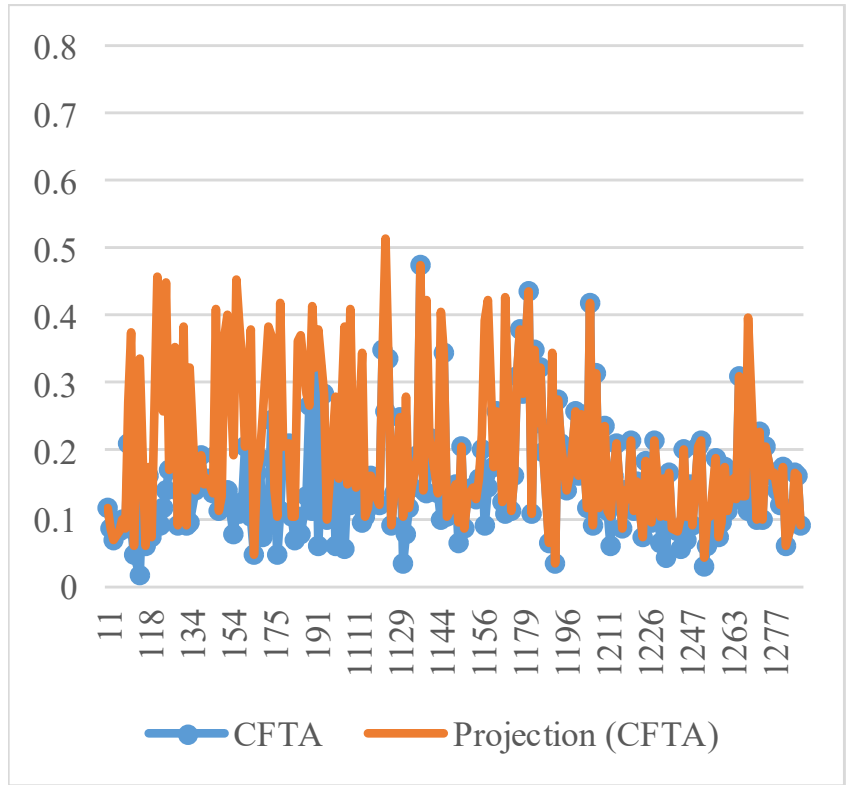


b) 2014

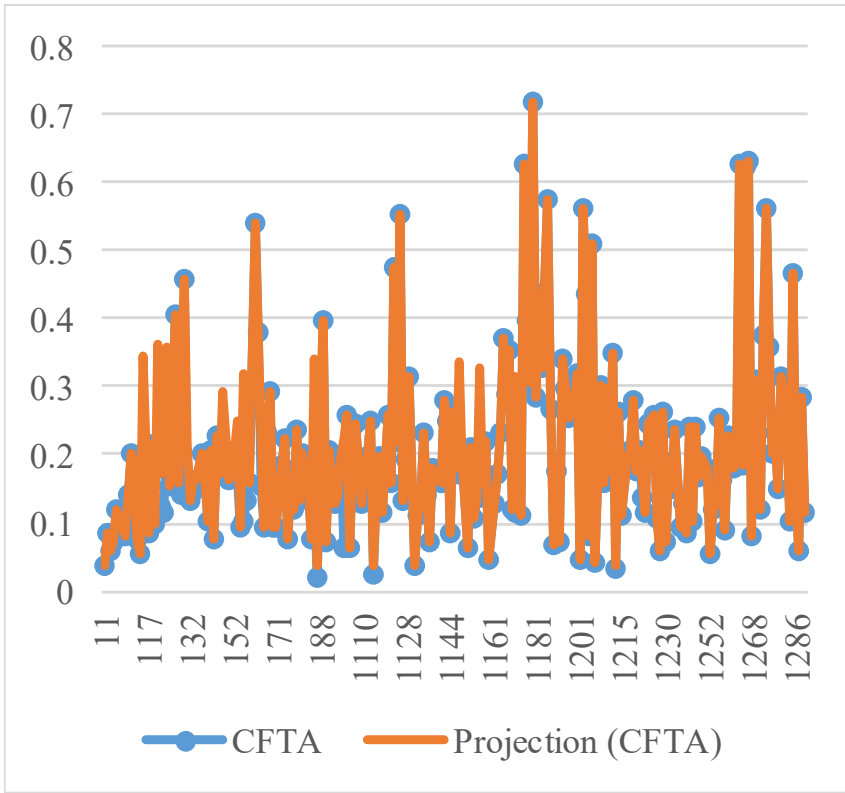
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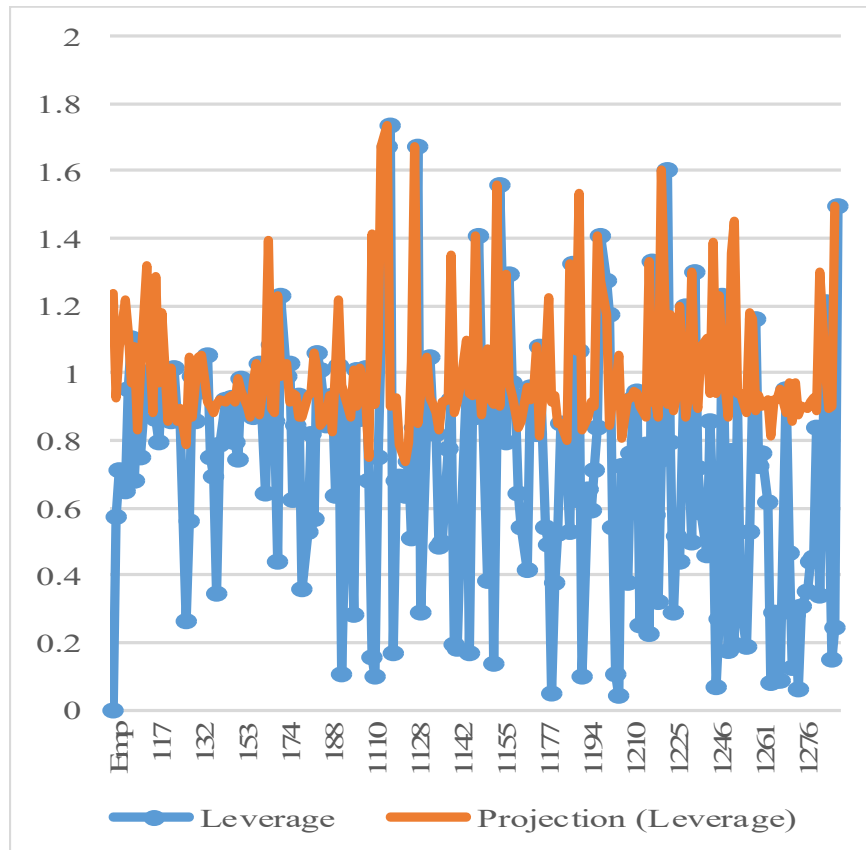


b) 2014

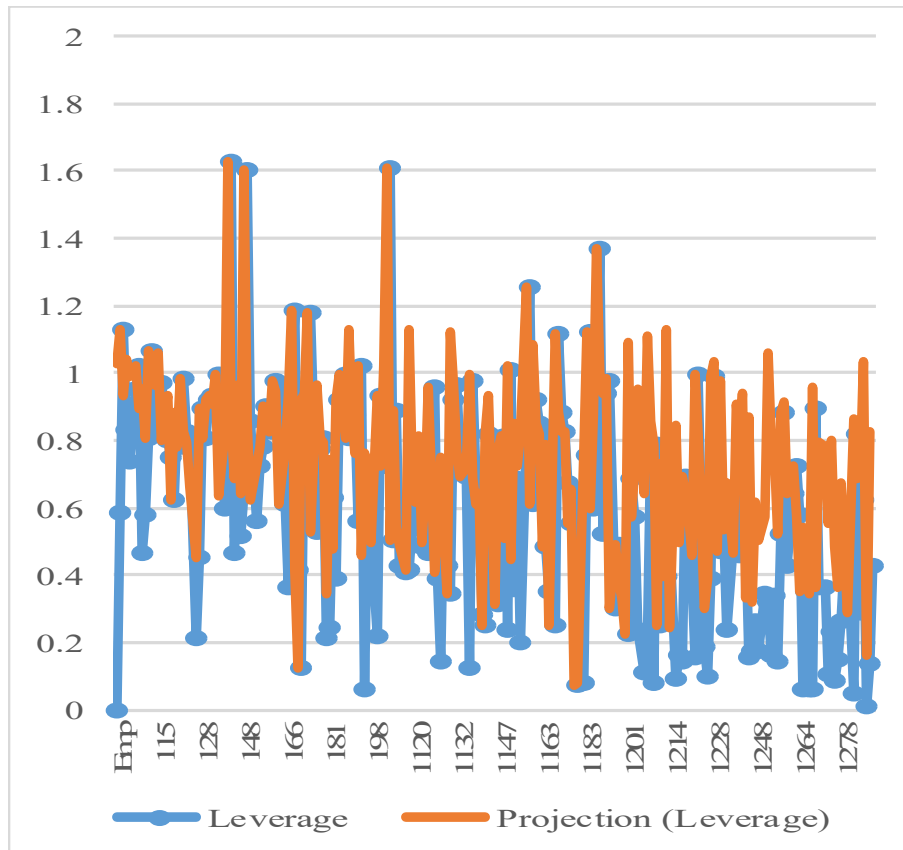
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a) 2010



b) 2014



1. This study provides new empiric evidence of the determinants of the financial performance of electric Portuguese firms;
2. It offers a better understanding of the efficiency variations of the selected firms in the period 2010-2014.
3. In general, it can be established, in both periods, that:
  - efficient firms were very profitable according to their ROE;
  - they were efficient in the generation of cash flows from their current operations; some efficient electric companies owned assets which did not allow them to cover their debt (which might be explained by the tariff deficit supported by trade companies);
  - efficient companies were replacing fixed assets with new ones in a fast manner.



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