















TABLE 2. RATIOS WITH 3 OUTPUTS AND 1 INPUT FOR THE 10 FIRMS FOR 5 YEARS

|     | 2006  |      |        |      | 2007  |      |        |      | 2008  |      |        |      | 2009   |      |        |      | 2010  |      |        |      |
|-----|-------|------|--------|------|-------|------|--------|------|-------|------|--------|------|--------|------|--------|------|-------|------|--------|------|
|     | X1    | X2   | X3     | X4   | X1    | X2   | X3     | X4   | X1    | X2   | X3     | X4   | X1     | X2   | X3     | X4   | X1    | X2   | X3     | X4   |
| E1  | 1.36% | 0.84 | 221.21 | 1.26 | 1.52% | 0.91 | 240.13 | 2.94 | 1.59% | 0.55 | 287.4  | 1.67 | 1.12%  | 0.32 | 257.04 | 2.78 | 1.41% | 0.1  | 240.13 | 1.19 |
| E2  | 2.24% | 0.26 | 248.3  | 2.1  | 2.70% | 0.69 | 202.78 | 2.53 | 7.35% | 0.44 | 238.56 | 2.11 | 3.21%  | 0.32 | 188.14 | 1.45 | 3.65% | 0.46 | 294.35 | 1    |
| E3  | 7.67% | 2.21 | 47.04  | 1.79 | 7.71% | 2.53 | 61.97  | 1.71 | 6.68% | 2.37 | 46.68  | 1.8  | 1.94%  | 1.92 | 55.22  | 1.69 | 6.41% | 1.59 | 68.22  | 1    |
| E4  | 9.21% | 1.76 | 36.46  | 2.43 | 8.85% | 1.75 | 32.44  | 2.82 | 7.33% | 2.17 | 42.34  | 3.41 | 6.97%  | 1.29 | 37.13  | 1.5  | 8.09% | 1.45 | 31.85  | 1.46 |
| E5  | 6.72% | 2.29 | 32.76  | 1.75 | 7.78% | 1.77 | 24.25  | 1.51 | 4.58% | 1.38 | 26.13  | 1.98 | 3.24%  | 1.05 | 31.33  | 1.33 | 1.51% | 1.9  | 25.07  | 1.4  |
| E6  | 8.06% | 1.38 | 70.87  | 1.92 | 4.78% | 1.54 | 85.68  | 1.46 | 1.58% | 1.34 | 61.24  | 1.71 | 4.88%  | 1.19 | 56.59  | 1.64 | 5.15% | 0.74 | 143.7  | 1.54 |
| E7  | 1.02% | 0.23 | 187.18 | 4.69 | 1.07% | 0.22 | 289.68 | 2.23 | 1.80% | 1.18 | 186.22 | 1    | 2.62%  | 0.17 | 193.12 | 2.57 | 1.96% | 0.15 | 143.7  | 1.96 |
| E8  | 6.68% | 9.46 | 58.03  | 1.48 | 6.86% | 8.33 | 60.73  | 1.44 | 2.64% | 9.75 | 63.37  | 1.19 | 3.14%  | 8.66 | 64.37  | 1.36 | 1.93% | 8.89 | 57.66  | 1.55 |
| E9  | 4.32% | 2.03 | 32.3   | 3.62 | 3.89% | 1.82 | 37.82  | 1.73 | 4.04% | 2.85 | 30.72  | 1.42 | 2.46%  | 2.31 | 33.83  | 2.03 | 1.92% | 1.91 | 31.63  | 1.96 |
| E10 | 3.88% | 2.7  | 125.86 | 2.53 | 5.87% | 3.48 | 401.1  | 3.89 | 6.38% | 5.03 | 215.98 | 2.28 | 11.73% | 3.66 | 260.71 | 1.92 | 7.48% | 3.78 | 215.98 | 2.15 |

Where,

- X1= return on asset
- X2 = receivables turnover ratio
- X3 = inventories turnover ratio (in days)
- X4 = current ratio
- E1= ALT
- E2=COCON
- E3=BYT
- E4=ILI
- E5=PROF
- E6=PCSYST
- E7=INTR
- E8=PLAIS
- E9=INF
- E10=MSL

TABLE 3. DESCRIPTIVE STATISTICS OF RATIOS FOR ALT

|                    | X1     | X2     | X3      | X4     |
|--------------------|--------|--------|---------|--------|
| Mean               | 1.410  | 0.470  | 256.170 | 2.145  |
| Standard Error     | 0.103  | 0.173  | 11.145  | 0.425  |
| Median             | 1.465  | 0.430  | 248.131 | 2.225  |
| Mode               |        |        | 240     |        |
| Standard Deviation | 0.207  | 0.346  | 22.290  | 0.851  |
| Sample Variance    | 0.040  | 0.11   | 496.870 | 0.724  |
| Kyrtosis           | 1.500  | -0.314 | 1.124   | -4.320 |
| Skewness           | -1.293 | 0.509  | 1.335   | -0.237 |
| Range              | 0.47   | 0.81   | 47.27   | 1.75   |
| Minimum            | 1.12   | 0.10   | 240.13  | 1.19   |
| Maximum            | 2      | 1      | 287     | 3      |

TABLE 4. DESCRIPTIVE STATISTICS OF RATIOS FOR COCON

|                    | X1    | X2    | X3       | X4     |
|--------------------|-------|-------|----------|--------|
| Mean               | 4.227 | 0.48  | 230.959  | 1.772  |
| Standard Error     | 1.058 | 0.077 | 23.636   | 0.340  |
| Median             | 3.430 | 0.450 | 220.669  | 0.340  |
| Mode               |       |       |          |        |
| Standard Deviation | 2.117 | 0.154 | 47.272   | 0.680  |
| Sample Variance    | 4.484 | 2.013 | 2234.700 | -2.464 |
| Kyrtosis           | 3.358 | 2.013 | -0.052   | -2.464 |
| Skewness           | 1.799 | 1.016 | 0.974    | 1.530  |
| Range              | 4.65  | 0.37  | 106.21   | 1.00   |
| Minimum            | 2.70  | 0.32  | 188.14   | 1.00   |
| Maximum            | 7     | 1     | 294      | 3      |



TABLE 5. DESCRIPTIVE STATISTICS OF RATIOS FOR BYT

|                           | X1     | X2     | X3     | X4     |
|---------------------------|--------|--------|--------|--------|
| <b>Mean</b>               | 5.720  | 2.102  | 58.022 | 1.752  |
| <b>Standard Error</b>     | 1.288  | 0.214  | 4.521  | 0.030  |
| <b>Median</b>             | 6.615  | 2.145  | 58.594 | 1.755  |
| <b>Mode</b>               |        |        |        |        |
| <b>Standard Deviation</b> | 2.577  | 0.428  | 9.242  | 0.061  |
| <b>Sample Variance</b>    | 6.644  | 0.183  | 85.424 | 0.003  |
| <b>Kyrtosis</b>           | 3.224  | -2.738 | -0.840 | -5.348 |
| <b>Skewness</b>           | -1.730 | -0.368 | -0.303 | -0.068 |
| <b>Range</b>              | 5.77   | 0.94   | 21.55  | 0.12   |
| <b>Minimum</b>            | 1.94   | 1.59   | 46.68  | 1.69   |
| <b>Maximum</b>            | 8      | 3      | 68     | 2      |

TABLE 6. DESCRIPTIVE STATISTICS OF RATIOS FOR ILI

|                           | X1     | X2     | X3     | X4     |
|---------------------------|--------|--------|--------|--------|
| <b>Mean</b>               | 7.810  | 1.665  | 35.940 | 2.297  |
| <b>Standard Error</b>     | 0.417  | 0.193  | 2.438  | 0.487  |
| <b>Median</b>             | 7.710  | 1.600  | 34.787 | 2.160  |
| <b>Mode</b>               |        |        |        |        |
| <b>Standard Deviation</b> | 0.835  | 0.386  | 4.877  | 0.974  |
| <b>Sample Variance</b>    | 0.698  | 0.149  | 23.790 | 0.949  |
| <b>Kyrtosis</b>           | -1.707 | -0.559 | -1.066 | -4.243 |
| <b>Skewness</b>           | 0.506  | 0.768  | 0.876  | 0.306  |
| <b>Range</b>              | 1.88   | 0.88   | 10.49  | 1.95   |
| <b>Minimum</b>            | 6.97   | 1.29   | 31.85  | 1.46   |
| <b>Maximum</b>            | 9      | 2      | 42     | 3      |

TABLE 7. DESCRIPTIVE STATISTICS OF RATIOS FOR PROF

|                           | X1    | X2     | X3     | X4    |
|---------------------------|-------|--------|--------|-------|
| <b>Mean</b>               | 4.277 | 1.525  | 26.690 | 1.555 |
| <b>Standard Error</b>     | 1.325 | 0.193  | 1.598  | 0.146 |
| <b>Median</b>             | 3.910 | 1.575  | 25.598 | 1.455 |
| <b>Mode</b>               |       |        |        |       |
| <b>Standard Deviation</b> | 2.651 | 0.386  | 3.184  | 0.292 |
| <b>Sample Variance</b>    | 7.031 | 0.149  | 10.140 | 0.085 |
| <b>Kyrtosis</b>           | 0.679 | -2.295 | 2.854  | 2.708 |
| <b>Skewness</b>           | 0.739 | -0.495 | 1.663  | 1.633 |
| <b>Range</b>              | 6.27  | 0.85   | 7.08   | 0.65  |
| <b>Minimum</b>            | 1.51  | 1.05   | 24.25  | 1.33  |
| <b>Maximum</b>            | 8     | 2      | 31     | 2     |

TABLE 8. DESCRIPTIVE STATISTICS FOR RATIOS FOR PCSYST

|                       | X1    | X2    | X3        | X4    |
|-----------------------|-------|-------|-----------|-------|
| <b>Mean</b>           | 4.097 | 1.202 | 86.803    | 1.587 |
| <b>Standard Error</b> | 0.842 | 0.170 | 20.010    | 0.050 |
| <b>Median</b>         | 4.830 | 1.265 | 73461.000 | 1.590 |

|                           |               |               |                 |               |
|---------------------------|---------------|---------------|-----------------|---------------|
| <b>Mode</b>               |               |               |                 |               |
| <b>Standard Deviation</b> | <b>1.685</b>  | <b>0.340</b>  | <b>40.020</b>   | <b>0.109</b>  |
| <b>Sample Variance</b>    | <b>2.841</b>  | <b>0.12</b>   | <b>1601.626</b> | <b>0.012</b>  |
| <b>Kyrtosis</b>           | <b>3.837</b>  | <b>1.232</b>  | <b>1.756</b>    | <b>-2.051</b> |
| <b>Skewness</b>           | <b>-1.947</b> | <b>-0.981</b> | <b>1.455</b>    | <b>-0.098</b> |
| <b>Range</b>              | <b>3.57</b>   | <b>0.80</b>   | <b>87.11</b>    | <b>0.25</b>   |
| <b>Minimum</b>            | <b>1.58</b>   | <b>0.74</b>   | <b>56.59</b>    | <b>1.46</b>   |
| <b>Maximum</b>            | <b>5</b>      | <b>2</b>      | <b>144</b>      | <b>2</b>      |

TABLE 9. DESCRIPTIVE STATISTICS OF RATIOS FOR INTR

|                           | X1            | X2           | X3              | X4            |
|---------------------------|---------------|--------------|-----------------|---------------|
| <b>Mean</b>               | <b>1.860</b>  | <b>0.430</b> | <b>203.182</b>  | <b>1.940</b>  |
| <b>Standard Error</b>     | <b>0.318</b>  | <b>0.250</b> | <b>30.830</b>   | <b>0.337</b>  |
| <b>Median</b>             | <b>1.880</b>  | <b>0.195</b> | <b>189.670</b>  | <b>2.095</b>  |
| <b>Mode</b>               |               |              |                 |               |
| <b>Standard Deviation</b> | <b>0.636</b>  | <b>0.500</b> | <b>61.668</b>   | <b>0.674</b>  |
| <b>Sample Variance</b>    | <b>0.405</b>  | <b>0.25</b>  | <b>3803.040</b> | <b>0.455</b>  |
| <b>Kyrtosis</b>           | <b>1.202</b>  | <b>3.929</b> | <b>2.309</b>    | <b>1.721</b>  |
| <b>Skewness</b>           | <b>-0.161</b> | <b>1.979</b> | <b>1.224</b>    | <b>-1.208</b> |
| <b>Range</b>              | <b>1.55</b>   | <b>1.03</b>  | <b>145.98</b>   | <b>1.57</b>   |
| <b>Minimum</b>            | <b>1.07</b>   | <b>0.15</b>  | <b>143.70</b>   | <b>1.00</b>   |
| <b>Maximum</b>            | <b>3</b>      | <b>1</b>     | <b>290</b>      | <b>3</b>      |

TABLE 10. DESCRIPTIVE STATISTICS OF RATIOS FOR PLAIS

|                           | X1           | X2           | X3            | X4            |
|---------------------------|--------------|--------------|---------------|---------------|
| <b>Mean</b>               | <b>3.642</b> | <b>8.907</b> | <b>61.530</b> | <b>1.385</b>  |
| <b>Standard Error</b>     | <b>1.100</b> | <b>0.303</b> | <b>1.501</b>  | <b>0.075</b>  |
| <b>Median</b>             | <b>2.890</b> | <b>8.775</b> | <b>62.050</b> | <b>1.400</b>  |
| <b>Mode</b>               |              |              |               |               |
| <b>Standard Deviation</b> | <b>2.201</b> | <b>0.606</b> | <b>3.003</b>  | <b>1.151</b>  |
| <b>Sample Variance</b>    | <b>4.847</b> | <b>0.37</b>  | <b>9.021</b>  | <b>0.022</b>  |
| <b>Kyrtosis</b>           | <b>3.070</b> | <b>1.707</b> | <b>-1.149</b> | <b>0.381</b>  |
| <b>Skewness</b>           | <b>1.696</b> | <b>1.164</b> | <b>-0.725</b> | <b>-0.530</b> |
| <b>Range</b>              | <b>4.93</b>  | <b>1.42</b>  | <b>6.71</b>   | <b>0.36</b>   |
| <b>Minimum</b>            | <b>1.93</b>  | <b>8.33</b>  | <b>57.66</b>  | <b>1.19</b>   |
| <b>Maximum</b>            | <b>7</b>     | <b>10</b>    | <b>64</b>     | <b>2</b>      |

TABLE 11. DESCRIPTIVE STATISTICS OF RATIOS FOR INFO

|                           | X1            | X2            | X3            | X4            |
|---------------------------|---------------|---------------|---------------|---------------|
| <b>Mean</b>               | <b>3.077</b>  | <b>2.222</b>  | <b>33.501</b> | <b>1.785</b>  |
| <b>Standard Error</b>     | <b>0.525</b>  | <b>0.234</b>  | <b>1.581</b>  | <b>0.137</b>  |
| <b>Median</b>             | <b>3.175</b>  | <b>2.110</b>  | <b>32.728</b> | <b>1.845</b>  |
| <b>Mode</b>               |               |               |               |               |
| <b>Standard Deviation</b> | <b>1.050</b>  | <b>1.469</b>  | <b>3.162</b>  | <b>0.275</b>  |
| <b>Sample Variance</b>    | <b>1.102</b>  | <b>0.22</b>   | <b>10.003</b> | <b>0.075</b>  |
| <b>Kyrtosis</b>           | <b>-4.630</b> | <b>-0.396</b> | <b>0.522</b>  | <b>-0.506</b> |
| <b>Skewness</b>           | <b>-0.200</b> | <b>0.979</b>  | <b>1.113</b>  | <b>-0.920</b> |
| <b>Range</b>              | <b>2.12</b>   | <b>1.03</b>   | <b>7.10</b>   | <b>0.61</b>   |

|                |             |             |              |             |
|----------------|-------------|-------------|--------------|-------------|
| <b>Minimum</b> | <b>1.92</b> | <b>1.82</b> | <b>30.72</b> | <b>1.42</b> |
| <b>Maximum</b> | <b>4</b>    | <b>3</b>    | <b>38</b>    | <b>2</b>    |

TABLE 12. DESCRIPTIVE STATISTICS OF RATIOS FOR MSL

|                           | <b>X1</b>    | <b>X2</b>    | <b>X3</b>       | <b>X4</b>    |
|---------------------------|--------------|--------------|-----------------|--------------|
| <b>Mean</b>               | <b>7.865</b> | <b>3.987</b> | <b>273.441</b>  | <b>2.560</b> |
| <b>Standard Error</b>     | <b>1.331</b> | <b>0.352</b> | <b>43.839</b>   | <b>0.449</b> |
| <b>Median</b>             | <b>6.930</b> | <b>3.720</b> | <b>215.976</b>  | <b>2.215</b> |
| <b>Mode</b>               |              |              |                 |              |
| <b>Standard Deviation</b> | <b>2.662</b> | <b>0.705</b> | <b>87.68</b>    | <b>0.899</b> |
| <b>Sample Variance</b>    | <b>7.090</b> | <b>0.5</b>   | <b>7687.628</b> | <b>0.808</b> |
| <b>Kyrtosis</b>           | <b>2.669</b> | <b>3.431</b> | <b>2.710</b>    | <b>3.494</b> |
| <b>Skewness</b>           | <b>1.640</b> | <b>1.816</b> | <b>1.680</b>    | <b>1.834</b> |
| <b>Range</b>              | <b>5.86</b>  | <b>1.55</b>  | <b>185.12</b>   | <b>1.97</b>  |
| <b>Minimum</b>            | <b>5.87</b>  | <b>3.48</b>  | <b>245.98</b>   | <b>1.92</b>  |
| <b>Maximum</b>            | <b>12</b>    | <b>5</b>     | <b>401</b>      | <b>4</b>     |

TABLE 13. AVERAGES OF RATIOS FOR EACH FIRM FOR THE PERIOD 2006-2010

|            | <b>X1</b>    | <b>X2</b>   | <b>X3</b>     | <b>X4</b>   |
|------------|--------------|-------------|---------------|-------------|
| <b>E1</b>  | <b>1.4%</b>  | <b>0.54</b> | <b>248.3</b>  | <b>1.96</b> |
| <b>E2</b>  | <b>3.83%</b> | <b>0.43</b> | <b>229.56</b> | <b>1.83</b> |
| <b>E3</b>  | <b>6.11%</b> | <b>2.12</b> | <b>53.21</b>  | <b>1.76</b> |
| <b>E4</b>  | <b>8.09%</b> | <b>1.68</b> | <b>35.68</b>  | <b>2.32</b> |
| <b>E5</b>  | <b>4.76%</b> | <b>1.67</b> | <b>27.51</b>  | <b>1.59</b> |
| <b>E6</b>  | <b>4.89%</b> | <b>1.23</b> | <b>74.95</b>  | <b>1.65</b> |
| <b>E7</b>  | <b>1.69%</b> | <b>0.39</b> | <b>190.1</b>  | <b>2.49</b> |
| <b>E8</b>  | <b>4.21%</b> | <b>9.01</b> | <b>60.73</b>  | <b>1.4</b>  |
| <b>E9</b>  | <b>3.32%</b> | <b>2.18</b> | <b>33.09</b>  | <b>2.15</b> |
| <b>E10</b> | <b>7.06%</b> | <b>3.73</b> | <b>213.45</b> | <b>2.55</b> |

Where,

X1= return on asset  
 X2 = receivables turnover ratio  
 X3 = inventories turnover ratio in days  
 X4 = current ratio

E1= ALT  
 E2=COCON

E3=BYT  
 E4=ILI  
 E5=PROF  
 E6=PCSYST  
 E7=INTR  
 E8=PLAIS  
 E9=INF  
 E10=MSL

TABLE 14. RATIO AVERAGE PER YEAR

|                | <b>X1</b>    | <b>X2</b>   | <b>X3</b>    | <b>X4</b>   |
|----------------|--------------|-------------|--------------|-------------|
| <b>2006</b>    | <b>5.09%</b> | <b>2.31</b> | <b>61.24</b> | <b>2.35</b> |
| <b>2007</b>    | <b>5.10%</b> | <b>2.3</b>  | <b>63.37</b> | <b>2.22</b> |
| <b>2008</b>    | <b>4.41%</b> | <b>2.7</b>  | <b>60.43</b> | <b>1.85</b> |
| <b>2009</b>    | <b>4.13%</b> | <b>2.08</b> | <b>63.37</b> | <b>1.82</b> |
| <b>2010</b>    | <b>3.95%</b> | <b>2.09</b> | <b>62.18</b> | <b>1.6</b>  |
| <b>Average</b> | <b>4.54%</b> | <b>2.3</b>  | <b>62.12</b> | <b>1.97</b> |

Where,

**X1**= return on asset

**X2** = receivables turnover ratio

**X3** = inventories turnover ratio in days

**X4** = current ratio

In our analysis we make an assumption concerning the ratios' prices when they are either zero or negative. In order to properly use these ratios, we took accepted these prices as positive, under the limitation that they are smaller compared to the relevant prices of the other firms for the particular year. This assumption ensures that we will have measurable values for all ratios and that the transformed values will not lead to wrong conclusions.

### VI. RATIOS' CORRELATION

In order to come to a final decision for the selected ratios we applied correlation tests for every one of them. Specifically, we examined for each firm the existence of correlation for ratios by testing these ratios pairwise with the Spearman correlation coefficient which is a non-parametric measure of statistical dependence between two variables and is denoted by  $\rho$ . The Spearman ratio evaluates how well the relationship between two variables is described using a monotonic function. If there are no repeated data values, a perfect Spearman correlation by +1 or -1 is the case where each

of the variables is a perfectly monotonic function of the other. The Spearman correlation coefficient is defined as the Pearson correlation coefficient between the rating variables. The  $n$  scores  $X_i, Y_i$  converted into rankings  $x_i, y_i$ , and  $\rho$  is calculated by the formula:

$$\rho = \frac{\sum_i(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i(x_i - \bar{x})^2 \sum_i(y_i - \bar{y})^2}}$$

Where,

- If  $\rho = \pm 1$  there is perfect linear correlation.
- If  $-0,3 \leq \rho < 0,3$  there is no perfect linear correlation.
- If  $-0,5 < \rho \leq -0,3$  ή  $0,3 \leq \rho < 0,5$  there is weak linear correlation.
- If  $-0,7 < \rho \leq -0,5$  ή  $0,5 \leq \rho < 0,7$  there is average linear correlation.
- If  $-0,8 < \rho \leq -0,7$  ή  $0,7 \leq \rho < 0,8$  there is a strong linear correlation.
- If  $-1 < \rho \leq -0,8$  ή  $0,8 \leq \rho < 1$  there is a very strong linear correlation.

The following tables (Tables 15-24) show the  $\rho$  value of correlation between ratios.

TABLE 15. RATIOS CORRELATION OF ALT

|           | <b>X1</b>   | <b>X2</b>   | <b>X3</b>  | <b>X4</b> |
|-----------|-------------|-------------|------------|-----------|
| <b>X1</b> | <b>1</b>    |             |            |           |
| <b>X2</b> | <b>0.36</b> | <b>1</b>    |            |           |
| <b>X3</b> | <b>0.24</b> | <b>0.3</b>  | <b>1</b>   |           |
| <b>X4</b> | <b>0.24</b> | <b>0.26</b> | <b>0.2</b> | <b>1</b>  |

TABLE 16. RATIOS CORRELATION OF COCON

|           | <b>X1</b>   | <b>X2</b>   | <b>X3</b>   | <b>X4</b> |
|-----------|-------------|-------------|-------------|-----------|
| <b>X1</b> | <b>1</b>    |             |             |           |
| <b>X2</b> | <b>0.05</b> | <b>1</b>    |             |           |
| <b>X3</b> | <b>0.18</b> | <b>0.13</b> | <b>1</b>    |           |
| <b>X4</b> | <b>0.03</b> | <b>0.38</b> | <b>0.37</b> | <b>1</b>  |

TABLE 17. RATIOS CORRELATION OF BYT

|           | <b>X1</b>   | <b>X2</b>   | <b>X3</b>   | <b>X4</b> |
|-----------|-------------|-------------|-------------|-----------|
| <b>X1</b> | <b>1</b>    |             |             |           |
| <b>X2</b> | <b>0.45</b> | <b>1</b>    |             |           |
| <b>X3</b> | <b>0.1</b>  | <b>0.47</b> | <b>1</b>    |           |
| <b>X4</b> | <b>0.56</b> | <b>0.24</b> | <b>0.22</b> | <b>1</b>  |

TABLE 18. RATIOS CORRELATION OF ILI

|    | X1   | X2   | X3   | X4 |
|----|------|------|------|----|
| X1 | 1    |      |      |    |
| X2 | 0.06 | 1    |      |    |
| X3 | 0.36 | 0.2  | 1    |    |
| X4 | 0.1  | 0.36 | 0.25 | 1  |

TABLE 19. RATIOS CORRELATION OF PROF

|    | X1   | X2   | X3   | X4 |
|----|------|------|------|----|
| X1 | 1    |      |      |    |
| X2 | 0.36 | 1    |      |    |
| X3 | 0.03 | 0.01 | 1    |    |
| X4 | 0.37 | 0.18 | 0.01 | 1  |

TABLE 20. RATIOS CORRELATION OF PCSYST

|    | X1   | X2   | X3   | X4 |
|----|------|------|------|----|
| X1 | 1    |      |      |    |
| X2 | 0.01 | 1    |      |    |
| X3 | 0.23 | 0.55 | 1    |    |
| X4 | 0.4  | 0.19 | 0.45 | 1  |

TABLE 21. RATIOS CORRELATION OF INTR

|    | X1   | X2   | X3   | X4 |
|----|------|------|------|----|
| X1 | 1    |      |      |    |
| X2 | 0.02 | 1    |      |    |
| X3 | 0.43 | 0.03 | 1    |    |
| X4 | 0.42 | 0.06 | 0.06 | 1  |

TABLE 22. RATIOS CORRELATION OF PLAIS

|    | X1   | X2   | X3  | X4 |
|----|------|------|-----|----|
| X1 | 1    |      |     |    |
| X2 | 0.24 | 1    |     |    |
| X3 | 0.24 | 0.03 | 1   |    |
| X4 | 0.31 | 0.09 | 0.2 | 1  |

TABLE 23. RATIOS CORRELATION OF INFO

|    | X1   | X2   | X3   | X4 |
|----|------|------|------|----|
| X1 | 1    |      |      |    |
| X2 | 0.22 | 1    |      |    |
| X3 | 0.11 | 0.59 | 1    |    |
| X4 | 0.29 | 0.36 | 0.09 | 1  |

TABLE 24. RATIOS CORRELATION OF MSL

|    | X1   | X2   | X3   | X4 |
|----|------|------|------|----|
| X1 | 1    |      |      |    |
| X2 | 0.24 | 1    |      |    |
| X3 | 0.49 | 0.27 | 1    |    |
| X4 | 0.49 | 0.24 | 0.38 | 1  |

Where,

**X1**= return on asset

**X2** = receivables turnover ratio

**X3** = inventories turnover ratio in days

**X4** = current ratio

From the above tables which are in line with the ratios' theory of when two variables are correlated and what kind of relationship they have with each other, we can conclude that the selected ratios have low correlation between them. The values of p range from 0.01 up to 0.56. Therefore, we can go to our calculations, using their values. The financial analysis of the examined firms based on the selected ratios is presented in the following section.

## VII. FINANCIAL ANALYSIS OF FIRMS BASED ON THE SELECTED RATIOS

In this section we can see the performance of the ten selected firms by using the four ratios, following with the conclusions for the examined firms. In our analysis we examine every firm for each ratio for the period of five years (2006-2010). Initially, firms are examined for each year, and then they are compared based on the average rate of the ten firms for the particular year, which is considered as the average rate of the sector. Then we find the overall averages of firms for the entire period of the five years.

According to the first ratio, which is the asset efficiency, we test the ten firms for their efficiency. As already mentioned, the efficiency of a company is its ability to generate profits. It shows how efficient is the firm's management to utilize its assets in an appropriate manner to produce revenues. The higher the index, the better is for the firm which can go on and to attract new capitals for investment.

The firm with the highest profit for 2006 was ILI with ratio 9.21%, much higher than the industry average, which is 5.09%. The lower profit ratio was for INTRA, at 1.02%. For 2007 ILI holds the primacy in the industry, with 8.85%, while INTRA notes a slight increase in profits with a ratio of 1.07%, but still remains last in the sector (sector is relatively steady at 5.1%). In 2008 COCON manages to be first with 7.35%, while ALT notes the smaller profits in the sector, with 1.59%, but at the same time the sector to fall to 4.41%. In 2009 the presence of MSL is dynamic, with a ratio 11.73%, much higher than the 4.13% of the sector, while the last in the sector is still ALT with a ratio of 1.12%. In 2010, the higher profits are again for ILI with a ratio of 8.09%, and the lower profits are for ALT by 1.41%, while the average of the sector are further reduced to 3.95%.

Then, we calculated the averages of ratios for each firm for the five years period. Overall in these five years

we see that ILI manages to have the largest profit, with an average for the five years at 8.09%, followed by MSL with 7.06%. Last on the scale is ALT with 1.4%.

The receivables turnover ratio shows how many times on average a firm collects its receivables during the accounting year. It is therefore desirable to have a higher ratio which means that the firm's sales are higher than its receivables.

For 2006, PLAIS is the firm that manages to collect the receivables better than the rest of the sector, with a ratio 9.46, compared to the sector's average 2.31, while the lowest percentage of receivables are collected by INTRA, with a ratio of 0.23. In 2007 PLAIS is again first with a downward trend at 8.33, while INTRA continues steadily to 0.22, and the average of the examined firms in the sector to be 2.3. In 2008 PLAIS notes a further increase with a ratio of 9.75, while COCON show a decrease in its ability to collect receivables with a ratio 0.44 while at the same time the average for the ten firms is 2.7. In 2009 PLAIS remains on the top although with a decrease to 8.66, and INTRA is last with a ratio 0.17, while the industry is on average 2.08. The best performance to collect receivables is therefore PLAIS for the five years period from 2006 to 2010 with an average ratio of 8.89, while ALT is last with a ratio 0.1 and the sector's average to be at a ratio of 2.09. For the total period of investigation the average receivables turnover ratio is greater for the firm PLAIS (9.01), while the lower ratio is for COCON (0.43)

The use of inventories turnover ratio offers significant findings relevant to the ability of a firm to manage its inventories efficiently.

For 2006 the firm which managed to sell inventories in hand in the best way was INFO, with a ratio of 11.3 and an average number of 32.3 days to sell inventories in hand, while on the other hand inventories of COCON had an average 248.3 days for this year and a ratio of inventories turnover ratio at 1.47, while for the sector the average ratio of inventories turnover ratio was 5.96 and the period of inventories in hand to sell was 61.24 days. For 2007, PROF's average number of days taken to sell its inventories on hand was better than the other firms, with an average ratio of 24.25 days and a ratio of inventories turnover ratio at 15.05, much lower than the sector's average of 63.37 days and inventories turnover ratio 5.76). At the same time MSL does not do so well, with an average time to replace its inventories of 401.1 days and ratio of inventories turnover ratio. 0.91. In 2008 PROF holds the lead with an average time to replace its inventories of 26.13 days and ratio inventories turnover ratio 13.97 (compared to 60.43 days and inventories turnover ratio 6.04 of the sector). The worse average number of days taken to sell inventories on hand for 2008 is ALT with a ratio of inventories turnover ratio 1.27 and an average of 287.4 days. In 2009 PROF notes a decrease, but still remains

high compared to the sector average, with an average time of 31.33 days and a ratio of inventories turnover ratio 11.65, while the sector is at 63.37 days and a Social Insurance Fund 5.76 and last is the MSL, with an average residence time of the stock 260.71 days and inventories turnover ratio is 5.76 and at the end is MSL with an average of 260.71 days and inventories turnover ratio 1.4. In 2010 PROF closes the five years period with an average time to replace its inventories 25.07 days and inventories turnover ratio 14.56, while COCON notes a lower ratio with an average time to replace its inventories 294.35 days and inventories turnover ratio 1.24. The sector's average in the respective year is 62.18 days and inventories turnover ratio 5.88. In 2010 PROF closes five years with an average time to replace its inventories 25.07 days and inventories turnover ratio 14.56, while COCON has a lower ratio with an average time to replace its inventories 294.35 days and inventories turnover ratio 1.24. At the same year the sector's average is 62.18 days and the ratio inventories turnover ratio 5.88.

From the averages of the time to replace its inventories for each firm for the entire period of the five years, we found that the lower average time to replace its inventories is for PROF, with 27.51 days and a ratio of inventories turnover ratio 13.27, followed by INFO, with 33.09 days and inventories turnover ratio 11.03. The highest average ratio for the entire period of five years is for ALT, with 248.3 days and a ratio of inventories turnover ratio 1.47, followed by COCON, with 229.56 days and inventories turnover ratio 1.59.

The current ratio defines the financial position of a firm in the short run and therefore its ability to meet its short-term liabilities. Specifically, we can see how many times a firm covers its current liabilities by its current assets. The higher this ratio is the better in terms of liquidity is the position of this firm.

Better liquidity for 2006 presented by INTRA, with a ratio of 4.69 and the lower for ALT, with a ratio of 1.26, while the average for all firms is 2.35. The 2007 MSL displays liquidity 3.89, higher than the 2.22 average of the sector, while PLAIS has a liquidity ratio

of 1.44. In 2008 ILI notes the highest of 3.41 and INTRA the lowest ratio of 1.0, while the sector shows a decrease in liquidity with 1.82. In 2010, the five years period ends with ALT showing the highest liquidity ratio between the ten examined firms, with a ratio of 2.78 and COCON the lowest one with a ratio of 1.0 while the sector's average is at 1.6.

From the averages of the current ratios for the ten firms for the entire five years period, we can see that the highest liquidity on average for the five years is for the company MSL, with a ratio of 2.55, followed by INTRA, with 2.49. The lower average ratio for the five years is for PLAIS with 1.4, followed by PROF, with 1.59.

A remarkable conclusion, based on the averages of the four ratios for all ten firms per year, is the downward trend which is noted in all four ratios over the examined years. The sector seems to fall in profits, starting from an average return on assets at 5.09% in 2006 and ending at 3.95% in 2010. It also seems that the average receivables turnover ratio was reduced from 2.31 in 2006 to 2.09 in 2010. Downward is also the average inventories turnover ratio, which starts from 5.96% in 2006 and ends at 5.87% in 2010. The average time to replace its inventories has increased over the years, from 61.24 days in 2006 to 62.18 days in 2010.

Last but not least, the liquidity of the examined firms of the sector is also declining, with the ratio to start in 2006 from 2.35 and to reach 1.6 in 2010. This downward trend in the examined ratios for the sector which are related with the outputs of our model shows the overall downward trend in the sector of Information Technology for the years 2006 to 2010, when the crisis period started in Greece.

#### VIII. APPLICATION OF DEA

To implement the DEA method, we applied the program DeaOS and the results from this application for the ten examined firms for the five years of investigation (2006-2010) are presented in Table 25.

TABLE 25. CORPORATE PERFORMANCE RESULTS FOR 2006-2010

|         | 2006 | 2007 | 2008 | 2009 | 2010 | Average |
|---------|------|------|------|------|------|---------|
| E1      | 0.05 | 0.14 | 0.07 | 0.18 | 0.08 | 0.1     |
| E2      | 0.07 | 0.14 | 0.18 | 0.15 | 0.07 | 0.12    |
| E3      | 0.7  | 0.47 | 0.87 | 0.51 | 0.41 | 0.59    |
| E4      | 1    | 1    | 1    | 1    | 1    | 1       |
| E5      | 0.93 | 1    | 1    | 0.83 | 1    | 0.95    |
| E6      | 0.45 | 0.24 | 0.37 | 0.6  | 0.2  | 0.37    |
| E7      | 0.22 | 0.9  | 0.08 | 0.22 | 0.22 | 0.33    |
| E8      | 1    | 1    | 1    | 1    | 1    | 1       |
| E9      | 1    | 0.64 | 1    | 1    | 1    | 0.93    |
| E10     | 0.23 | 0.12 | 0.24 | 0.27 | 0.23 | 0.22    |
| Average | 0.57 | 0.57 | 0.58 | 0.58 | 0.52 | 0.56    |

Where,

E1= ALT  
E2=COCON  
E3=BYT  
E4=ILI

E5=PROF  
E6=PCSYST  
E7=INTR  
E8=PLAIS  
E9=INF  
E10=MSL

TABLE 26. DESCRIPTIVE STATISTICS FOR PERFORMANCE

|                           | 2006          | 2007          | 2008          | 2009          | 2010          |
|---------------------------|---------------|---------------|---------------|---------------|---------------|
| <b>Mean</b>               | <b>0.622</b>  | <b>0.565</b>  | <b>0.581</b>  | <b>0.576</b>  | <b>0.521</b>  |
| <b>Standard Error</b>     | <b>0.127</b>  | <b>0.122</b>  | <b>0.134</b>  | <b>0.113</b>  | <b>0.133</b>  |
| <b>Median</b>             | <b>0.700</b>  | <b>0.555</b>  | <b>0.620</b>  | <b>0.555</b>  | <b>0.320</b>  |
| <b>Mode</b>               | <b>1</b>      | <b>1</b>      | <b>1</b>      | <b>1</b>      | <b>1</b>      |
| <b>Standard Deviation</b> | <b>0.383</b>  | <b>0.388</b>  | <b>0.424</b>  | <b>0.360</b>  | <b>0.422</b>  |
| <b>Sample Variance</b>    | <b>0.147</b>  | <b>0.151</b>  | <b>0.179</b>  | <b>0.129</b>  | <b>0.178</b>  |
| <b>Kurtosis</b>           | <b>-1.935</b> | <b>-2.084</b> | <b>-2.298</b> | <b>-1.959</b> | <b>-2.174</b> |
| <b>Skewness</b>           | <b>-0.305</b> | <b>0.019</b>  | <b>-0.098</b> | <b>0.093</b>  | <b>0.323</b>  |
| <b>Range</b>              | <b>0.93</b>   | <b>0.88</b>   | <b>0.93</b>   | <b>0.85</b>   | <b>0.93</b>   |
| <b>Minimum</b>            | <b>0.07</b>   | <b>0.12</b>   | <b>0.07</b>   | <b>0.15</b>   | <b>0.07</b>   |
| <b>Maximum</b>            | <b>1</b>      | <b>1</b>      | <b>1</b>      | <b>1</b>      | <b>1</b>      |

## IX. GENERAL CONCLUSION

From Table 20 with the efficiency scores for the ten firms for the five years period, we can draw conclusions from the implementation of the method. Resulting conclusions on which firms managed to qualify as efficient (efficiency is equal to 1), and which firms were non-profitable firms. We can draw conclusions about which firms are close to be characterized as efficient and which are very low in efficiency in relation to the other firms of the sector. Conclusions can be made comparing all the firms for each year, but also for each company within the period of the five years (2006-2010).

### 8.1 Conclusions for the per year efficiency of firms

Specifically, for 2006 only three firms (E4, E8, E9) are efficient, i.e. only the 30% of the sample, while the average efficiency for this year is 0.57. From the non-efficient firms, E1 (0.05), has the lower efficiency while at the same levels we find also E2, E3. Very close to be characterized as efficient is firm E5 while moderate efficiency is presented for E6.

For the year 2007, efficient are three firms (E4, E5, E8), i.e. 30% of the sample while E7 (0.9) is very close to efficiency (close to 1). The average efficiency for the year is 0.57. From the inefficient firms, E10 (0.12), E1 (0.14) and E2 (0.14) show low efficiency.

In 2008 four firms manage to have efficiency equal to 1 (E4, E5, E8, E9) so 40% of the sample is efficient while the average for 2008 is equal to 0.58. The lower efficiency is for the firms E1 and E7, while relatively high (close to 1) is the efficiency of E3 (0.87).

In 2009 the efficient firms are again three (E4, E8, E9), so 30% of the sample is efficient, while the average for this year is 0.58. From the inefficient firms

E2 (0.15) has the lower efficiency followed by E1 (0.18), while E5 is approaching to become efficient with 0.83.

In 2010 efficiency firms are four (E4, E5, E8, E9), which represents the 40% of the sample, while the average efficiency is equal to 0.52. From the inefficient firms, E6 (0.02) shows the lower efficiency, followed by E2 (0.07) and E1 (0.08).

### 8.2 Conclusions for each firm for the five years period

The firms E4 and E8 are efficient for the entire period of the five years. As far as the other five firms, the best efficiency score is achieved by the firm E5, with an average of 0.95 in five years, followed by the firm E9 with an efficiency score of 0.93. The firm E3 has a relatively low efficiency score (0.59), while E6 and E7 are following with even lower efficiency scores (0.37 and 0.33 respectively) and in the last position we find the firm E10 with a score of 0.22, the firm E2 with a score of 0.12 and the firm E1 with a score of 0.1.

The firm E1 has very low efficiency scores in the period of the five years, ranging from 0.05 up to 0.18, presenting the lowest efficiency scores in all the years compared to the other firms of the sample. The firm E2 is moving in the same context with the E1, with an average of five years slightly higher than E2, (0.12 compared to the 0.1 of E1). The firm E3 presents high variation in the rates of return for the period of the five years, with values ranging from 0.07 in 2006 to 0.87 in 2008. The average rate of efficiency for the firm E3 is 0.59, which means that it cannot be characterized as particularly efficient during this five years period.

The firms E4 and E8 are efficient for the entire period of the five years according to the DEA method.



The firm E5 is efficient for the three of the five examined years, while for two years it is not efficient although its scores are quite high (0.93 and 0.83). The firm E6 has relatively low efficiency in the five years, with an average of 0.37. Its higher efficiency score 0.6 is in 2009 and its lower efficiency score 0.2 is in the year 2010, while the firm E7 is also equally inefficient to E6. The average of the firm E6 for the examined period is 0.33 with its higher score of efficiency to be in the year 2007 (0.9) and lower efficiency score in 2008 (0.08). The firm E9 is almost in the same level with the firm E5, being efficient for four of the five years of the investigated period, while for one year it is inefficient, with a score of efficiency 0.64 and an average efficiency score for the five years 0.93. Finally, the firm E10 has a low efficiency scores, with an average of 0.22 for the five years period with its highest efficiency score to be in the year 2009 (0.27) and its lowest in 2007 (0.12).

#### X. COMPARISON OF DEA RESULTS WITH FINANCIAL ANALYSIS

Comparing the efficiency scores of DEA for the firms with the results of the financial analysis of the same firms several interesting conclusions are generated.

Starting from the two firms E4 and E8 which are characterized as efficient for the entire period of the five years, we see that for E4 efficiency is established also by the DEA method, since E4 has managed the highest profits for the five years and has on average the highest asset efficiency. On the other hand, firm E8 notes the highest average of turnover receivables ratio but at the same time it is the firm with the lower liquidity compared to the other firms for the period of the five years. Therefore, we can see that at a high percentage, the results of DEA are in line with the results of the financial analysis for both firms E4 and E8.

Continuing with the examination of the inefficient firms, E9 shows quite low average turnover inventories ratio which means that it manages to sell inventories on hand in less days and also has quite good liquidity performance. Also the firm E5 has the greatest turnover inventories ratio with the highest average rate among the firms of the examined sample. However, E5 presents a low current ratio for the period of five years which allows us to conclude again that DEA method is at a high percent in line with the results of the financial analysis for the examined firms.

The firm E3 has an average efficiency ratio 0.59 for the five years, which places it in a fair condition of the efficiency scale. This is confirmed also by its financial situation, since in the average ratios for the period of the five years the efficiency score is close to the overall averages of the sector. In particular, the profitability of its assets is 6.11 slightly higher than the sector's average (for five years is 4.53, Tables 13 and 14) the receivables turnover ratio is 2.12, slightly lower than the average of the sector, which is 2.3 while the current asset ratio for E3 is averaged again near the average of the sector, i.e. 1.76 compared to 1.97. Finally, the average inventories turnover ratio is lower than the

sector's average which is 53 days compared with 62 days respectively. In this case we can conclude that financial analysis for E3 is in line with the result of the DEA.

As far as the firms E6 and E7 are concerned, they are the firms with the lower efficiency, followed by E10 which is close to them. More specifically efficiency for E6 is on average equal to 0.37 while according to the financial analysis the receivables turnover ratio is half (1.23) compared to the sector's average (2.3), and the days taken to sell inventories on hand is on average 74 days for the five years period, much longer than the average of the sector (62 days). Also with the DEA method firm E7 is ranked as inefficient, with an efficiency ratio of 0.33. From the financial analysis we can see that the return on asset efficiency is 1.69 on average for the five years, compared to the sector's average 4.5, while its receivables turnover ratio is also low (0.39). Nevertheless, the current ratio average is just above the sector's average (2.49), but its number of days to sell inventories on hand is very high (190 days). The firm E10 is also low in terms of efficiency (0.22). In more detail, the return on assets, the receivables turnover ratio and the current ratio are lower than the sector's averages, while the average number of days to sell inventories on hand is also lower. Therefore, the results of DEA are in line with the results of the financial analysis for the two of the three examined firms.

Finally, the firms with the lowest efficiency are E1 and E2. The firm E1 has the lowest efficiency score of 0.1, while E2 is inefficient with efficiency score equal to 0.12. The firm E1 according to the financial analysis has the lowest profits in the period of five years, the lowest return on assets ratio, and relatively low receivables turnover ratio. On the other hand, E2 shows very low ratio for the five years both in terms of asset efficiency and for the average number of days taken to sell inventories on hand and also lower current ratio compared to the other firms. Therefore, also in this case of the DEA method the results are in line with the results of the financial analysis.

In conclusion, we can say that for nine of the ten firms the results of DEA are in line with the conclusions resulting from the financial analysis for the sample of firms. Therefore, we can say with certainty that the evaluation of the ten firms of the information technology sector is satisfactory and to draw reliable conclusions about their efficiency.

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