Examining changes in financial performance: Evidence from the European companies

Posouzení změn ve finanční výkonnosti: analýza evropských podniků

Martina Novotná [1]

Abstract

The paper examines changes in the financial performance of industrial companies across twelve EU countries. Specifically, changes in five financial ratios over the period 2005-2009 are investigated. The data used in this paper is extracted from Amadeus database and comprises more than 21,500 observations of European companies, including five financial indicators for each company. The comparison of ratios over the selected period is carried out by the means of parametrical t-paired test and non-parametrical sign test and Wilcoxon test. The results document that the financial crisis significantly influenced the performance of companies; however there are obvious differences among individual countries.

Key words

Analysis, financial crisis, comparison, performance, sign test, t-paired test, Wilcoxon test.

JEL Classification: G32

1. Introduction

This study aims at examining the changes in financial performance across twelve selected countries from the European Union. The countries were selected randomly; the only criterion was including countries both more and less affected by the crisis. The final dataset comprises data of companies from the Czech Republic, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Poland, Slovakia, Spain, and the United Kingdom over the period 2005-2009. This period covers the financial crisis which substantially affected companies all over the world, including the ones from the European Union.

The paper intends to examine how European companies performed during the crisis in comparison with the pre-crisis period. Several hypotheses will be examined. First, it is hypothesized that the overall financial performance significantly deteriorated during the crisis in all selected countries. Second, differences of performance changes are expected at the level of particular countries. Some countries have been affected by the crisis much more than the other ones, thus the changes in performance at the level of companies should be different.

The growth rate of GDP volume for the selected countries is demonstrated in the following table (Table 1). A large decline of GDP in countries such as Latvia, Ireland and Hungary is evident in the table below, while less decline of GDP over the period 2008 – 2009 is apparent

[1] Ing. Martina Novotná, Ph.D., Technical University of Ostrava, Faculty of Economics, martina.novotna@vsb.cz

in the case of Poland or France. Thus, one would expect that the performance changes of Irish or Latvian companies would be significantly greater than those of companies from Poland.

Table 1: Growth rate of GDP volume – percentage change on previous year

	2005	2006	2007	2008	2009
Czech Rep.	6,3	6,8	6,1	2,5	-4,1
France	1,8	2,5	2,3	-0,1	-2,7
Hungary	3,2	3,6	0,8	0,8	-6,7
Germany	0,8	3,4	2,7	1,0	-4,7
Greece	2,3	5,2	4,3	1,0	-2,0
Ireland	6,0	5,3	5,6	-3,5	-7,6
Italy	0,7	2,0	1,5	-1,3	-5,2
Latvia	10,6	12,2	10,0	-4,2	-18,0
Poland	3,6	6,2	6,8	5,1	1,7
Slovakia	6,7	8,5	10,5	5,8	-4,8
Spain	3,6	4,0	3,6	0,9	-3,7
United Kingdom	2,2	2,8	2,7	-0,1	-4,9

Source: Eurostat

2. Selection of data and overview of the methodology

The main purpose of this paper is to investigate the impact of recent financial crisis on the corporate performance of European industrial companies. The hypothesis that financial crisis had a negative effect on the companies' performance will be tested by means of both parametrical and non-parametrical tests. The paper also intends to find if there are differences among selected countries. For the purposes of analysis, the data of twelve European countries is extracted from Amadeus database[2]. There are five performance indicators which will be used in the analysis,

- return on equity (ROE = profit (loss) for period/shareholders' funds),
- return on assets (ROA = profit (loss) for period/total assets),
- current ratio (CURR = current assets/current liabilities),
- profit margin (PRMA = profit before tax/operating revenue),
- interest coverage ratio (IC = operating profit/interest paid).

For each country, financial indicators of two thousand randomly selected industrial companies[3] are extracted for the period 2005 – 2009.

2.1 Metodology

The approach used in this study is commonly applied in empirical finance when examining the impact of an event on a selected indicator, which is the financial performance indicator in our case. Firstly, an event must be defined, including the specification when the event occurred. This method is used in the study of Easton and Jarell (1998) who examines the impact of total quality management on the performance of firms that began its implementation. Barber and Lyon (1996) used event studies to evaluate the choice of an accounting based performance measure, a statistical test, and a model of expected operating performance. Another studies include for example Ashenfelter and Sullivan (1987) who used

[2] AMADEUS is a database containing financial information on public and private European companies countries.

[3] If there are less observations than 2000 for a country, all the observations available are included.

this approach to test the models of market structure, however the methods can be used also when examining market anomalies, for example Lakonishok and Smidt (1988).

In this study, determining when the event occurred is difficult, because the financial crisis did not become evident at the same time in all countries. However, unification is needed for the purposes of this study. The event is the financial crisis, but the determining of its occurrence is ambiguous. As the crisis period was initiated in October 2007, the years 2005 and 2006 can be assumed as the pre-crisis period. However, it is more difficult to determine the post-crisis period, because there is still not a consensus whether the crisis is over. Based on the data in the table above, one can conclude that the crisis became evident in 2008 and 2009 in the European countries. Thus, the main objective of this study is examining the impact of financial crisis on financial performance indicators. The aim is to compare the following ratios: return on equity, return on assets, current ratio, profit margin and interest coverage paid, over the selected period of time. The hypothesis that the financial performance indicators are significantly different before and after the financial crisis will be tested by both parametrical and non-parametrical tests of significance.

A popular technique for comparison between means is the paired-samples t-test. A study of this type consists of two measurements taken on the same subject, one before and one after the event. The basic idea is as follows: if the event had no effect, the average difference between the measurements is equal to zero and the null hypothesis holds. If the event did have an effect, the average difference is not zero and the null hypothesis is rejected. The sample consists of measurements taken on the same companies and thus the paired-samples t-test seems to be a suitable technique for the analysis. For parametrical techniques, it is assumed that the mean differences should be normally distributed. The normality of distribution of dataset is tested by the Kolmogorov-Smirnov statistic and shows that the assumption of normality is violated. Even if the violation of this assumption should not cause any major problem in case of large enough sample sizes, e.g. more than 30 (Pallant, 2007), the second phase of the analysis uses non-parametrical tests which make minimal assumptions about the population from which the sample comes (DeFusco, 2007).

2.2 Paired samples t-test

Parametric tests concern with parameters, for example mean and variance, and their validity depends on a set of assumptions, for example normality of the distribution of the population. Paired samples t-test is the technique suitable for the analysis of two dependent samples, specifically in our case when comparing two samples of companies in different time. We then have pairs of "before" and "after" observations for the same companies. The t-test is based on data arranged in paired observations and the test is sometimes called a paired comparison test (DeFusco, 2007).

For the description of this method, the following text is extracted from DeFusco (2007, p. 266). Letting A represent "after" and B "before", suppose we have observations for the random variables X_A and X_B and the samples are dependent. We arrange the observations in pairs. Let d_i denote the difference between two paired observations. We can use the notation $d_i = x_{Ai} - x_{Bi}$, where x_{Ai} and x_{Bi} are the *i*th pair of observations, i = 1,2,…, n on the two variables. Let μ_d stand for the population mean difference. We can formulate the following hypothesis, where μ_{d0} is a hypothesed value for the population mean diference:

$H_0 : \mu_d = \mu_{d0}$ versus $H_a : \mu_d \neq \mu_{d0}$, where the most commonly used value for μ_{d0} is 0.

In the case of normally distributed populations with unknown population variances, we formulate a t-test. First, we calculate the sample mean difference,

$$\bar{d} = \frac{1}{n}\sum_{i=1}^{n} d_i , \tag{1}$$

where n is the number of pairs of observations. The standard error of the mean difference is then calculated by using the following formula,

$$s_{\bar{d}} = \frac{1}{\sqrt{n}}\sqrt{\frac{\sum_i \left(d_i - \bar{d}\right)^2}{n-1}} . \tag{2}$$

Test statistic for a test of mean differences with unknown variances, a t-test is based on

$$t = \frac{\bar{d} - \mu_{d0}}{s_{\bar{d}}} \tag{3}$$

with n-1 degrees of freedom, where n is the number of paired observations, $\bar{d}$ is the sample mean difference, and $s_{\bar{d}}$ is the standard error of $\bar{d}$.

2.3 Nonparametric tests

A nonparametric test can be used when the assumptions of parametric tests do not hold for the particular data, for example when the data do not meet distributional assumptions. The nonparametric test usually involves the conversion of observations into ranks according to magnitude (DeFusco, 2007). If we assume that differences d_i have symmetric distribution, then we test the hypothesis that their theoretical distribution has a zero average or median. For this purpose, a sign test or Wilcoxon signed-rank test may be used (Hendl, 2009).

The sign test involves working with only "greater than" or "less than" relationships (using the signs + and – to denote those relationships) and is used to test the null hypothesis whether or not two groups are equally sized. It is based on the direction of the plus and minus sign of the observation, and not on their numerical magnitude. The null hypothesis is set up so that the sign of + and – are of equal size, or the population means are equal to the sample mean. [4] For each observation, the difference d_i is calculated and the number of positive (n_p) and negative (n_n) differences is counted (cases in which $x_{Ai} = x_{Bi}$ are ignored). In case of large sample (if $n_p + n_n > 25$), the significance level is based on the normal approximation[5],

$$Z_C = \frac{\max(n_p, n_n) - 0.5(n_p + n_n) - 0.5}{0.5\sqrt{n_p + n_n}} . \tag{4}$$

The test can be used to detect significant change by comparing the number of positive changes with the number of negative changes. If no changes take place, the numbers of small positive and negative changes can be expected to be nearly the same. (Taylor, 2007).

The Wilcoxon signed-ranks test method tests the null hypothesis that two related medians are the same. This test is a nonparametric equivalent of the t-paired test and allows comparing a single median against a known value or paired medians from the same (or matched) sample. Ranks are based on the absolute value of the difference between the two test variables. For each case, the difference $d_i = x_{Ai} - x_{Bi}$ and the absolute value of d_i are computed. All

[4] http://www.statisticssolutions.com/resources/directory-of-statistical-analyses/sign-test
[5] PASW Statistics 18, 2009

nonzero absolute differences are then sorted into ascending order and ranks are assigned. Then, the average rank of positive differences (S_p) and negative differences (S_n) are calculated. The average positive rank $\overline{X}_p$ and the negative rank $\overline{X}_n$ is given by the following formulas,

$$\overline{X}_p = S_p / n_p , \quad (5)$$

$$\overline{X}n = Sn / n_n . \quad (6)$$

The test statistic is

$$Z = \frac{\min(S_p, S_n) - [n(n+1)/4]}{\sqrt{n(n+1)(2n+1)/24 - \sum_{j-1}^{l} t_j{}^3 - t_j)/48}} , \text{ where} \quad (7)$$

n is number of cases with non-zero differences, l is number of ties and t_j is number of elements in the j-th tie, j=1,…l.[6]

3. Comparison tests and interpretation of results

This paragraph demonstrates using both parametrical and non-parametrical tests when comparing the performance of selected companies over the period 2005-2009. This period involves financial crisis which can be assumed as "the event". It allows comparing the performance "before" and "during" the times of crisis (for example, the performance of 2007 may be compared with the year 2008). With respect to the crisis, it is expected that companies mostly experienced a decline in the performance measured by the selected financial indicators. The presumption is that the decline was more significant in countries more affected by the crisis, for example Hungary, Latvia or Ireland.

Results of the tests[7] (Tables 4, 5, 6, 7, and 8 in the appendix) support the presumption that there was a large deterioration of corporate performance indicators during the period 2007-2009. Values in the column "t-test" give the average mean differences between two years (a negative sign shows that there was a decline of the indicator). For example, there was a significant decline in ROE of Czech companies between years 2008-2009 (ROE fell by 4,395 on the average). There was even a greater decline of ROE between years 2007-2008 (by 6.787), while there was a small, statistically insignificant change between 2005-2006 and 2006-2007. These results are supported by all three tests (see Table 4, first row).

The summary of five countries with the most important changes in indicators between years 2007-2008 and 2008-2009 is in the tables below (Table 2, 3).

Table 2: Countries with the greatest average mean differences between years 2007-2008

Return on equity	Return on assets	Current ratio	Profit margin	Interest coverage
LT↓	LT↓	SK↑	LT↓	LT↓
UK↓	IE↓	IE↑	IE↓	PL↓
IE↓	PL↓	UK↑	UK↓	IE↓
PL↓	UK↓	PL↑	PL↓	HU↓
SP↓	SP↓	SP↑	SP↓	SP↓

[6] PASW Statistics 18, 2009

[7] Full results and statistics of tests can be provided by the author of this paper on demand.

Table 3: Countries with the greatest average mean differences between years 2008-2009

Return on equity	Return on assets	Current ratio	Profit margin	Interest coverage
LT↓	LT↓	SK↓	SK↓	UK↑
SK↓	SK↓	CZ↑	LT↓	IT↑
IE↓	IE↓	LT↑	IE↓	GE↑
HU↓	HU↓	PL↑	HU↓	FR↑
GR↓	CZ↓	UK↑	GR↓	GR↓

Generally, there was a decline of return on equity, return on assets and profit margin on the average. The greatest drop between years 2007-2008 experienced Latvia, followed by Ireland, the United Kingdom, Poland, Hungary and Spain. The tables in appendix include the average mean differences between years and their statistical significance. For example, the average ROE of Latvian companies between years 2007-2008 fell by 13.317 (statistically significant at the level of significance .05 by all three tests). Results show that changes in ROA were also significant, however lower than changes in ROE. On the contrary, changes in current ratio are relatively small and statistically significant only for the first four countries (see Table 2). Profit margin fell largely in Latvia (by 2.828), similarly as interest coverage ratio (by 14.435). In the next period, Slovakia achieved large negative changes in return on equity, return on assets, current ratio and profit margin. Spain was replaced by Greece and Czech companies experienced a fall in ROA by 1.358 on average. The interest coverage ratio began increasing between years 2008-2009 in countries such as the United Kingdom, Italy, Germany, or France (for example, the average ROE in the United Kingdom increased by 4.439 and the interest coverage ratio rose by 7.777).

4. Conclusion

The paper demonstrates that financial performance of industrial companies was deteriorated across all twelve European countries over the selected period. Based on five financial indicators, the greatest, almost unfavorable changes were experienced between years 2007-2008 and 2008-2009. Both parametrical and non-parametrical tests confirm the expectation that the financial crisis has negatively affected European companies, especially in Latvia, Slovakia, the United Kingdom and Ireland.

The results also show that the performance in Latvia, Ireland, the United Kingdom, Poland and Spain was firstly affected by the crisis between years 2007-2008, followed by negative changes in performance in Slovakia, Hungary or Greece in the period 2008-2009. Results also show that both techniques are suitable for the analysis of differences in financial indicators when investigating changes over some period of time.

Appendix: Results and Statistics

Table 4: ROE paired samples t-test, Sign test, Wilcoxon test

	2009-08			2008-07			2007-06			2006-05		
	t-test	S	W	t-test	S	W	t-test	S	W	t-test	S	W
CZ	-4,395*	y	y	-6,787*	y	y	-0,67	n	n	-0,762	n	n
FR	-2,4	y	y	-6,455*	y	y	2,5*	y	y	1,436	n	n
GE	-4,674*	y	y	-5,794*	y	y	-0,181	n	n	0,253	y	y
GR	-5,552*	y	y	-7,25*	y	y	3,37*	y	y	0,928	y	y
HU	-8,105*	y	y	-4,367*	y	y	-3,56*	y	y	0,365	n	n
IE	-11,693*	y	y	-10,91*	y	Y	-3,25*	y	y	-0,99	y	y
IT	-1,649	y	y	-4,441*	y	y	0,309	y	n	1,333	n	n
LT	-18,068*	y	y	-13,317*	y	y	-3,435	n	y	-1,396	y	y
PL	-0,717	y	y	-9,081	y	y	2,137*	y	y	-0,713	n	n
SK	-15,103*	y	y	-1,659	y	y	-6,11*	y	y	2,068	y	y
SP	-4,458*	y	y	-6,901*	y	y	0,743	n	n	-0,242	n	n
UK	4,439*	n	n	-12,485*	y	y	-0,808	n	y	-5,901*	y	y

* Statistically significant at the level of significance .05
The value in the column t-test is the average mean difference between two years.
S denotes to the Sign test, W denotes to the Wilcoxon test (y – statistically significant, n – statistically insignificant).

Table 5: ROA paired samples t-test, Sign test, Wilcoxon test

	2009-08			2008-07			2007-06			2006-05		
	t-test	S	W	t-test	S	W	t-test	S	W	t-test	S	W
CZ	-1,358*	y	y	-1,42*	y	y	0,565*	y	y	0,591*	y	y
FR	-0,515*	y	y	-1,113*	y	y	0,398*	y	y	0,382*	y	y
GE	-0,868*	y	y	-0,685*	y	y	0,01	n	n	0,727*	y	y
GR	-1,21*	y	y	-1,12*	y	y	0,338*	y	y	0,452*	y	y
HU	-1,862*	y	y	-1,108*	y	y	-0,555*	y	y	0,567*	n	y
IE	-2,395*	y	y	-3,145*	y	y	-0,555	n	n	0,418	n	n
IT	-0,523*	y	y	-0,496*	y	y	0,194	y	y	0,33*	n	n
LT	-4,684*	y	y	-4,415*	y	y	0,957	n	n	1,679*	y	y
PL	0,148	n	n	-2,367*	y	y	0,847*	y	y	0,82*	y	y
SK	-3,759*	y	y	-0,187	y	y	-0,527*	y	y	1,055*	y	y
SP	-0,684*	y	y	-1,515*	y	y	0,235	n	n	0,273*	n	n
UK	0,862*	y	y	-1,959*	y	y	0,263	y	y	0,063	n	n

* Statistically significant at the level of significance .05
The value in the column t-test is the average mean difference between two years.
S denotes to the Sign test, W denotes to the Wilcoxon test (y – statistically significant, n – statistically insignificant).

Table 6: CURR paired samples t-test, Sign test, Wilcoxon test

	2009-08			**2008-07**			**2007-06**			**2006-05**		
	t-test	S	W	t-test	S	W	t-test	S	W	t-test	S	W
CZ	0,3*	y	y	0,013	y	y	0,114*	y	y	-0,073	y	y
FR	0,071*	y	y	0,03	y	y	-0,018	y	n	-0,042	y	n
GE	0,133	y	y	-0,051	n	n	-0,462*	n	n	-0,523*	n	n
GR	0,08*	y	y	0,01	n	n	0,054*	y	y	-0,068	y	y
HU	-0,002	y	y	0,023	y	y	0,011	n	n	-1,503	n	n
IE	0,14	y	y	0,32*	y	y	0,025	y	y	0,185	y	Y
IT	0,047	y	y	0,039	n	n	-0,054	y	y	-0,004	y	y
LT	0,246*	n	y	0,032	n	n	-0,164*	n	n	0,07*	n	n
PL	0,214*	y	y	0,067*	n	y	-0,002	y	y	0,02	y	y
SK	-0,442*	y	y	0,574*	y	y	0,168	y	n	-0,143	y	n
SP	0,101*	y	y	0,062	y	y	0,081*	y	y	-0,145*	n	n
UK	0,179*	y	y	0,11*	y	y	-0,057	n	n	-0,038	y	y

* Statistically significant at the level of significance .05
The value in the column t-test is the average mean difference between two years.
S denotes to the Sign test, W denotes to the Wilcoxon test (y – statistically significant, n – statistically insignificant).

Table 7: PRMA paired samples t-test, Sign test, Wilcoxon test

	2009-08			**2008-07**			**2007-06**			**2006-05**		
	t-test	S	W	t-test	S	W	t-test	S	W	t-test	S	W
CZ	-0,737*	y	y	-1,336*	y	y	0,473*	y	y	0,419*	y	y
FR	-0,415*	y	y	0,913*	y	y	0,06	y	y	0,31*	y	y
GE	-0,873*	y	y	-1,048*	y	y	0,37*	y	y	0,481*	y	y
GR	-1,152*	y	y	-0,844*	y	y	0,511*	y	y	0,976*	y	y
HU	-1,503*	y	y	-1,159*	y	y	-0,218	n	n	0,746*	y	y
IE	-2,59*	y	y	-2,528*	y	y	0,278	y	n	2,648*	n	n
IT	-0,196*	n	n	-0,987*	y	y	0,009	n	n	0,369*	y	y
LT	-3,562*	y	y	-2,828*	y	y	0,164	n	n	1,123*	y	y
PL	0,346	y	y	-1,482*	y	y	0,672*	y	y	0,71*	y	y
SK	-3,908*	y	y	0,295	y	y	-0,526	n	n	1,348*	y	y
SP	-0,893*	y	y	-1,346*	y	y	0,046	n	n	0,322	n	n
UK	0,155	y	y	-1,665*	y	y	0,18	y	y	0,363	n	n

* Statistically significant at the level of significance .05
The value in the column t-test is the average mean difference between two years.
S denotes to the Sign test, W denotes to the Wilcoxon test (y – statistically significant, n – statistically insignificant).

Table 8: IC paired samples t-test, Sign test, Wilcoxon test

	2009-08			**2008-07**			**2007-06**			**2006-05**		
	t-test	S	W	t-test	S	W	t-test	S	W	t-test	S	W
CZ	4,5*	n	n	-2,71	y	y	-5,3*	n	n	-4,6*	n	n
FR	5,11*	y	y	-0,32	y	y	-4,275*	n	y	-3,756*	n	n
GE	6,051*	y	y	-3,873*	y	y	0,214	n	n	0,027	y	y
GR	-5,05*	y	y	-1,203	y	y	2,004	n	n	-2,415	n	n
HU	3,281	y	y	-5,025*	y	y	n.a.			n.a.		
IE	-1,827	y	y	-6,383*	y	y	-9,056*	n	n	2,804	n	n
IT	7,669*	y	y	-1,668	y	y	-0,741	y	y	-0,752	n	n
LT	-1,231	y	y	-14,435*	y	y	-8,056*	y	y	4,666	y	y
PL	3,97	y	y	-9,51*	y	y	2,56	y	y	2,86	y	y
SK	1,98	y	y	-1,3	y	y	-3,977*	n	n	-4,96*	n	n
SP	4,691*	y	y	-4,721*	y	y	-0,575	y	y	-1,861	y	y
UK	7,777*	y	y	0,251	y	y	-1,062	n	n	-2,438	n	n

* Statistically significant at the level of significance .05
The value in the column t-test is the average mean difference between two years.
S denotes to the Sign test, W denotes to the Wilcoxon test (y – statistically significant, n – statistically insignificant).

References

[1] BARBER, B. – LYON, J., 1996. Detecting abnormal operating performance: The empirical evidence power and specification of test statistics. *Journal of Financial Economics*, 41, pp. 359-399.

[2] DeFUSCO et al. 2007. *Quantitative Investment Analysis*. New Jersey: John Willey & Sons, Inc.

[3] HENDL, J., 2009. *Přehled statistických metod*. Praha: Portál.

[4] PALLANT, J., 2007. *SPSS Survival Manual*. Berkshire: McGrawHill.

[5] TAYLOR, S., 2007. *Business Statistics: For Non-mathematicians*. Palgrave Macmillan.