IT Companies in Rough Seas: Predictive Factors for Bankruptcy Risk in Romania

MIRUNA MAZURENCU MARINESCU
Department of Statistics and Econometrics
Bucharest University of Economics
Bucharest, Romania
E-mail: miruna@ase.ro

PETER NIJKAMP
Department of Spatial Economics,
Free University,
Amsterdam, The Netherlands
E-mail: pnijkamp@feweb.vu.nl

Pn318mm

Abstract

The rationale of this paper is to identity the causes of low performance companies that are operating in the information technology sector, which is seen as a key driver of the Romanian economy. A model is designed to extract the productivity distribution of the sector's companies based on a data set from the Romanian Chamber of Commerce and Industry. Through the statistical analysis of this particular sub-sample of low performing firms, important characteristics can be derived and tested for significance. In our study, also a benchmark value for productivity will be identified that can offer an early warning indication for potential trouble zones when assessing a newly-founded company.

Key words: insolvency risk, predictors, benchmark value, IT based companies.

1. Introduction

In our modern age of the knowledge and information society, it is increasingly accepted that R&D, innovation, creativity and technological progress are key elements of any competitive strategy. In this context, information technology (IT) plays a central role, but this is also a vulnerable sector.

Fundamental research and innovation represent strategic activities in Europe, as they are meant to entrance socio-economic progress and to maintain competitiveness and prosperity in the long run. For IT companies - and especially those involved in research and development (R&D) -, becoming and remaining competitive on global markets requires a permanent access to up-to-date and tailor-made information. The *Financial Perspectives 2007-2013* recorded a substantial increase in the financing of R&D and IT&C (information technology and communication) activities. These activities are currently however at a turning point, and the quality of their future results depends increasingly on synergy and interdisciplinarity with complementary scientific and technological fields. The massive dissemination of IT&C and R&D in society determines a series of organizational, social, ethical as well as technological changes, which is more and more visible due to our increasing dependency on computers and computer networks, in both our personal and professional lives.

A recent study of the European Science Foundation (ESF) shows that many technological achievements that have been highly successful in several economic and commercial fields have contributed substantially to life quality enhancement. For these reasons, our study

aims to enrich the knowledge on critical success and failure conditions in the IT&C field, as well as to avoid the negative implications of potential break-downs (e.g., bankruptcy) in these key sectors, which may be seen as triggers of global economic development. In order to achieve this goal, this study offers a critical assessment of the IT&C sector by analyzing the selected IT&C companies' performance in Romania starting from the data provided by the Romanian Chamber of Commerce.

2. Data Set

The observations in our data-base are gathered from the Romanian Chamber of Commerce and Industry, i.e., the CD-ROM 2007 edition of all Romanian registered companies. Due to the scarce available data, the only selection criterion to be used by us for selecting firms was the declared main activity (in our case, the IT&C sector). Therefore, we were able to select only those companies that declared information technology as main activity. So we had to rule out those records that presented missing information for certain variables. Finally, our data-base comprised 463 validated records. The resulting collection of companies included cross-sectional records for the following variables: registration number and date, address, contact information, number of employees, turnover, equity and gross profit. The selected companies have never been listed on the stock exchange, so that the speculation effects are ruled out in our empirical research.

3. Characterization of Romanian IT Companies

The majority of the companies that are active in this field - more precisely 83.1% - have a limited liability (private limited companies, ltd.), while 16.3% of them are public limited companies (plc). Similarly, the majority of the firms has a relatively small equity capital, viz., less than 300 RON, as shown in Figure 1 below.

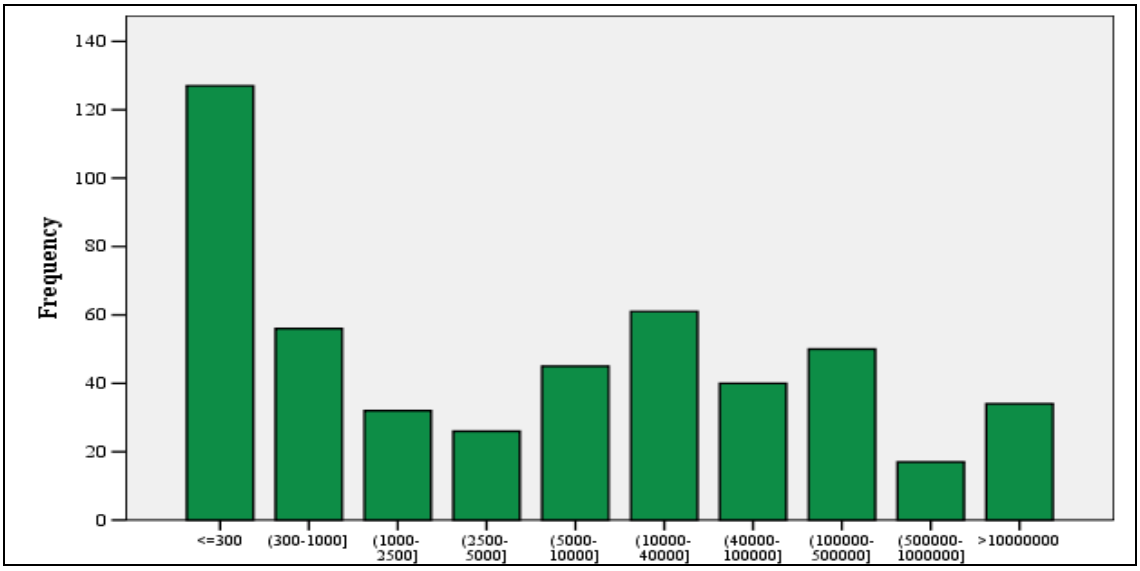

Figure 1. Firms' distribution by equity capital

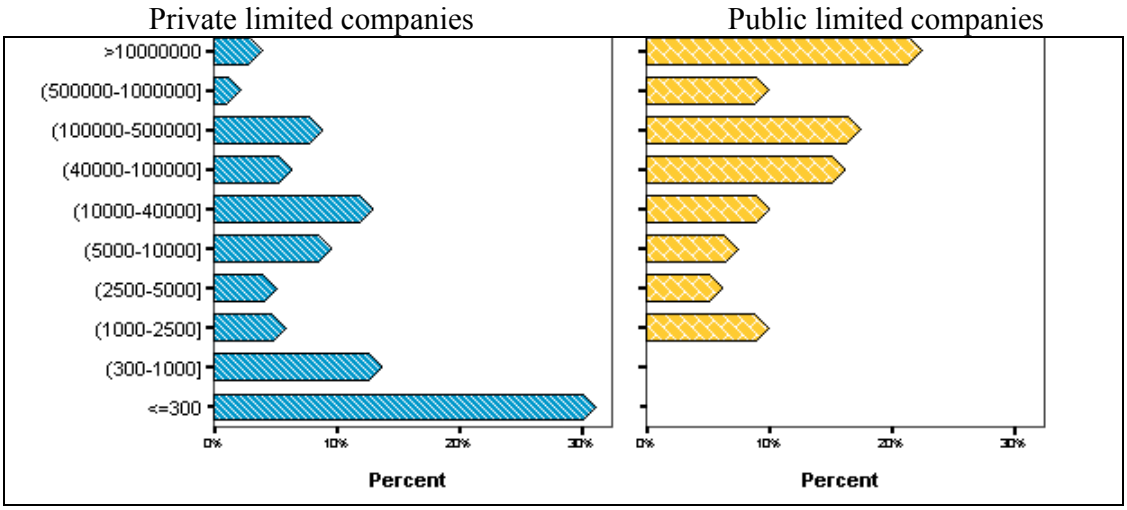

Figure 2. Firms' distribution by equity capital and type (RON)

If we analyze the firms' distribution by both equity capital and juridical type, we notice that there are major differences in the distribution of the two types of companies' equity capital (as shown in Figure 2). Whereas 31.2% of private limited companies has an equity capital which does not exceed 300 RON[1], only 22.5% of the public limited companies have their equity capital in excess of 10,000,000 RON.

In order to measure the intensity of the connection between variables *Juridical Type* and *Equity Capital*, we looked at the coefficients presented in Table 1. All these coefficients have been calculated on the basis of a χ^2 test value. We shall follow here the interpretation of Cramer's V coefficient, as its value range can be placed in the interval

[1] RON stands for new Romanian leu, 1 leu=0.23229 euro.

[0.1], in contrast to the contingency coefficient (for which the upper limit of its value interval depends on the number of rows and columns in the contingency table), thus allowing for comparison.

In our case, the obtained value for this coefficient – 0.332 – indicates a low intensity connection between the two variables. However, this connection is statistically significant for a certainty level α=0,0001, which corresponds to a probability of 99.9999%.

Table 1. Correlation coefficients for the variables *Juridical Type* and *Equity Capital*

		Value	Approx. Sig.
Nominal by Nominal	Phi	,469	,000
	Cramer's V	,332	,000
	Contingency Coefficient	,425	,000
N of Valid Cases		488	

As expected, these discrepancies are also found if we analyze the firms by their turnover (as shown in Figure 3). The private limited companies appear to have an average turnover of 909.9945 thousand RON, while the public limited companies have a turnover of 15272.93 thousand RON.

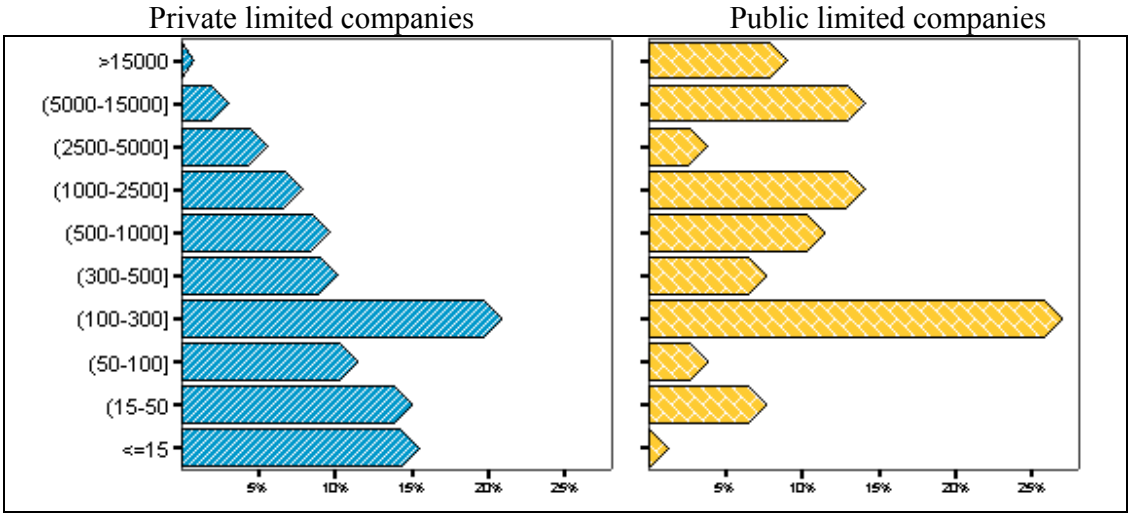

Figure 3. Firms' distribution by turnover (thousand RON) and type

In order to measure the intensity of the correlation between variables *Juridical Type* and *Turnover*, we looked at the coefficients presented in Table 2. The obtained value for the V coefficient – 0.234 – indicates an even lower intensity connection between the two variables, as compared to the previous example. The coefficient is yet statistically significant at a significance level α=0,0001, which corresponds to a probability of 99.9999%.

Table 2. Correlation coefficients for the variables *Juridical type* and *Turnover*

		Value	Approx. Sig.
Nominal by Nominal	Phi	,404	,000
	Cramer's V	,234	,000
	Contingency Coefficient	,375	,000
N of Valid Cases		473	

Similarly, distributions by the number of employees presented in Figures 4 and 5 suggest a bigger concentration of private limited companies in the small value groups. These have an average 39.15 employees /company, while the public limited companies have an average of 262.62 employees /company.

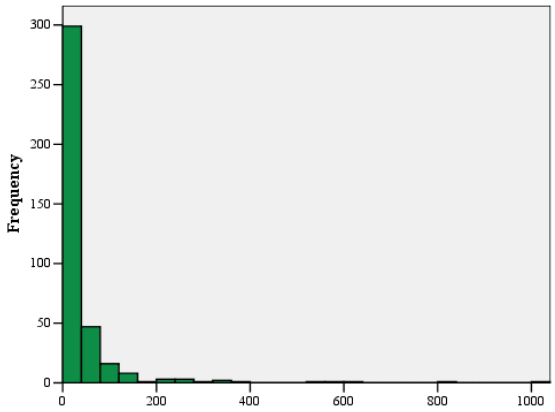

Figure 4. The distribution of the number of employees for an ltd

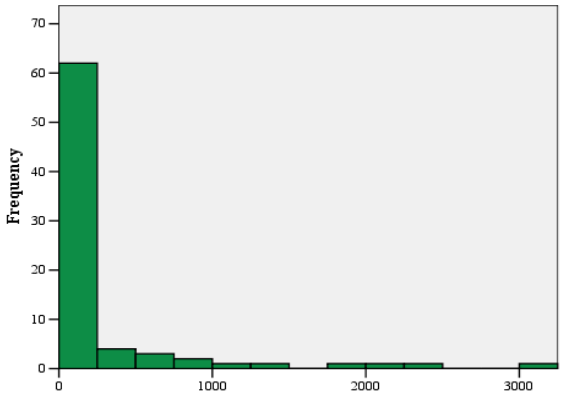

Figure 5. The distribution of the number of employees for a plc

The difference between the two means is rather large and statistically significant (as shown in Table 3). The value of the F statistics calculated in conformity with the Levene test for equality of variances is 50.571, which leads us to the rejection of dispersion equality. Under these circumstances, we decided to run the t-test for equality of means under the hypothesis of variance inequality. We can now interpret the results in the second row of the table: the calculated value of the t-test appears to be now 2.1, which leads us to reject the equality hypothesis with a probability of 96.4%.

Table 3. Results of the mean comparison test for the variable *no. of employees* for groups by juridical type

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Company size	ces ıed	50,571	,000	-4,6	462	,000	-413,396	90,191	-590,630	-236,16
	Equal variances not assumed			-2,1	77	,042	-413,396	200,132	-811,902	-14,890

Interestingly, such discrepancies as the ones mentioned above are not so strong when we analyze the distribution of the gross profit for the two types of companies (Figure 6). Although the public limited companies have more assets / resources, these do apparently not result in a correspondingly higher gross profit value. Consequently, the difference between the average gross profits of the two types of companies is not statistically significant.

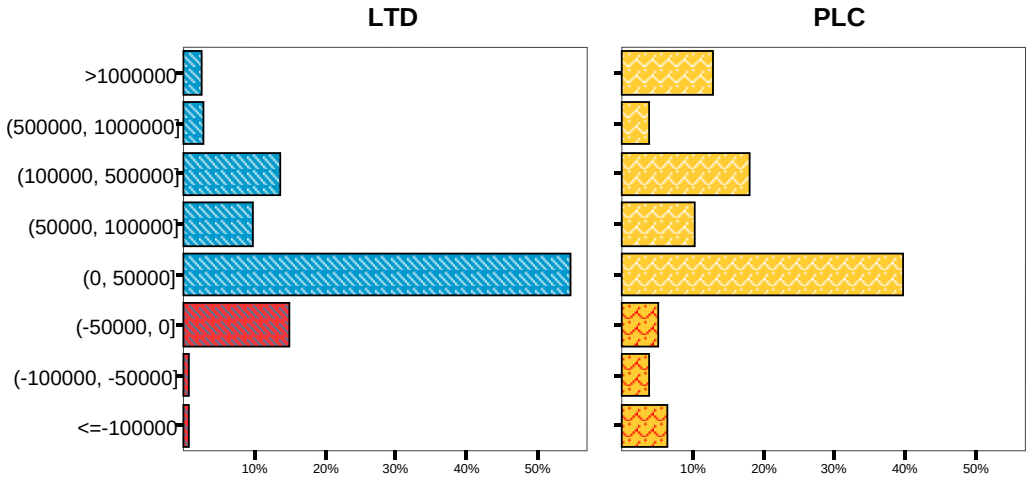

Figure 6. Distribution of IT companies by their gross profit (thousand RON)

The value of the F statistics, calculated in conformity with the Levene test, is 57.07, which leads us to the rejection of dispersion equality. Under these circumstances, we have applied the t-test for equality of means under the hypothesis of variance inequality. We will now interpret the results in the second row of the table: the calculated value of the t-test is 1.69, which does not allow us to reject the means' equality hypothesis.

Table 4. Results of the mean comparison test for the variable *Gross profit* for groups classified by juridical type

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Gross profit	Equal variances assumed	57,07	,000	-3,829	474	,000	-33065424	8635987	-5E+007	-2E+007
	Equal variances not assumed			-1,690	77	,095	-33065424	2E+007	-7E+007	5895816

4. An Analysis of the Characteristics of the IT Companies with Bankruptcy Risk

It is of course of critical importance to identify the IT&C firms that are in potential trouble (such as the risk of bankruptcy). In order to further analyze this subsector we considered a typical Cobb-Douglas CRS production function:

$$Y = TFP * L^{\alpha} * K^{(1-\alpha)}$$

where:

- Y is output;
- L is labour input;
- K is capital input;
- TFP is total factor productivity;
- α is the portion from the output attributable to labour income.

When logaritmized, the following relation is obtained:

$$\ln TFP = \ln Y - \alpha \ln L - (1-\alpha) \ln K$$

Based on this relation, we can estimate the total factor productivity distribution, using as a best proxy Y for turnover, L for the number of employees and K for capital (equity). Although it would have been ideal to use total invested capital instead, due to data limitation we were unfortunately forced to use equity. The turnover, denoted by CA, was used as the best proxy for the output. We have chosen this theoretical model to estimate the sector productivity distribution, as a decrease in productivity will increase the costs which in turn will affect the profitability margin with a negative impact on liquidity. If the lack of liquidity becomes chronic, it points at insolvability as a bankruptcy predictor.
The following regression model was used throughout the data analysis:

$$\ln CA = \alpha + \beta \ln L + \chi \ln K + \delta \ln w + \varepsilon$$

Running the model we formed the following estimates:

$$\ln \hat{w} = \ln \hat{ca} - 3,68 - 1,066 \ln \hat{l} - 0,071 \ln \hat{k}$$

The summary output is presented in Annex 1. This variable has the following distribution (see Figure 7).

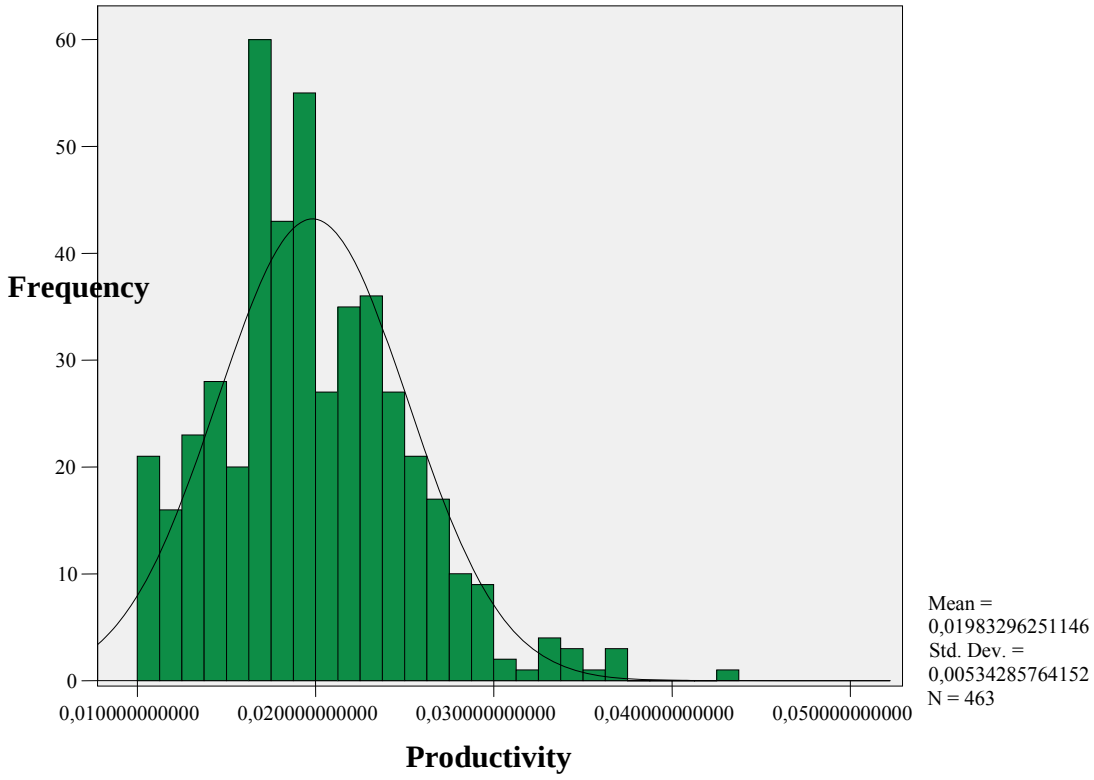

Figure 7. Histogram of log productivity

In order to identify some characteristics specific to IT companies that risk bankruptcy, we constructed two groups of companies on the basis of their distribution by productivity. The first group we will focus on, is formed by the first quartile of the distribution, coined here RG-IT (risk group in the IT sector), while the second group is formed by the remaining quartiles. In our analysis we aim now at comparing the following characteristics: the company's age, its number of employees and the development region of the two groups. Table 5 presents the analyzed quantitative variables' indicators.

Table 5. Descriptive statistics indicators for the variables *age* and *no. of employees*

Group Statistics

	Low _W	N	Mean	Std. Deviation	Std. Error Mean
Age	Yes	111	9,28	4,390	,417
	No	352	14,72	53,568	2,855
Size	Yes	111	3,12	1,985	,188
	No	352	142,26	849,491	45,278

In order to verify if the values of the average levels are less statistically significant for this group, we resorted to a z-test (unilaterally left) for comparing the two means. The output presented in Table 6 was obtained by processing the test for equality of means in SPSS. Due to the fact that the dispersions in the population were known when conducting the test, we were able to interpret the results in the second row of the table (rejection of the hypothesis of dispersion equality). The calculated values were compared with the theoretical value z_α=-1.65 (corresponding to a unilateral left test, as we wanted to guarantee the results with a 95% probability).

Table 6. The results of the mean comparison test for the variables *age* and *no. of employees*

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Diff.	
		F	Sig.	t	df	Sig. (2-t)	Mean Diff.	Std. Error Diff.	Lower	Upper
Age	Equal variances assumed	,32	,57	-1,07	461,00	,29	-5,44	5,09	-15,45	4,57
	Equal variances not assumed			-1,89	365,58	,06	-5,44	2,89	-11,11	,23
Size	Equal variances assumed	6,00	,01	-1,72	461,00	,09	-139,15	80,69	-297,71	19,42
	Equal variances not assumed			-3,07	351,01	,00	-139,15	45,28	-228,20	-50,10

We can now state (with at least 95% probability) that the companies in the risk group are generally newly-founded and that they have a small number of employees.
Although most IT&C firms are concentrated in the Bucharest-Ilfov[2] region (63%), we cannot maintain that there are regions with a statistically significant higher concentration of risk companies. The calculated value of the χ^2 test, determined on the basis of the

[2] Bucharest-Ilfov region is the area surrounding the Romanian capital, Bucharest.

contingency Table 7 (χ^2=3.75), shows that the *Region* variable does not influence IT&C firms' competitiveness.

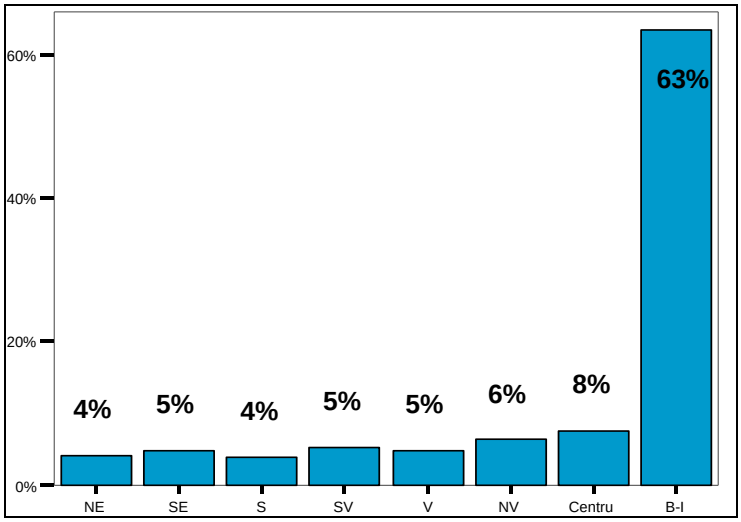

Figure 8. The distribution of IT&C companies by development regions

We also analyzed the type of connection between productivity and company's age, and between productivity and the company's number of employees for each of the two constituted groups (as shown in Table 6).

Table 7. The distribution of IT&C companies by their pertaining RG-IT and the development region

W_low * Region Crosstabulation

			Region								Total
			NE	SE	S	SV	V	NV	Centru	B-I	
Low_W	Yes	Count	4	3	5	5	4	7	6	77	111
		% within Region	21,1%	13,6%	27,8%	20,8%	18,2%	24,1%	17,1%	26,2%	24,0%
	No	Count	15	19	13	19	18	22	29	217	352
		% within Region	78,9%	86,4%	72,2%	79,2%	81,8%	75,9%	82,9%	73,8%	76,0%
Total		Count	19	22	18	24	22	29	35	294	463
		% within Region	100,0%	100%	100%	100,0%	100,0%	100%	100,0%	100%	100,0%

Table 8. Correlation matrix for the variables
age-no. of employees; age-productivity

Correlations

Low_W			Age	Size	productivity
Yes	Age	Pearson Correlation	1	,183	,278**
		Sig. (2-tailed)		,055	,003
		N	111	111	111
	Size	Pearson Correlation	,183	1	,882**
		Sig. (2-tailed)	,055		,000
		N	111	111	111
	productivity	Pearson Correlation	,278**	,882**	1
		Sig. (2-tailed)	,003	,000	
		N	111	111	111
No	Age	Pearson Correlation	1	-,007	-,022
		Sig. (2-tailed)		,893	,677
		N	352	352	352
	Size	Pearson Correlation	-,007	1	,459**
		Sig. (2-tailed)	,893		,000
		N	352	352	352
	productivity	Pearson Correlation	-,022	,459**	1
		Sig. (2-tailed)	,677	,000	
		N	352	352	352

**. Correlation is significant at the 0.01 level (2-tailed).

On the basis of the correlation matrix (Table 8), we tried to examine the interdependencies present inside the analyzed groups. For instance, we observed that in the case of the RG there is a strong direct connection between productivity and a company's number of employees (r = 0.882): the companies with a small number of employees seem to be the most vulnerable. Similarly, a company's age has a direct, though weak (r = 0.278), influence on productivity.
In the case of the IT&C companies that are not part of the RG, we notice that the age of the company has no influence on efficiency. The number of employees however, still has a statistically significant influence on productivity, though the connection is weaker than in the previously analyzed group.

Conclusions

The vulnerable IT&C companies that we identified are the public limited companies. These firms have more resources than the private limited companies; for instance, their average number of employees and average equity capital are statistically significantly higher. Nevertheless, these bigger resources do not result in a correspondingly higher gross profit. These companies' average gross profit is similar to the private limited companies' average figure.

The IT&C firms that pertain to the risk group are generally small enterprises, relatively recently founded, and with a limited number of employees. Productivity is strongly

influenced by their number of employees, and therefore companies with a limited workforce tend to be the most vulnerable. As the age of the company and the number of workers does not bear upon the efficiency of those companies that are not part of the risk group, we consider that a log productivity level of 0.0164 is an appropriate threshold for bankruptcy risk. When analyzing the performance of a certain firm by directly computing its productivity and the level is lower than the threshold, that means the firm will enter a trouble area, therefore it requires immediate response from the management in order to avoid further deterioration of its financial health, hence avoiding bankruptcy.

Some limitations of the work are to be mentioned and have to be overcome in future research: the records for our analysis did not include the amount of invested capital, the percentage of the turnover attributable to the declared main activity was missing, and there was no information regarding the main events in the firms' life course.

An important outcome of our analysis is the quantitative assessment of those factors that are essential in the process of bankruptcy risk evaluation in the case of IT&C companies.

References

Audretsch D.B. and Mahmood, T. "The Hazard Rate of New Establishments", Economic Letters, 36, 2 (1991), pp. 409-412;

Audretsch, D.B. and Mahmood, T. "New Firm Survival: New Results Using a Hazard Function", The Review of Economics and Statistics, 77, 1 (1995), pp. 97-103;

Barua, A. Pinnell J., Shutter, J. Whinston, A.B. and Wilson B., Measuring the Internet Economy (2001);

Barua, A., Pinnell J., Shutter, J. and Whinston, A.B. "Measuring the Internet Economy: An Exploratory Study", Working paper, Center for Research in E-Commerce, UT Austin, (1999).

Barua, A., Whinston, A.B. and Yin, F. "Not All Dot Coms Are Created Equal: An Exploratory Investigation of the Productivity of Internet Based Companies", Working paper, UT Austin, May 2000.

Cox, D.R. "Partial Likelihood", Biometrics, 62, 2 (1975), pp. 269-275.

Croson D.C., Jacobides M.G. and A.T. Nguyen, "Explaining Entry Decisions and Crowdedness in Business-to-Business E-Commerce Markets", Presented at the 13th Workshop on Information Systems and Economics, New Orleans, LA, 2001.

Das, S. and Srinivasan, K. "Durations of Firms in an Infant Industry: The Case of Indian Computer Hardware", Journal of Development Economics, 53, 1 (1997), pp.157-167.

Greene, W.H. Econometric Analysis, Upper Saddle River, NJ: Prentice Hall, 2000.

Hensler, D.A., Rutherford, R.C. and T.M. Springer, "Survival of Initial Public Offerings in the Aftermarket", Journal of Financial Research, 20, 1 (1997), pp. 93-110.

Honjo, Y. "Business Failure of New Firms: An Empirical Analysis Using a Multiplicative Hazards Model", International Journal of Industrial Organization, 18, 4 (2000), pp. 557-574.

Klein, J.P. and Moeschberger, M.L. Survival Analysis: Techniques for Censored and Truncated Data, New York, NY: Springer, 1997.

Le C.T., Applied Survival Analysis, New York: Wiley, 1997.

Annex 1

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.839673
R Square	0.705051
Adjusted R Square	0.703769
Standard Error	0.526593
Observations	463

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	304.9169	152.4585	549.7961	1.1E-122
Residual	460	127.558	0.2773		
Total	462	432.4749			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	3.688111	0.073227	50.36551	2.6E-189	3.54421	3.832012	3.54421	3.832012
X Variable 1	1.066118	0.045408	23.47853	1.04E-80	0.976885	1.155351	0.976885	1.155351
X Variable 2	0.071064	0.022941	3.097751	0.002069	0.025983	0.116145	0.025983	0.116145