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Are firm failure processes different? Evidence from seven countries

Abstract

The main purpose of the paper is to study whether firm failure processes are different for similar firms in various countries. The study focuses on firm failure processes in SMEs from six European countries with different development level. This study is the first one to extract and compare failure processes in a number of different countries. The data are based on random samples of 93 failed firms from six European countries (Belgium, Croatia, the Czech Republic, Estonia, Russia, and the United Kingdom) resulting in a total sample of 558 firms. The results are also validated on a sample of 80 USA firms meeting the given size and turnover criteria. Empirical results are found using the factor analysis to extract the main dimensions of financial variables from different periods before failure and the cluster analysis to classify the processes into similar groups. Four different failure processes are established sharing characteristics with those described in the literature (Argenti, 1976; D'Aveni, 1989; Laitinen, 1991). The frequencies of the processes are different with respect to all European countries and the USA, therefore reflecting internationally different distributions for these processes.

Keywords: firm failure, bankruptcy, failure process, financial ratios, European countries, USA.
JEL Classification: G33, M10, M21, O57.

Introduction

Studies about firm failure mostly focus on the prediction of corporate collapse, and thus, numerous models have been created for different environments and industries (see e.g. Dimitras et al., 1996; Balcaen and Ooghe, 2006; Lensberg et al., 2006). The accuracy of failure prediction is largely dependent of the homogeneity of firms in the dataset, namely whether they go through a similar failure process or not (Laitinen, 1991; Laitinen, 1993). With the rise in the share of firms that collapse suddenly, the prediction of failure inevitably becomes more difficult. The domain of failure processes has been scantily studied in literature since the seminal work by Argenti (1976). A handful of theoretical and empirical studies have been published, which have univocally established that a small number of distinct failure processes can be outlined. Most of the studies have still their own limitations, namely applying only financial variables (e.g. Laitinen, 1991), or lacking of large-scale empirical proof (e.g. Argenti, 1976; Ooghe and de Prijcker, 2008). Some studies (e.g. Hambrick and D'Aveni, 1988; D'Aveni, 1989; Moulton et al., 1996) also connect financial and non-financial variables in the failure process. However, in spite of numerous failure prediction studies there has been so far no research available that would study whether firm failure processes across countries are alike or not. With this study, we intend to fulfil this important gap in the literature.

The main purpose of the paper is to study whether firm failure processes are different for similar firms in various countries. By applying financial variables, the study focuses on small and medium-sized firm (SME) failure processes from six European countries with different levels of development and other characteristics. It also validates the results on a sample of similar firms from the USA. The study is structured in the following way. The next section presents the literature review, which focuses on the main findings in available studies about firm failure processes. Then, data and methodology will be described, which is followed by the results of the empirical study of firm failure processes and their discussion. The paper ends with concluding remarks, which also include study implications and future research directions. The main contribution of the current paper lies in the fact that it is the first one to extract and compare failure processes in a number of different countries. It will show that a distinct number of different failure processes can be found sharing characteristics with those introduced in the literature (Argenti, 1976; D'Aveni, 1989; Laitinen, 1991), however, the frequencies of the processes differ between countries.

1. Studies about firm failure processes

When there are hundreds of studies available about failure prediction (see e.g. literature reviews by Dimitras et al., 1996; Altman and Narayanan, 1997; Balcaen and Ooghe, 2006), the spectrum of literature about firm failure processes is quite fragmented. While some studies capture the whole lifecycle of firms, namely outlining the trajectory of its performance through its existence, others focus only on the final stages of collapse. The pioneering work by Argenti (1976) outlined three trajectories, including a newly founded firm that will never become successful (trajectory 1), firms that witness quick growth and similarly fast decline (trajectory 2),

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and gradually declining mature firms (trajectory 3). The paths in Argenti (1976) have been elaborated in several follow-up studies, such as Richardson et al. (1994) and Ooghe and de Prijcker (2008). The failure paths in these studies have a remarkable connection with two deterministic views, namely liability of newness and liability of adolescence (Henderson, 1999; Thornhill and Amit, 2003; Strotmann, 2007). There are also traces of voluntaristic view, as Argenti's trajectories 2 and 3 can be very well explained by the curse of success approach (see Mellahi and Wilkinson, 2004). While the shapes of Argenti's failure paths remain theoretical, several empirical studies have outlined them based on specific cases especially for the pre-failure stage (e.g. D'Aveni, 1989; Moulton et al., 1996). Still, as demonstrated in Weitzel and Jonsson (1989), during the different phases of failure process a firm has multiple opportunities to reverse the decline, thus a large variety of trajectories could emerge from empirical examples. Therefore, there is always a question where to draw the line between similarity and differences of specific paths. Correspondingly, firm turnaround literature would suggest multiple trajectories for firm survival or failure, being for instance dependent on the severity of decline, external conditions, and management action (see the overview by Trahms et al., 2013).

The simplest way to model the failure process is by using single variables (e.g. different profitability measures as given in Robbins and Pearce II, 1992; Barker III and Duhaime, 1997). Still, as noted in Trahms et al. (2013), such approach is too simplistic and will probably not capture the whole nature of decline phenomenon. Also, scores of bankruptcy multivariate models (either taken from previous studies or specially composed for specific study) have been widely applied to view the dynamics of failure, but they have not proven to be suitable when the dataset consists of bankruptcies and non-failing poorly performing firms (Gilbert et al., 1990). Another issue might be that bankruptcy prediction models have been developed to discriminate between surviving and failing firms based on a set of variables having the best predictive abilities, but they do not pay attention to how different financial variables are connected in different phases of firm failure.

Focusing on the existence of different failure processes, the studies by D'Aveni (1989) and Laitinen (1991) have reached relatively similar conclusions in respect of the presence of varying processes. Namely, while the former suggests and proves the presence of three failure processes (lingerers, gradual decliners and sudden decliners), the latter comes to the same conclusion about the number of processes (chronic failure, revenue financing failure and acute failure firms). Although the established trajectories in these studies are not directly comparable (D'Aveni applied both financial and non-financial variables for trajectory building, while Laitinen used only financial variables), it is interesting to compare the frequencies of processes. The three processes in Laitinen (1991) had a quite similar representation among Finnish firms (occurrence ranges from 27.5% to 40%), but in D'Aveni the acute failure process was rare (10%) and the other two had both high representation (39% for gradual decliners and 51% lingerers) among USA firms. Thus, available evidence about the presence of different failure processes across various countries is mixed, and therefore needs further and closer clarification. D'Aveni applied a specifically developed D-score (calculated by using one financial variable and one non-financial variable) to describe the decline process of firms, but Laitinen extracted failure processes with the help of factor analysis by applying six different financial variables.

This short review of relevant literature allows us to conclude that in general it is possible to outline a small number of distinct failure processes that firms go through and that these processes could be differently represented across various countries. Therefore, we set a single research hypothesis that a few distinct firm failure processes exist, but they have significantly different representation across different countries.

2. Data and methodology

2.1. Failure data selection. In the present study, the financial variables to describe the failure process are chosen to be the same as in Laitinen (1991). These variables are: return on investment ratio, the rate of growth in total assets, net sales to total assets ratio, (operating) cash flow to net sales ratio, equity to total assets ratio, and quick ratio. Laitinen (1991) originally used traditional cash flow instead of operating cash flow, however, we use the operating cash flow to extend our analysis to cash-based ratios. The formulas of variables applied in this study are listed in Appendix, Table 1A. Several causes motivate the choice of variables. Firstly, in Laitinen's (1991) study the importance of these variables in failure process has been theoretically motivated and therefore it is well-suited to the objective of this study. Secondly, these variables reflect the basic financial dimensions (growth, efficiency, profitability, cash flow, leverage, and liquidity) which are found to be important in empirical failure research (see Balcaen and Ooghe, 2006). Thirdly, by using variables from the mentioned study, we make it possible to compare results with an existing taxonomy, but also with Finnish firms, as data from that country was not

available for us. We apply variables from four consecutive pre-insolvency years, noting the year previous to insolvency year with t-1 and others with its respective number (2, 3 or 4). This is motivated by available studies that outline the failure process to be mostly described by the firm's performance a few years prior to the bankruptcy year (see e.g. D'Aveni, 1989; Barker III and Duhaime, 1997). As this study applies SME data and their failure has been noted to be quicker than for large firms (Laitinen, 1991), then we consider the applied time frame for financial variables to be long enough. As some variables given in Appendix, Table 1A are calculated based on data from two consecutive years, financial statement data from five pre-insolvency years should be present for all firms.

The firm-level financial data for the study are obtained from the Bureau van Dijk's (BvD) Orbis database. Only firms from countries for which the insolvency dates are known can be applied in the analysis. By using the insolvency dates, we apply only those firms which have financial data available for all relevant years starting from the t-1 year (one year prior to failure). When downloading the financial data and applying previously given restrictions, six European countries are valid for modelling purposes (Belgium, Croatia, the Czech Republic, Estonia, Russia, the United Kingdom) which have over one hundred failure firms with known insolvency dates. Also, data about USA firms is applicable, but as it includes only larger listed firms, we have to exclude them from the initial analysis. It can be said that the available six countries conditionally represent three different domains. Namely, two of them are advanced Western economies (Belgium and the United Kingdom), whereas the former socialist countries divide between two domains. One represents new member states of the European Union (Estonia, the Czech Republic and Croatia), while Russia is not a member. It must be noted that while Belgium and the United Kingdom have a high (but sufficiently different) GDP per capita, all four Eastern European countries have very similar GDP per capita values, around a third less than the two Western European countries. Still, all three new EU member states have very similar average gross salaries, but in Russia it is on remarkably lower level.

In addition to different development levels, according to the World Bank's Doing Business database some of these countries vary a lot in respect of insolvency procedure time, creditor claim satisfaction rate, firm founding conditions, strength of legal rights, extent of director liabilities and other variables. Therefore, our dataset includes countries with similar and different backgrounds, but we do not include the aforementioned country characteristics in analysis, as derived from the objective we do not seek an answer to the causes for failure process differences/similarities between countries. It must also be noted that European countries have quite similar conditions to initiate insolvency proceedings, which makes the pre-insolvency financial data comparable (see Philippe et al., 2002). Although USA firms are not included in the initial analysis, in order to offer a wider perspective we validate the results based on USA firms afterwards.

For modelling purposes, the firms from different countries should have a comparable size, as failure processes common to SME firms can diverge from those of large ones (see Hambrick and D'Aveni, 1988; Laitinen, 1991). Also, in order to avoid a bias towards a process common to some specific country, we selected the same number of firms from the six countries for analysis in the following way. Firstly, the status of the firm must be coded as "bankruptcy" or "dissolved (bankruptcy)" in the database, which indicates entering into formal bankruptcy proceedings. Codings for firms from the UK differed: "active (insolvency proceedings)", although the meaning was the same as for the other countries. Secondly, we want all firms in the analysis to fall under EU criteria (see Eurostat, 2008) for SMEs in respect of firm size (total assets) and turnover. Thus, a firm is deleted if (in the last financial statement) the size of total assets exceeds 43 million euros or turnover exceeds 50 million euros. The selection is not based on the number of employees, as information on that SME criterion is not disclosed for all firms. After these initial screening steps, we identified the country with lowest number of valid cases, which in the current case was the UK with 93 observations. Then, we selected 93 cases randomly from all remaining five countries. This resulted in a dataset of 558 firms (93 from each country). An equal number of cases from each country guarantees that in case some failure process in a specific country is dominant, it will not alter the final results. Afterwards, results are also validated on a sample of USA firms with bankruptcy status, of which 80 firms meet the total assets and turnover criteria given above.

Table 1. Size statistics by country, taken from the last financial statements prior to failure (in thousands euros)

Country	N	Variable	Median	Mean	Std. dev.
Belgium	93	Total assets	4,453	7,477	7,270
		Turnover	7,857	10,958	10,390

Table 1 (cont.). Size statistics by country, taken from the last financial statements prior to failure (in thousands euros)

Country	N	Variable	Median	Mean	Std. dev.
Czech Republic	93	Total assets	481	2,572	6,065
		Turnover	785	2,605	4,721
Estonia	93	Total assets	526	1,656	3,576
		Turnover	829	2,501	5,810
United Kingdom	93	Total assets	4,758	11,067	17,807
		Turnover	5,831	13,832	23,186
Croatia	93	Total assets	1,022	4,560	9,333
		Turnover	213	1,420	2,375
Russia	93	Total assets	249	844	1,815
		Turnover	132	737	1,482
United States	80	Total assets	17,998	29,940	46,973
		Turnover	9,518	20,223	28,363

The size statistics in Table 1 show that the average turnover and total assets are larger in the advanced Western country samples, in spite of the SME criteria that were applied in the sample selection process. The years of the failed firms' last financial statements range from 1995 to 2012, with an emphasis on the recent years. The country-specific distributions are tabulated in Appendix, Table 2A.

The dispersion of firm failures across main industry groups in each of the seven countries is given in Appendix, Table 3A. A feature that is very specific to Russia is the high share of group 1 (agriculture, forestry and fishing) firms, comprising over one-quarter of all Russian firms in the sample. Also, a striking feature is the high share of group 2 (manufacturing, mining, etc.) firm failures in USA (61.3%), compared to other countries.

2.2. Extraction of failure processes. *2.2.1. Factor analysis.* The extraction of failure processes in this study will be made in two stages by applying SAS statistical package. Firstly, we apply factor analysis (the FACTOR procedure in SAS) on the above mentioned six variables from four pre-insolvency years (i.e. in total 24 variables). Factor analysis extracts the relevant latent dimensions of failure processes and forms a standardized score which is useful in later analyses. Since failure processes are based on correlations between financial variables from different periods before failure, the factor analysis is a useful method to find out the determinants of these processes. The number of factors is determined by the eigenvalue-greater-than-one rule (K1 or Kaiser criterion, see Kaiser, 1960). Panel 1 of Table 2 presents the eigenvalues for factors 1 to 10. The K1 criterion leads to the choice of the eight-factor solution. There are also other alternatives for the choice of the number of factors, such as the scree plot test (Cattell, 1966). This test is, however, subjective and is therefore not recommended. The application of the Kaiser criterion results in an eight-factor solution explaining 69.3% of the total variance of the 24 variables, being remarkably higher than in the Laitinen (1991) study (i.e. 52%).

Table 2. The results of the factor analysis

Panel 1. Variance explained by different factors				
Factor	Eigenvalue	Difference	Proportion explained	Cumulative proportion
1	4.9824	2.1458	0.2076	0.2076
2	2.8366	0.6813	0.1182	0.3258
3	2.1553	0.3957	0.0898	0.4156
4	1.7596	0.3469	0.0733	0.4889
5	1.4127	0.1906	0.0589	0.5478
6	1.2220	0.0551	0.0509	0.5987
7	1.1669	0.0661	0.0486	0.6473
8	1.1009	0.1083	0.0459	0.6932
9	0.9926	0.0816	0.0414	0.7345
10	0.9110	0.0368	0.0380	0.7725

Panel 2. Rotated factor loadings								
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
$CFLOP_{t-1}$	0.1192	-0.0781	-0.1504	-0.2409	-0.0474	0.5780	0.1445	-0.1369
$CFLOP_{t-2}$	-0.1650	-0.0872	-0.0095	0.1396	0.0736	0.0239	0.7711	-0.1224
$CFLOP_{t-3}$	0.0698	-0.1059	-0.0803	0.1009	0.2311	0.1178	0.4540	0.0463
$CFLOP_{t-4}$	-0.1299	-0.0870	-0.0374	-0.1136	0.6280	-0.0043	0.0955	-0.0159

Table 2 (cont.). The results of the factor analysis

Panel 2. Rotated factor loadings								
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
ROA_{t-1}	-0.1103	0.0980	-0.0372	0.2101	0.1436	0.7604	0.0525	-0.0407
ROA_{t-2}	-0.0047	0.0908	0.0295	0.8324	0.1794	0.0682	0.1373	-0.0551
ROA_{t-3}	0.1282	0.1425	0.0039	0.2255	0.6874	0.1779	-0.0247	0.1603
ROA_{t-4}	0.2912	0.1790	0.1451	0.0307	0.6540	0.0032	0.2673	0.1393
$QUICKR_{t-1}$	0.0951	0.0492	0.7287	0.2766	0.1822	0.1165	-0.3294	-0.0764
$QUICKR_{t-2}$	0.1643	0.0696	0.7906	0.1356	0.0058	-0.0021	-0.2837	-0.0568
$QUICKR_{t-3}$	0.1982	0.1148	0.8411	-0.0815	-0.0322	-0.0691	0.0859	0.0687
$QUICKR_{t-4}$	0.2237	0.0703	0.7615	-0.1028	-0.0694	-0.0174	0.3416	0.1270
$EQUITYR_{t-1}$	0.6761	0.0492	0.1464	0.3637	0.1679	0.2638	-0.2527	0.0541
$EQUITYR_{t-2}$	0.8835	0.0933	0.1390	0.2303	0.0596	-0.0535	-0.1569	0.0403
$EQUITYR_{t-3}$	0.9246	0.0575	0.1905	-0.0999	0.0716	-0.0169	0.0111	0.0319
$EQUITYR_{t-4}$	0.8862	0.0410	0.1985	-0.1391	-0.0816	0.0024	0.1415	0.0156
$GROWTH_{t-1}$	0.0661	0.0553	0.2243	0.1383	0.0589	0.6075	-0.0511	0.3286
$GROWTH_{t-2}$	0.1310	0.1259	0.0756	0.6520	-0.2705	0.0485	0.1839	0.3190
$GROWTH_{t-3}$	-0.0368	0.1265	0.0882	0.0489	-0.0034	0.1602	-0.0752	0.7263
$GROWTH_{t-4}$	0.1059	0.0397	-0.0706	0.0322	0.1958	-0.1518	0.0174	0.6606
$OPRETA_{t-1}$	0.0803	0.8141	0.0768	0.0841	0.0459	0.0345	-0.1061	-0.0891
$OPRETA_{t-2}$	0.0372	0.8992	0.0680	0.0140	0.0352	0.0395	-0.1164	0.0814
$OPRETA_{t-3}$	0.0348	0.9155	0.0109	0.0936	0.0260	0.0309	-0.0306	0.0710
$OPRETA_{t-4}$	0.0511	0.8271	0.1029	0.0205	0.0043	-0.0253	0.0455	0.1811

Note: For variable formulas see Appendix, Table 1A.

In this study, the factor scores are made uncorrelated using the Varimax rotation that is regarded to be the best orthogonal rotation (Fabrigar et al., 1999). The benefit of given rotation is that the solution is made simple and conceptually clear. For the interpretation of the failure processes it is important that the processes are made independent of each other. Panel 2 of Table 2 presents the loadings of the Varimax rotated eight-factor solution on the original financial variables. The highest loadings show that each factor has special characteristics of its own. The first factor is strongly associated with the time-series development of the equity ratio (EQUITYR), while the second factor refers to that of the operating revenue to total assets ratio (OPRETA). In addition, the third factor is closely associated with the development of the quick ratio (QUICKR), whereas the last or eighth factor has high loadings on the rate of growth in total assets (GROWTH). The seventh factor is especially linked to the operating cash flow to cash operating revenue (CFLOP) in the two and three years prior to failure. Besides these pure factors, factors 4-6 are hybrid linking together two different financial variables. The fourth factor is associated with the return on assets ratio (ROA) and the rate of growth in total assets (GROWTH) in two years before failure. The fifth factor has its highest loadings on CFLOP and ROA in the fourth year prior to failure but also on ROA in the third year. Finally, the sixth factor links together CFLOP, ROA, and GROWTH, all in the first year before failure.

2.2.2. Cluster analysis. Cluster analysis is applied to find out different failure processes. Clustering, as defined in Jain et al. (1999, p. 264), is "the unsupervised classification of patterns (observations, data items, or feature vectors) into groups (clusters)". In general, cluster analysis is based on several assumptions. It is assumed that the sample is representative for the population which here is ensured by using random sampling. In cluster analysis, distance measures are sensitive to different scales of the variables. It is also assumed that the variables are uncorrelated. Therefore, we use the rotated factor scores (8) as input variables for the cluster analysis since they are standardized and uncorrelated. Here, we apply *k*-means clustering, which is directed to partitioning n observations (here n = 558) into k clusters in which each observation belongs to the cluster with the nearest mean (the FASTCLUS procedure in SAS). We also applied *k*-medians clustering for comparison but the results were similar since the factor scores are quite normally distributed.

The main problem in clustering is the determination of k, as there are no ideal methods for that. According to Milligan and Cooper (1985), the pseudo F-statistic (F) and the cubic clustering criterion (CCC) were two of the three best methods to determine number of clusters. In our sample, the local maximum of F and CCC are obtained for k = 5 (F = 41.12 and CCC = -11.436). Therefore, a five-cluster solution is chosen. This solution has the following distribution of firms among the five

clusters: 1 cluster − 78 cases, 2 − 72, 3 − 343, 4 − 63, and 5 − 2. The number of firms in four clusters out of five is large enough to facilitate their interpretation, but in one cluster there are only two cases from the United Kingdom. This points to the fact that this cluster includes some outliers (which is also proven by the abnormal values of financial variables for firms in that cluster) and does not represent a separate distinct process. Therefore, the given two cases are included in the cluster nearest to that (i.e. Cluster 1). Each established cluster characterizes a distinct failure process and its interpretation will be carried out by applying the median values of 24 variables. Median values will be applied as they are insensitive to non-normality and outliers. Also, established processes will be qualitatively compared to those outlined in D'Aveni (1989) and Laitinen (1991). Finally, chi-square tests will be conducted to find out whether the processes have significantly different representation across countries and which country pairs differ from each other.

3. Results and discussion

3.1. Different failure processes. The descriptive statistics of the financial variables in the four clusters are presented in Table 3. Each of the clusters represents one failure process. The first type of process (i.e. Cluster 1 or Process 1) symbolizes a sudden failure (N = 80 or 14%). It should, however, be noted that the variables even in year t-1 do not point to fatal problems. Of course, a remarkable decrease in assets and the evaporation of equity and profitability to an almost zero level in the first year before failure indicate the emergence of problems, but these symptoms do not necessarily point to forthcoming failure (only to a sudden increase in its probability). Thus, it is very difficult to predict the bankruptcy of firms that are characterized by Process 1 type failure, at least earlier than year t-1. For this process, OPRETA is exceptionally high referring to the fact that the average firm in this cluster is strongly sales-intensive. The failure trajectory has remarkable similarities with that given in Laitinen (1991) for an acute failure firm, but some variable values (e.g. $CFLOP_{t-1}$) point to the fact that failure for such firms is even more acute than for those in Laitinen (1991), at least when measured by the operating cash flow (instead of the traditional one). Also, the theoretical shape of sudden failure trajectory in D'Aveni (1989, p. 579) very well explains such process, although the one established by empirical analysis (D'Aveni, 1989, p. 589) does not coincide as well.

The second type of process (i.e. Cluster 2 or Process 2) has some similarities with the first one (N = 72 or 13%). CFLOP has much higher values, but in turn OPRETA is lower and ROA becomes negative in t-1 year. The main difference between Process 1 and 2 is the growth rate in assets. Namely, in Process 1 for all years except t-1 firms witness a steady and incremental positive growth rate, and only in t-1 the rate becomes negative. At the same time, in Process 2 firms witness extreme intensive growth for t-3 and t-4. Therefore, Process 2 firms are high growth companies that witness sudden failure, whereas Process 1 firms symbolize sudden failure firms that witness normal growth. Thus, it can be suspected that while Process 1 firms fail due to some shocks in their ordinary business activities, Process 2 firms fail due to overexpansion or some failed new project. Thus, evidence is found of two different types of sudden failures: ordinary and high growth firms. The evidence in Laitinen (1991) does not outline Process 2 firms, but in turn that trajectory very well meets the shape of Argenti's (1976, p. 157) type 2 theoretical trajectory.

The third type of process (i.e. Cluster 3 or Process 3) symbolizes a firm in which the values of all variables constantly and gradually worsen through all studied years (N = 343 or 61%). The ratio values collapse in a steady manner and there are no large sudden changes. Thus, such process very well meets the idea of gradual decliner (D'Aveni, 1989), and revenue financing failure firm (Laitinen, 1991). Still, the median values in Laitinen (1991) are not directly comparable to those found in the current study. Such trajectory has been also noted by Argenti (1976, p. 161) as type 3 failure and by Ooghe and de Prijcker (2008) as an apathetic established company. In addition, the failure path is in accordance with the gradual decline path described in Hambrick and D'Aveni (1988).

The fourth type of process (i.e. Cluster 4 or Process 4) characterizes firms that witness very poor performance for most of the studied four-year period (N = 63 or 11%). Thus, this failure type vividly meets the idea of chronic failure firm outlined in Laitinen (1991) and lingerer introduced in D'Aveni (1989). Still, in Laitinen (1991) the median values of variables for chronic failure firms do not point to such extreme decline as found in the current research. The study of income statements of these firms revealed that many of them are asset-intensive and have very low sales, so Process 4 could be characteristic for at least two types of companies. Firstly, those which are failed start-ups and do not succeed in selling their products at all or in very small quantity (e.g. biotechnology companies), and secondly, those which have lost their competitive advantage and can linger for multiple years working unprofitably due to (large) established equity reserves or an injection of new equity capital (e.g. firms, the technology of which has become obsolete and they are seeking new opportunities).

The taxonomies available in the literature have therefore found proof on the example of firms from six

European countries. The acute failure firm is divided into two types, which were not characteristic to D'Aveni (1989) and Laitinen (1991) that revealed only one acute type. However, when excluding the very different asset growth rates, both Process 1 and Process 2 characterize a sudden collapse.

3.2. Failure processes in different countries. The analysis of the extracted four failure processes is followed by studying the representation of established processes across different countries, which is outlined in Table 4. It can be seen from Table 4 that Process 3, pointing to a gradual decline, is most common among all countries. This process has the largest share in Belgium (81.7%) and smallest in Estonia (44.1%), the figure for all applied European countries being 61.5%. Generally, studied Eastern European countries have a smaller share of Process 3 firms when compared to two Western countries. Processes 2 and 4 have quite low representation in Western countries, whereas in former socialist countries the representation of all processes except for Process 3 does not follow a clear pattern. Failure processes 1 and 2 both depicting sudden failure, together make up less than 30% for all European countries except for Estonia, where their summed share is 48.4%, almost half of all failure cases. In the USA, Processes 2 and 3 dominate.

Table 3. Descriptive statistics by different processes (clusters) established

	Process 1			Process 2			Process 3			Process 4		
	Median	Mean	Std. dev	Median	Mean	Std. dev	Median	Mean	Std. dev	Median	Mean	Std. dev
$CFLOP_{t-1}$	1.20	1.51	9.90	3.32	7.01	57.28	1.43	4.83	61.77	2.40	30.46	112.08
$CFLOP_{t-2}$	1.55	1.22	6.30	4.09	7.96	55.05	2.47	-3.69	35.89	121.97	110.23	89.59
$CFLOP_{t-3}$	1.07	0.79	5.75	3.87	11.16	51.13	3.32	3.12	46.46	8.89	32.65	90.33
$CFLOP_{t-4}$	0.81	-2.10	18.08	5.27	7.27	44.17	4.34	8.54	52.80	-0.20	10.79	86.17
ROA_{t-1}	0.13	-4.86	36.53	-2.25	-4.85	20.09	-5.97	-12.97	22.87	-1.48	-10.70	24.27
ROA_{t-2}	3.71	1.56	22.06	1.02	-4.28	22.38	-1.40	-4.79	15.60	-2.02	-8.36	22.51
ROA_{t-3}	3.87	0.52	23.24	4.45	5.51	21.27	0.29	-2.25	14.32	-4.36	-14.06	24.91
ROA_{t-4}	3.38	1.29	21.81	4.29	7.60	30.47	1.72	-0.70	16.51	-0.01	0.82	26.40
$QUICKR_{t-1}$	0.61	0.78	0.85	0.53	0.73	0.98	0.47	0.63	0.79	0.25	0.41	0.57
$QUICKR_{t-2}$	0.82	0.95	0.85	0.60	0.87	1.12	0.55	0.68	0.71	0.30	0.66	1.06
$QUICKR_{t-3}$	0.85	0.93	0.83	0.76	1.07	1.14	0.58	0.67	0.57	0.72	1.29	1.54
$QUICKR_{t-4}$	0.76	0.87	0.72	0.75	1.23	1.31	0.61	0.66	0.49	0.92	1.72	1.83
$EQUITYR_{t-1}$	1.57	-5.01	40.77	2.20	-4.84	38.46	3.80	-1.07	38.38	-47.22	-41.54	43.20
$EQUITYR_{t-2}$	11.27	13.93	26.43	8.28	8.11	33.08	14.12	12.21	33.10	-34.93	-24.16	51.27
$EQUITYR_{t-3}$	10.88	13.12	29.99	10.17	17.51	31.29	19.76	18.45	31.08	0.31	5.01	48.28
$EQUITYR_{t-4}$	13.95	16.78	30.47	16.02	24.21	37.77	20.82	20.98	30.61	15.83	18.86	44.37
$GROWTH_{t-1}$	-18.11	-10.44	60.27	-3.08	19.93	85.13	-10.98	-14.49	31.62	-10.67	-21.27	33.36
$GROWTH_{t-2}$	3.78	11.49	52.71	10.44	48.12	95.92	-3.90	-0.97	32.66	-25.04	-16.19	54.04
$GROWTH_{t-3}$	7.64	13.14	43.76	72.36	92.99	87.44	-0.30	2.46	26.75	-10.47	-13.14	27.57
$GROWTH_{t-4}$	6.04	13.57	47.93	100.51	107.23	108.02	2.98	11.36	39.05	-2.73	-1.10	31.36
$OPRETA_{t-1}$	3.33	3.90	2.24	0.79	1.36	1.58	0.95	1.04	0.91	0.04	0.61	1.56
$OPRETA_{t-2}$	3.72	4.22	1.86	1.34	1.65	1.59	1.06	1.17	0.85	0.06	0.55	0.89
$OPRETA_{t-3}$	3.67	4.34	2.04	1.58	1.98	1.70	1.21	1.24	0.85	0.27	0.68	0.94
$OPRETA_{t-4}$	3.66	4.13	2.14	1.58	2.51	2.67	1.23	1.33	1.06	0.54	1.04	1.31

Table 4. Frequencies and shares of failure processes in seven countries

	Process 1		Process 2		Process 3		Process 4	
	Number of cases	Share in country	Number of cases	Share in country	Number of cases	Share in country	Number of cases	Share in country
Belgium	11	11.8%	5	5.4%	76	81.7%	1	1.1%
Czech Republic	12	12.9%	15	16.1%	51	54.8%	15	16.1%
Estonia	18	19.4%	27	29.0%	41	44.1%	7	7.5%
United Kingdom	21	22.6%	2	2.2%	61	65.6%	9	9.7%
Croatia	4	4.3%	11	11.8%	59	63.4%	19	20.4%
Russia	14	15.1%	12	12.9%	55	59.1%	12	12.9%
Total by process in European countries	80	14.3%	72	12.9%	343	61.5%	63	11.3%
United States	5	6.3%	26	32.5%	37	46.3%	12	15.0%

Note: Chi square test with USA excluded – statistic 75.99, p-value < 0.0001, Chi square test with USA included – statistic 95.97, p-value < 0.0001.

Table 5. Frequencies and shares of failure processes in industry groups (high level aggregation, 10 categories)

Industry group	Process 1		Process 2		Process 3		Process 4		Total number of cases
	Number of cases	Share of process in industry group	Number of cases	Share of process in industry group	Number of cases	Share of process in industry group	Number of cases	Share of process in industry group	
1	1	3%	3	8%	29	76%	5	13%	38
2	15	8%	30	15%	122	62%	29	15%	196
3	14	14%	19	18%	58	56%	12	12%	103
4	37	22%	21	12%	98	57%	16	9%	172
5	2	8%	7	28%	15	60%	1	4%	25
6	0	0%	1	50%	0	0%	1	50%	2
7	0	0%	0	0%	0	0%	0	0%	0
8	7	16%	8	19%	19	44%	9	21%	43
9	1	11%	1	11%	7	78%	0	0%	9
10	2	18%	2	18%	6	55%	1	9%	11
11	6	15%	6	15%	26	67%	1	3%	39
Total	85	13%	98	15%	380	60%	75	12%	638

Note: Industry NACE codes are classified using the 10-category "high level aggregation" system (see Eurostat, 2008). The key to the industry group codes has been given in Appendix, Table 3A.

The extent to which the four processes are associated with industrial groupings is reported in Table 5. The various failure processes do not appear to have strong tendencies to be concentrated on particular, unique industrial groups (the respective Chi-square test p-value 0.0145). Perhaps the most outstanding feature is that Process 1 sudden failures are most frequent in industry group 4 (wholesale and retail trade, transportation and storage, accommodation and food service). A more detailed analysis based on industry grouping sub-classes could reveal interesting, specific industry-process associations. Unfortunately, reliable sub-class evidence requires a larger number of observations than our present sample enables. Also, in case of different processes the median size of firms is not significantly different, therefore it can be said that none of the processes is specifically characteristic to some size category.

The analysis is followed by using the Chi-square test to study which countries are significantly similar or dissimilar in respect of the frequency of different failure processes. It can be seen in general from Table 6 that the analyzed countries show quite different frequencies for the failure processes established. The tests show that only two pairs of countries are not significantly different at 0.1 level (i.e. Croatia and the Czech Republic, Russia and the Czech Republic) and three more at 0.01 level (i.e. Estonia and the Czech Republic, USA and the Czech Republic, USA and Estonia). In all, Table 6 includes 21 different pairs of countries (i.e. (49-7)/2). Based on the tests it can be said that there are multiple similarities among former socialist countries, thus similar historic background could have some influence here. Belgium and the United Kingdom as advanced Western countries have stronger differences to these countries, but they differ substantially in respect to their economic and legal environment as well. It is remarkable that the USA shows more significant differences to Belgium and the UK than to the former socialist countries the Czech Republic, Estonia, Croatia, and Russia.

Table 6. Chi-square test statistics and p-values for inter-country relationships of four failure processes

	Belgium	Czech Republic	Estonia	United Kingdom	Croatia	Russia	United States
Belgium		22.21****	31.78****	12.45**	23.86****	15.92**	38.48****
Czech Republic	22.21****		8.62*	14.79**	5.67	0.97	7.46*
Estonia	31.78****	8.62*		25.95****	24.42****	9.63*	7.96*
United Kingdom	12.45**	14.79**	25.95****		21.40****	9.28*	35.95****
Croatia	23.86****	5.67	24.42****	21.40****		7.32*	11.91**
Russia	15.92**	0.97	9.63**	9.28**	7.32**		12.03**
United States	38.48****	7.46*	7.96*	35.95****	11.91**	12.03**	

Note: **** p-value < 0.0001, *** < 0.001, ** < 0.01, * < 0.1.

Conclusion

The present paper is the first study to compare firm failure processes in different countries. Previous studies (e.g. D'Aveni, 1989; Laitinen, 1991) have outlined quite similar taxonomies of failure processes based on data from a specific country, but no international comparisons are available. The established taxonomies in prior literature include three types of firms, namely very quickly declining (acute or

sudden failure firm), gradually collapsing, and for a long time very poorly functioning firms (chronic failure firm or lingerer). These established processes have also similarities with the three trajectories outlined in the seminal work by Argenti (1976).

We applied factor and cluster analysis on a total of 558 firms from six European countries (the United Kingdom, Belgium, Estonia, the Czech Republic, Croatia, and Russia) and established four distinct failure processes. The processes are highly similar to those three given in literature with the exception that the suddenly collapsing firm has two subtypes, namely the fast growth and the slow or normal growth firm. The most common process is the gradual failure firm, i.e. Process 3 (61.5% of all European firms studied), which is followed by a rather equal representation of other three processes. In highly developed Western European countries (Belgium and the United Kingdom) the gradual failure firm is more common than in Eastern European countries. Although this gradual process is also dominant in former socialist European countries, these countries are not homogenous in respect of other processes. There are only a few similarities in the representation of different processes among countries studied. In European countries, the larger the differences in the development level of countries, the more unlikely the similarities in the distribution of processes are. However, in the USA the frequencies of the four failure processes are more similar to those in Eastern Europe than in Western Europe.

There are several opportunities to elaborate the current study. Firstly, more countries could be introduced in analysis, especially from other continents than Europe. Secondly, a larger number of firms in analysis would allow to study whether any process could be broken into different sub-processes. Thirdly, a larger dataset would enable to examine whether different processes or sub-processes are associated with specific industry group sub-classes. Finally, if such data would be available, an important study domain would be to link failure processes established with actual causes for failure.

The study carries several implications. Firstly, the multitude of institutions offering credit (e.g. banks and commercial firms) can make use of the results by adjusting their scoring models to take into account which process dominates in a specific country. Secondly, policy makers can improve different SME policies (e.g. reporting, founding, and financial support) by accounting for which failure process types are most dominant in specific environments. As there is a myriad of studies focusing internationally on bankruptcy prediction, we hope that this pilot study about the international comparison of failure processes will similarly initiate a series of research on this topic.

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Appendix

Table 1A. Variables for the composition of failure processes

Variable	Formula
Return on assets ratio (ROA)	100 · EBIT/total assets
Quick ratio (QUICKR)	(Current assets – stocks)/current liabilities
Operating revenue to total assets ratio (OPRETA)	Operating revenue/total assets
Equity ratio (EQUITYR)	100 · (Share capital + other shareholders funds)/total assets
Operating cash flow to cash operating revenue (CFLOP)	100 · (EBITDA − Δcurrent assets minus stocks + Δcash + Δcurrent liabilities)/ (operating revenue − Δaccounts receivables)
Rate of growth in total assets (GROWTH)	100 · Δtotal assets/total assets in the beginning of year

Table 2A. Distribution of the years of last financial statements in the data, by country

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Belgium	6	8	3	2	6	4	4	0	5	6	4	3	12	11	6	7	6	0	93
Czech Republic	0	0	0	0	0	0	0	0	0	0	0	0	0	2	32	33	26	0	93
Estonia	0	0	0	0	0	0	0	0	0	0	0	6	18	37	21	8	3	0	93
United Kingdom	0	0	0	1	0	2	1	1	0	0	0	0	4	5	5	15	51	8	93
Croatia	0	0	0	0	0	0	0	0	0	0	2	0	5	6	14	15	51	0	93
Russia	0	0	0	0	0	0	0	0	1	13	20	13	12	7	14	11	2	0	93
United States	0	0	0	0	1	4	6	6	3	4	6	6	8	11	12	9	4	0	80
Total	6	8	3	3	7	10	11	7	9	23	32	28	59	79	104	98	143	8	638

Table 3A. Distribution of firms across industries (number of firms and percentages), by country

Industry group	Belgium		Czech Republic		Estonia		United Kingdom		Croatia		Russia		USA		All	
1	0	0.0%	6	6.5%	1	1.2%	1	1.1%	5	5.4%	25	26.9%	0	0.0%	38	6.3%
2	23	35.4%	33	35.9%	16	18.8%	17	18.7%	26	28.0%	32	34.4%	49	61.3%	196	32.7%
3	12	18.5%	14	15.2%	22	25.9%	32	35.2%	7	7.5%	13	14.0%	3	3.8%	103	17.2%
4	21	32.3%	29	31.5%	36	42.4%	20	22.0%	45	48.4%	15	16.1%	6	7.5%	172	28.7%
5	2	3.1%	2	2.2%	4	4.7%	3	3.3%	3	3.2%	0	0.0%	11	13.8%	25	4.2%

Table 3A (cont.). Distribution of firms across industries (number of firms and percentages), by country

Industry group	Belgium		Czech Republic		Estonia		United Kingdom		Croatia		Russia		USA		All	
6	0	0.0%	0	0.0%	0	0.0%	1	1.1%	0	0.0%	0	0.0%	1	1.3%	2	0.3%
7	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
8	5	7.7%	8	8.7%	3	3.5%	11	12.1%	5	5.4%	4	4.3%	7	8.8%	43	7.2%
9	1	1.5%	0	0.0%	1	1.2%	4	4.4%	0	0.0%	1	1.1%	2	2.5%	9	1.5%
10	1	1.5%	0	0.0%	2	2.4%	2	2.2%	2	2.2%	3	3.2%	1	1.3%	11	1.8%
11	28		1		8		2		0		0		0		39	
Total	93	100%	93	100%	93	100%	93	100%	93	100%	93	100%	80	100%	638	100%

Note: Industry NACE codes are classified using the 10-category "high level aggregation" system (see Eurostat, 2008). The percentages are calculated using only firms with a known NACE category. Thus, the firms in Industry group 11 (NACE code not available) are not included in obtaining the percentage figures. The industry groups are: 1 = Agriculture, forestry and fishing; 2 = Manufacturing, mining and quarrying and other industry; 3 = Construction; 4 = Wholesale and retail trade, transportation and storage, accommodation and food service activities; 5 = Information and communication; 6 = Financial and insurance activities; 7 = Real estate activities; 8 = Professional, scientific, technical, administration and support service activities; 9 = Public administration, defence, education, human health and social work activities; 10 = Other services; 11 = NACE code not available.