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PREDICTING THE LIFESPAN OF A COMPANY: AN IMPORTANT FACTOR FOR CAPITAL REALLOCATION

PREDVIĐANJE ŽIVOTNOG VEKA PRIVREDNOG DRUŠTVA: ZNAČAJAN FAKTOR REALOKACIJE KAPITALA

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Abstract:
In this paper, the authors will attempt to estimate the expected percentage of the companies that currently have credit rating and that will go bankrupt after a certain period of time. The authors applied the method of simulation, *i.e.* the transition matrix of a Markov chain, using the relevant information on the credit ratings of open joint-stock companies listed on the S&P 500 Index. Research results suggest that the most likely situation is that half of those companies with a CCC (C) credit rating will cease operations after only four years; that is, they will lose their credit rating and will be replaced by some other, more prosperous companies.

Key words:
Joint-stock companies, Markov chain, credit rating, S&P 500.

Apstrakt:
U ovom radu, autori su pokušali da predvide očekivani procenat privrednih društava, koja trenutno imaju kreditni rejting, a koja će prestati sa poslovanjem nakon izvesnog vremena. Autori su primenili metod simulacije, odnosno tranzicionu matricu Markovljevih lanaca, na podacima o kreditnom rejtingu otvorenih akcionarskih društava sa liste S&P 500 berzanskog indeksa. Rezultati istraživanja pokazuju da je najverovatniji scenario da će polovina privrednih društava sa najlošijim kreditnim rejtingom, na primer CCC (C), prestati da postoje nakon samo četiri godine. Odnosno, ta privredna društva će izgubiti kreditni rejting i biće zamenjena nekim drugim, prosperitetnijim, privrednim društvom.

Ključne reči:
otvorena akcionarska društva, Markovljevi lanci, kreditni rejting, S&P 500.

1. INTRODUCTION

The global economic crisis has changed the international business environment and increased business risks. In circumstances where investors are becoming more cautious and the reallocation of capital in business is more risky, one of the important factors for a valid assessment of justification of investment undertakings is the ability to predict the lifespan of a company's operations. When starting a business, the investors usually believe their companies will operate over a long period of time. However, during the first year, companies bear the highest bankruptcy risk. In order to become more efficient and avoid risk, major stakeholders will reallocate capital from one company, which is not expected to operate in a long run, to other areas of investment with safer investment and greater profitability. These interventions will affect the price of financial instruments issued by the company. Besides these factors, the greater the demand and the higher the perception of the value of the company, the higher the price of a financial instrument will be. The demand for a certain financial instrument mainly depends on the investor's perception of a company-issuer in terms of its business success. That perception is frequently based on the credit rating of an issuer or a financial instrument. Investors choose, based on the credit rating, in which companies they will invest their capital, whereby they wish to make sure that their investment will be as long-term and profitable as possible. Liquidation or bankruptcy is almost always the last chapter of a company's life cycle. The later investors notice the signs that the company is facing difficulties in its operations, the less capital they will be able to reallocate. Therefore, bankruptcy is, in a way, the last chance for the redistribution of capital from those companies which have no possibility of increasing their working capital to those that can. Taking into account the above-mentioned, the main goal of the authors of this paper will be to attempt to estimate, by means of the probability of credit ratings, company's trends (open joint-stock companies) and the expected period when a company's lifespan will face a bankruptcy. In the first part of the paper, the authors will explain the role which credit ratings may have in predicting the lifespan of a business entity. The second and third part of the paper will place an emphasis on the analysis of the applied methodology and the results obtained by the research.

2. RESEARCH METHODOLOGY

Credit rating agencies are also, indirectly, concerned with bankruptcy as one of the ways by which companies cease business operations. The main goal of credit rating agencies is to provide information on the assessed success of operations of a company-issuer or financial instrument. The credit rating agencies provide, inter alia, forecasts about the termination of companies. According to Caraiani (2012), despite non-linearity and determinist chaos in macroeconomic fluctuations present

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in developing economies, it is still possible to reliably predict, to a certain extent, the termination of a company's operations. In doing so, these agencies apply similar models and data used by auditors in order to check whether the going concern principle has been fulfilled by the audit client. Namely, since the 'Sarbanes-Oxley Act' was adopted in 2002, the role of credit ratings and credit rating agencies which determine such ratings has been additionally clarified and defined. This basically came as a result of financial crises and scandals (referring primarily to 'Enron', which had a very good credit rating only a few days before initiating bankruptcy proceedings) and negative trends in the financial markets (Congress, 2002). Of course, it was followed by the biggest financial and economic crisis, which additionally made the question of the importance of credit ratings and credit rating agencies, as well as the degree of trust which investors have in these agencies, more topical. In this research, the authors will focus on the credit ratings of companies which are open joint-stock companies, because these business entities must have a credit rating so that their shares can be listed on the Stock Exchange.

Since 1980, when the modern evaluation of companies was introduced in practice, credit ratings of large companies in the US have recorded a downward tendency. In that period about 60 companies had the best rating. By 1995 this number had halved and in mid-2011 there were only four companies in the US with the best rating. At the time of writing this paper, three companies maintained this rating, while Apple was still unsuccessfully trying to catch up with them (Dash, 2011).

The following figure shows credit ratings according to Standard & Poor's in 2011 for companies which are open joint-stock companies and listed in the S&P 500 Index. These facts will later serve as the basis of the research on and prediction of the lifespan of these companies.

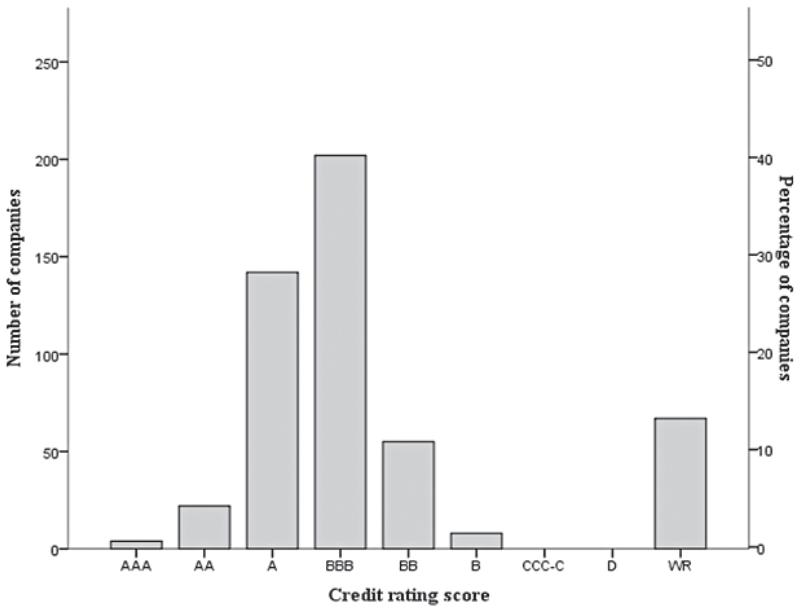

Figure 1. Distribution of credit ratings among S&P 500 companies in 2011

Source: (Dash, 2011)

Analysts believe that the most frequent reason for a credit rating decrease is the acquisition of companies by large legal entities, which thus transfer huge debts in order to justify investment. Considering that the debt ratio is an indicator which is often used for determination of credit rating, this assumption has its justification. However, although credit ratings are not reliable and often indicate unsuccessful operations of companies too late, there is, beyond doubt, an evident relationship between the general business environment (recession) and trends in ratings. This means that a decrease in credit rating may suggest a deterioration of a company's operations to the point at which the opening of bankruptcy proceedings is inevitable.

Credit rating trends may be predicted to a certain level. Eventually, all companies for which rating is assessed will sooner or later end their life cycle, but the question is when it will happen. Therefore, the authors needed a sample to assess reliably enough the lifespan of a company. It was necessary to classify and monitor the trends of financial and economic standing of the companies over a certain period. Furthermore, the authors needed a methodology that would allow them to determine, while applying the basic probability principles, the expected average lifespan of a company. Trends in economic and financial standing may be monitored through market indices. Among these indices, the S&P 500 represents 'the most popular' market-weighted index, because it has a much wider base in comparison to other indices. This index monitors trends in prices of shares of 500 companies, of which 400 are industrial, 20 are transport, 40 are public sector and 40 are financial entities. However, these are not always the same companies – that is, open joint-stock companies – because if the credit rating of one company falls below the acceptable rating, it is replaced by another prospective company so that there are always fluctuations in the structure of the index.

For the purpose of this research, the authors ignored these changes in order to be able to follow the financial standing of a certain number of companies and foresee the moment when these companies will go bankrupt. Based on the above-stated, it can be concluded that 500 open joint-stock companies represent what the authors consider a solid sample. Therefore, if the authors assume that a company has a credit rating of, for example BBB, based on the credit rating migrations to a better or worse rating in the past, they can determine the probability that this company will have the same, worse or better credit rating next year. Accordingly, the authors may predetermine the probability of the financial standing of the open joint-stock companies in the future. In order to determine the probability of a company's credit rating trends, the authors will use random (stochastic) processes which represent mathematical models of processes whose evolution is described by probability laws. Among the most well-known processes are the Markov processes, which are random processes with the property that the future condition of the process depends only partly on its present state. Models of the term structure of credit spreads based on a discrete state Markov chain of the default process rely on the risk-neutral transformation of the empirical transition intensity matrix (Jarrow *et al.*, 1977). For instance, if we have a random process {Xt}, a $t \in T$, the process will be a Markov process if ($\forall n \in N$). The above-stated means that if we treat the moment tn as present, we may assume that the future state of a process depends on the past

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only through the present. The implementation of Monte Carlo methods requires sampling from high-dimensional probability distributions (Hastings, 1970).

In essence, information from the past of a certain process which is relevant for the future (or for the determination of probability) exists in the present. Therefore, if we know the present value, knowing the historical values of the process is not necessary, except for the definition of the transition matrix. Therefore, if we can assume that T is a set with the initial point for describing these processes, it is enough to know conditional distributions $P\ (X_t \in B/X_s)$ for s < t and initial distributions P $(X_{t0} \in B)$. Thus, it is possible to reach the final dimensional distributions.

Markov chains are a special type of Markov methods, whereby a process can only be in the final number of states. These processes are frequently used in statistical modeling and suit our research best because they assume that the process, which with a discrete set of times can only take a limited number of different values, represents a Markov chain. Namely, if there is a system which in certain sets of time t_0, t_1,... can be in some of the defined n states, then if at time ts the system is in state i, we define Xs = i. In that case, the process {Xs} is a Markov chain if:

$$P(X_{s+1}) = r / X_0, X_1, \ldots, X_s) = P(X_{s+1} = r / X_s) \quad (1)$$

Accordingly, to be able to calculate probability in which state a certain system will be in a certain time, we need to know distribution P0(p) = P(X0=p), as well as probabilities of movement from state p in time ts into state r in time tt. Or, $ppr(st) = P(X_t = r / X_s = p)$, when pr = 1,2..., n and for $(\forall s<t)$. This methodology can be especially simply applied in the case when the system is homogenous, *i.e.*, when probability of movement of state ppr(st) does not depend on time ts and tt but only on the difference between s-t. Then, it is possible to calculate the probability of movement from one state to another in one step:

$$ppr = P(X_{s+1}) = r / X_s = p),\ s = 0,1,\ldots,\ p,\ r = 1,2,\ldots n \quad (2)$$

The migration matrix of Markov chains can be expressed as $\Pi = //p_{pr}//$. The vector of the initial probabilities p(0) = (p1(0), ..., pn(0)), pp(0) = P(X0 = p). Furthermore, the previous vector and matrix define the behaviour of the Markov chain, because if p(0) is a vector of initial probabilities and if Π is a migration matrix Xs,then the vector of probabilities in the s-step is as follows:

$$p^{(s)} = p^{(0)}\ \Pi^s,\ s = 1,2,\ldots \quad (3)$$

$$p^{(s)} = (p_1^{(s)}, \ldots, p_n^{(s)})\ i\ p^{p(s)} = P(X_s = p),\ i = 1,2,\ldots,n \quad (4)$$

For the purpose of this research, the state of the system is the credit rating of the company after a certain period of time. The state of the system at any time depends solely on the state in the past moment, that is, the credit rating of a company in one year depends solely on the state in the previous year. This means that it is a Markov system and since the probability of movement from one state – *i.e.* credit rating into another – does not depend on time, then it is a homogenous chain (Ethier & Kurtz, 2005). The precondition to determine the probability that a company will no longer be in business is to determine the probability of movement from one state to another, that is, from one credit rating to the next. If this methodology had been defined a few decades ago, the use of this method would be much easier today owing to computers and modern software. The authors analysed the credit ratings of the companies listed in the S&P 500 based on the data for the year 2011, using at the same time credit rating trends for the period 1920–1996 and the probability of credit rating trends from year to year, based on the data published by Moody's credit agency which are shown in Table 1 below (Moody's Investors Service, 1997).

The abbreviation WR – withdrawn ratings – means a situation in which a credit rating agency withdraws and/or does not determine a credit rating for certain reasons (similar to a disclaimer of opinion in auditing). These situations are commonly connected with an increase in the risk that the company will go out of business, although there are situations in which a company may simply waive the credit rating request and start issuing securities which do not require a credit rating. Table 1 shows the above-mentioned transition matrix with presented probability that, for example, a company in the upper left-hand corner with a credit rating of Aaa will maintain the same rating next year with 88.32% probability. On the other hand, the probability that the company will migrate to a lower rating Aa is 6.15% *etc.*, whereas the probability that it will migrate to ratings B or C or that it will stop operating is zero. Furthermore, in the second row we see that the probability that a company with

					Rating To (%):				
Rating From:	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	WR
Aaa	88.32	6.15	0.99	0.23	0.02	0.00	0.00	0.00	4.29
Aa	1.21	86.76	5.76	0.66	0.16	0.02	0.00	0.06	5.37
A	0.07	2.30	86.09	4.67	0.63	0.10	0.02	0.12	6.00
Baa	0.03	0.24	3.87	82.52	4.68	0.61	0.06	0.28	7.71
Ba	0.01	0.08	0.39	4.61	79.03	4.96	0.41	1.11	9.40
B	0.00	0.04	0.13	0.60	5.79	76.33	3.08	3.49	10.54
Caa-C	0.00	0.02	0.04	0.34	1.26	5.29	71.87	12.41	8.77
Default	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
WR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00

Table 1. Transition probability of credit rating companies in the period 1920–1996
Source: (Moody's Investors Service, 1997)

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a credit rating of Aa will migrate to a better rating is slightly above 1% and there is the probability that it will go out of business (0.06%).

Companies with a credit rating C have the highest probability of terminating operations – 12.5%. The percentages shown diagonally, from the left top corner to the right bottom corner, represent the probability that the company will maintain its credit rating, whereas the percentages marked as Default show the probability that a company will stop operating. To the best of the authors' knowledge, there is no study of credit migration risk or any out-of-sample forecasting exercise (Kavvathas, 2001). After defining the methodology and the database required for the research, the research results are presented in the text below.

3. RESULTS AND DISCUSSION

Based on the current ranking of 500 companies included in the sample and projected probabilities of their credit rating trends, we can define the expected life span of a company for each credit rating. For the purpose of this research, we have chosen the time horizon of 100 years because after that period the reliability of credit rating trend probability is very low, as is the usefulness of the research. Results for three credit ratings AAA, BBB and CCC (or any other credit rating scale) are presented in the graphs below, while for other ratings graphs are given in the Appendix.

In the above Figure 2, the x-axis represents the percentage of companies which will cease business operations, whereas with the y-axis we can analyze the time period in which it will happen. The graph shows quintiles in the cumulative distribution where the line in the middle shows what will most likely happen. The closer to the middle the other lines are, the smaller the dispersion of expected outcomes and the more reliable the assessment is. By analyzing the graph, we can conclude that according to the most pessimistic scenario (1% of all situations), all companies with a credit rating of AAA will cease to exist within only 80 years; *i.e.*, they will be replaced by new and more successful companies and will lose their credit rating. However, what is 'more realistic' is that in the first 37 years there is very little probability that any of the companies with a top credit rating

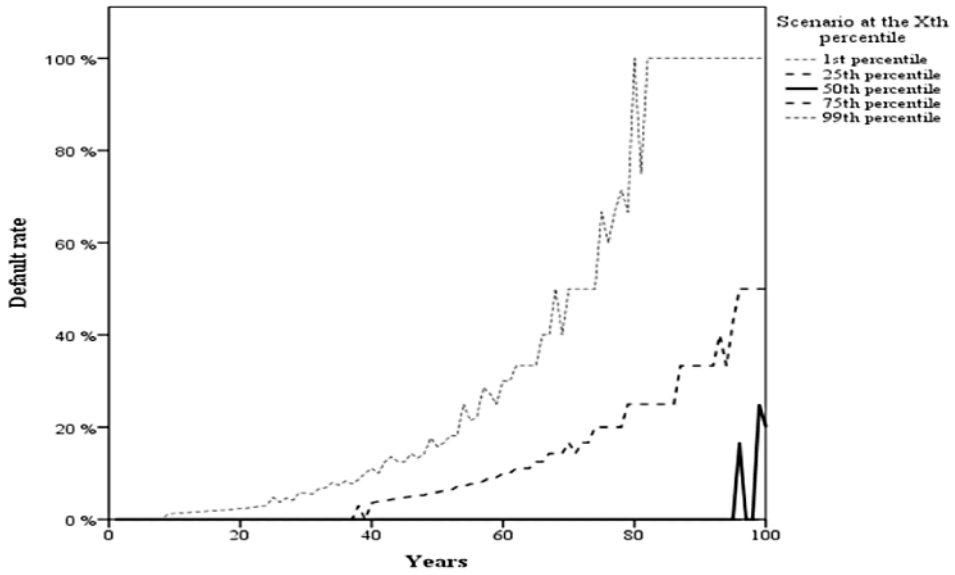

Figure 2. Expected cumulative default rates for AAA-rated companies over time

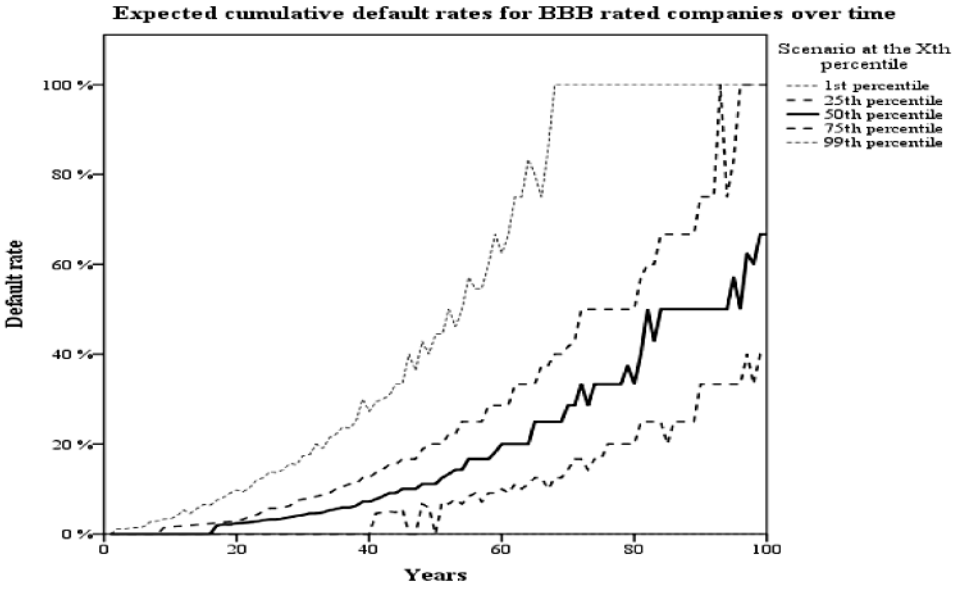

Figure 3. Expected cumulative default rates for BBB-rated companies over time

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will cease business operations. When analyzed over the longer period, in the next 60 years, only 20–40% of the companies with the highest credit rating may appear to be in bankruptcy. Only after 97 years will a maximum 25% of the companies with a credit rating of AAA (in our sample, only one company) go bankrupt, which seems to be the most likely outcome.

In Figure 3, we can see that the likelihood that the companies with a credit rating of BBB will go out of business in the first few years is considerably higher. One-fifth of the companies will be in bankruptcy after 60 years and one-half of the companies with a credit rating of BBB will stop operating after 81 years. In the worst case, all companies with a BBB rating will be in bankruptcy after 68 years, whereas in the best case none of the companies will go bankrupt over the observed period. The graph below shows the prediction results for business entities with the so-called junk rating CCC or C. We can notice that the dispersion of the expected results is absolutely the lowest and reliability prediction the highest.

Based on the results of the conducted research, it can be concluded that as many as 70% of the companies with a credit rating of C (CCC) will stop operating after only 11 years. The most realistic situation is that half of these companies will no longer be in business after as little as four years and 80% after 16 years. All companies with this credit rating will cease operations after 60 years, or in the worst scenario, after 25 years. These companies are mainly legal entities which have not yet become major 'players' in the market or companies at the end of their life cycle. The above results largely correspond to the results of the research conducted by the Small Business Development Center in the US which suggests that as many as 95% of small businesses cease to operate after the first five years (Bradley & Cowdery, 2004). The same authors stress that small businesses have only a 37% chance to survive the first four years, which almost entirely coincides with the results of our research. In the above graphs, we can see that the probability of a company stopping operations increases when there is a decrease in its credit rating quality, which is not surprising. However, if we want to find out how long it takes a company on average to stop operating, notwithstanding its credit rating, we can look at the following graph.

The most realistic scenario is that, on average, after 86 years half of all companies presently with a credit rating will be out

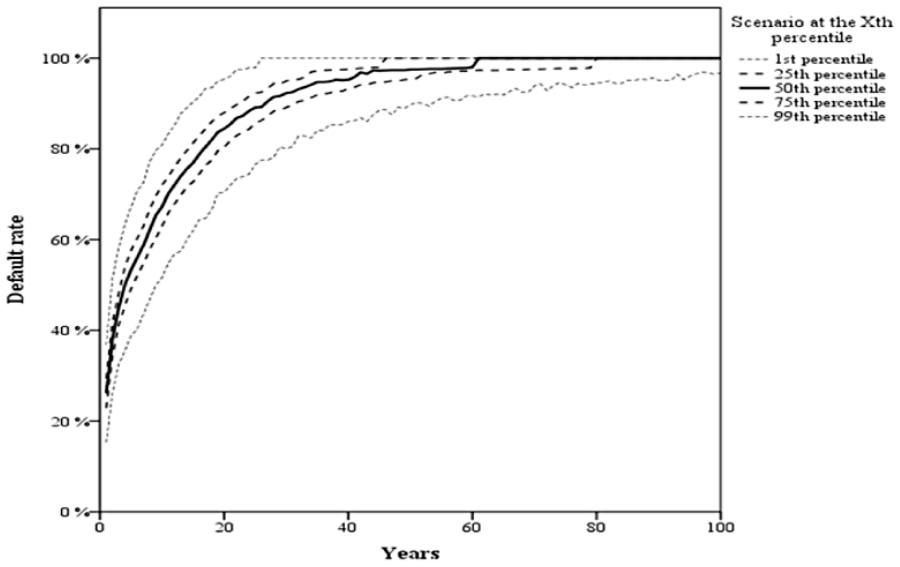

Figure 4. Expected cumulative default rates for CCC-C rated companies over time

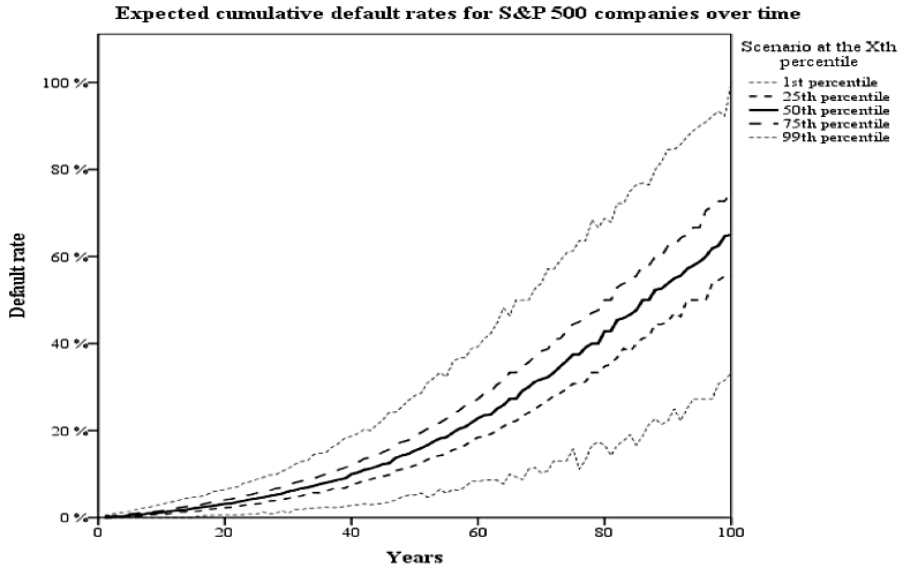

Figure 5. Expected cumulative default rates for S&P 500 companies over time

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of business, which means they will be excluded from this stock exchange index and replaced by more successful companies. In the worst scenario, this will happen after 66 years. We expect that approximately 65% of the companies which are presently listed on the S&P 500 Index will stop operating, taking into account the current distribution of credit ratings. In one per cent of the worst scenarios, all companies will go out of business after 100 years of operations. It is most likely that after 100 years only 35% of companies will continue operations.

4. CONCLUDING REMARKS

In circumstances when foreign direct investment, as one of the key preconditions for successful positioning of companies in the international market, is becoming increasingly risky, a valid assessment of the justification for investment undertaking and reallocation of capital in business operations also requires a prediction of a company's long-term operations. This paper particularly focuses on the assessment of the period in which companies with a credit rating will stop operating. The results of the research show that it is most likely that half of the companies with a credit rating of CCC (C) will go out of business within only four years. Half of the companies rated BBB, BB or B will, on average, close down in 50 years. Within 94 years, only a quarter of companies with credit ratings AAA, AA and A will stop operating. On average, half of all companies will stop operating within 86 years, irrespective of their credit rating. The authors suggest that some future research should be based on the data on credit ratings of companies listed in some other stock exchange indices which include a larger number of companies. Furthermore, significant progress in further research would be achieved by including the probability of credit rating trends over the last 15 years, taking into consideration the multiple challenges of the financial crises the companies were facing in that period. The S&P 500 Index is related to the territory of the United States, but the capital of the companies included in this index in most cases is not from that region, so it can be said that the results of the research presented in this paper are universal. For future research, it should be noted that for countries with a developed stock exchange and financial markets it is possible to conduct research for national stock exchange indices, whereby prediction of the longevity of company operations would be specialized for a specific territory.

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