THE STRUCTURAL AND ECONOMIC PROFILES OF ENTERPRISES WITH GREATER LONGEVITY[1]

Agata Maria Madia Carucci, Roberto Antonello Palumbo, Giovanni Vannella

Abstract. In this paper, after dividing the companies of the FRAME SBS into long-lived and non-long-lived companies and having described their characteristics, the probability of survival of the companies over time is estimated as the structural and economic conditions change. In particular, the COX semiparametric regression model is used to compare the probabilities of survival and identify the profile of long-lived and non-long-lived companies.

1. Introduction

Since the 1960s several studies have been conducted with the aim of implementing statistical models to forecast and evaluate company performance. Initially, these studies were based on univariate approaches through which the statistical indices of companies close to bankruptcy were compared with those of "healthy" companies (Beaver, 1967). Subsequently, multivariate approaches were proposed in the literature such as the Z-Score model (Altman, 1968) which, through a combination of financial statement indices and using discriminant analysis, assigned a score to healthy and unhealthy companies, with some "variants" such as those based on the application of logit models (Ohlson, 1980) or on the comparison of different approaches. In this sense, particularly interesting is the study by Balcaen and Ooghe in which 43 corporate bankruptcy prediction models are examined, grouped into 4 categories: univariate models (1), models based on risk indices (2), AMD models (21) and models probabilistic (19) (Balcaen and Ooghe, 2006).Previous studies have mainly focused on the prediction of the risk of corporate insolvency or default since this is the greatest risk that can typically arise in the entrepreneurial sphere. However, the variability of profits and financial balances, which insolvency depends on, "are not the only measure of corporate success. They are an end. [...] survival is an unquestionable, perhaps the ultimate, mark of

[1] The paper is the result of the joint study of the three authors, paragraphs 2.1 and 3 are attributed to A.M.M. Carucci, paragraphs 2.2 and 2.3 to R.A. Palumbo, paragraphs 1, 4 and 5 to G. Vannella.

success". (Cassis, 1997). Understanding the factors that drive family companies' longevity is essential not only to improve the strategies of existing companies, but also to inform investors' decisions to support start-ups, taking on the responsibility of long-term allocation of resources (Dossena, 2022).On the other hand, studies have rarely been conducted to predict company longevity and to analyse what could be the structural characteristics of companies that would discriminate long-lived vs. non-long-lived companies.Furthermore, a major obstacle to company forecasting models has always been the difficulty of easily finding detailed economic and structural information on a large sample of companies (note that the classic company surveys are based on samples and the administrative source of public budgets is not exhaustive).The enormous coverage of FRAME SBS (therefore FSBS) and ASIA (Active Enterprise Statistical Archive) data in terms of number, structure variables and economic variables, combined with the availability of information in historical series, constitutes a particularly interesting information base for the description of the system over the years and for the evaluation of its evolution in the last decade. In this paper, using this database, the profiles of the companies active since 2012 (the first year of data availability) have been outlined, identifying the structural and economic determinants of these companies and which, consequently, the main factors that led companies not to survive in the period under review.The factors that have influenced the longevity of companies have been identified through regressive models and, in particular, the Cox-hazard statistical model (Cox, 1972) helps evaluate how different characteristics of companies, considered jointly, have influenced their survival probability.

2. Data

2.1. General aspects

Since 2012, the statistics on the economic results of companies and the estimates of the National Accounts have been produced by Istat on the basis of FSBS data (AA.VV., 2020; LUZI, 2016).

It represents the most important integrated system of administrative and statistical data which, starting from the units included in the ASIA database, brings together information deriving from administrative sources and from Istat structural surveys on companies, thus creating an exhaustive archive (in terms of enterprises) with economic and structural variables. This richness of information is particularly useful to analyse the health of Italian companies.

The information of the statistical archive is available in aggregate form on the Istat data warehouse, in the business and competitiveness section or, after appropriate request, as microdata file. In this paper we chose to measure the health

of the production system considering the companies for the period 2012-2019. This choice is subject to the availability of the FRAME SBS (2012 is the first year of data) and the pandemic event. In fact, 2019 is the last year for which the FRAME SBS appears to be less subject to the effects of business closures due to the pandemic event itself.

Starting from the data relating to the years 2012-2019, two sets of companies have been identified:

– Enterprises present in both groups and therefore defined as "long-lived" (hereinafter LLE)

– Enterprises present in 2012 and not present in 2019, "not long-lived" (hereinafter NLLE).

For each enterprise was awarded:

– the flag=1 for «long-lived» companies

– the flag=0 for «not long-lived» companies.

The enterprises present in the 2012 FRAME SBS archive and simultaneously present in the 2019 FSBS are 60% of the total initial enterprises (long lived) while over 1.7 million enterprises stopped their activity before 2019 (Tab. 1).

Table 1 – *Long lived and not long lived enterprises.*

	Number of enterprises	
	Absolute value	Percentage value
NLLE	1737350	39.9
LLE	2613668	60.1
TOTAL	4351018	100

Elaborations on ISTAT data

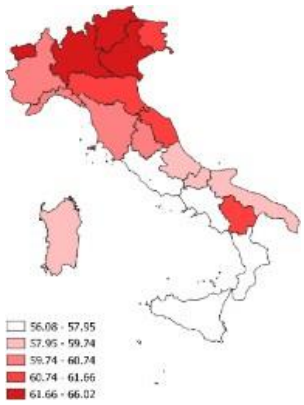
In order to measure the age of the company, the proxy variable was calculated, starting from the ASIA data, expressed in terms of months of life up to 2019 or to the possible date of activity cessation.

2.2. Some elements of analysis: the structure of long-lived and non-long-lived enterprises

To understand which indicators could be chosen for the multivariate analysis, we carried out a descriptive analysis that could support this choice and then examined the distribution of LLEs/NLLEs in relation to the various structural characteristics of the companies. For the sake of conciseness, only the most significant findings are reported below. First, the territorial aspect was particularly relevant (Fig. 1), the presence of LLEs decreases moving from the

North-East to the North-West and from the North to the South. The region with the highest incidence of LLEs is Trentino Alto Adige with 66% of enterprises while the region with the lowest incidence is Lazio (56%).

Figure 1 – *Long -lived enterprises in Italy. Percentage incidences.*

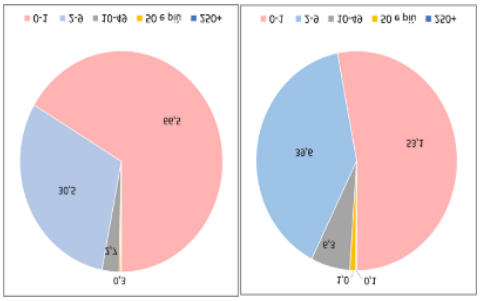


Elaborations on ISTAT data.

The second most interesting aspect was the size of the companies measured in terms of number of employees (Fig. 2), the growth of which tends to increase the longevity of the company. Companies with only one employee represent just over 50% of LLEs and 66.5% of NLLEs; on the other hand, those with 2-9 employees represent almost 40% of LLEs and about 30% of NLLEs and finally the class with 10-49 employees represents 6.3% of LLEs and 2.7% of NLLEs. On average, LLEs employ 4.5 people and NLLEs 2.5. With reference to the sector of economic activity (Fig. 3), 45% of LLEs are in the other services sector, 32.4% in trade commerce sectorand just over 10% in the construction and industrial sectors.

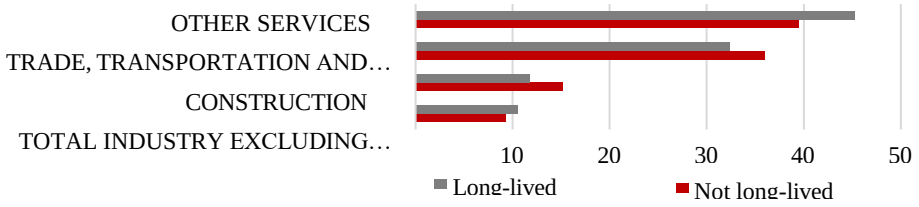
Figure 2 – *Long and not long-lived enterprises by size.*

NLLE *LLE*



Elaborations on ISTAT data

Figure 3 - *Long and not long-lived enterprises by activities*



Elaborations on ISTAT data.

2.3. Usable variables and chosen indicators

Therefore, in order to identify potentially discriminating statistical indicators, the main economic-company variables in the FSBS were analysed, which, given its explanatory purposes, does not contain the aggregates of the balance sheet.

A set of potentially discriminating statistical financial indicators was constructed, the main results of which are reported below (Tab. 2).

Indicators of productivity and remuneration of work:

– Revenue from sale of goods and services/Employees
– Value added/Persons employed
– Gross Operating Margin/Employees
– Value added/Employees
– Wages and salaries/Employees

expressed in euro per employees, indicate to some extent how much economic production activity over a given period can be attributed to each employed person, and also how it changes, as well as the average salary cost per employee.

Indicators of propensity for international trade:

– Exports of goods/(Revenues from sale of goods and services+Others operative revenues)
– Imports of goods/Purchases of raw materials, supplies and consumable.

expressed as a percentage, they measure the propensity to international markets.

– Other cost and value added indicators
– Personnel costs/ (Purchases of goods and services+Costs for use of third- party assets+Personnel costs+Other operative revenue) explains how much of the costs is absorbed by personnel costs
– Value added/Revenue from sale of goods and services describes the increase in value that business activity brings to the transformation processes of

goods and services on the value of sales. It also indicates how large the margin is to remunerate internal production factors.

Table 2 - *Economic indicators: productivity and remuneration of work.*

Productivity and remuneration of work	*NLLE*	*LLE*
Revenue from sale of goods and services/Employees	211188	290446
Value added/Employees	45965	66504
Gross Operating Margin/Employees	16895	30489
Value added/Persons employed	26714	48741
Wages and salaries/Employees	20989	25915
Propensity for international trade	*NLLE*	*LLE*
Exports of goods/(Revenue from sale of goods and services+Others operative revenues)	0.06	0.13
Imports of goods/Purchases of raw materials, supplies and consumables	0.11	0.21
Other indicators	*NLLE*	*LLE*
Personnel costs/ (Purchases of goods and services+Costs for use of third-party assets+Personnel costs+Other operative revenue)	0.15	0.13
Value added/Revenue from sale of goods and services	0.22	0.23

Elaborations on ISTAT data.

In particular, the LLEs, compared to the NLLEs, have significantly higher observed average values of the indicators of productivity, remuneration of work and of propensity for international trade, not relevant differences for the other economic indicators.

These results appeared completely convincing also on the theoretical side, as the longer-lived companies can have a greater "yield" of the workforce both in terms of average turnover per employee and profitability per employee and employee compared to the less long-lived ones, as well as the longest-lived companies can be characterized by higher remuneration for the work employed. Similarly, the companies with greater longevity had higher incidence on both foreign turnover than total turnover and foreign purchases than total turnover, as this increased ability to move across all markets, both domestic and foreign, allows companies to have greater elasticity.

On the other hand, the small difference between the LLEs and the NLLEs with reference to the value added/turnover indicator raised some concerns, as one would have expected a greater difference in the profitability of the turnover between the two sub-populations.

3. Methodology

To evaluate the factors that influence the longevity of companies, the statistical Cox-hazard regression model was used to estimate how different structural and economic characteristics of companies, considered jointly, influence their survival probability (COX, 1972).

The Cox model is widely used in applied statistics (for example in medical statistics) as it is considered a valid tool in the development of survival analyses and for the evaluation of the impact of predictive factors on a specific outcome. A great advantage of the Cox model is given by the possibility of taking into account two observable situations (presence or absence of the event) and more covariates.

The fundamental element of Cox regression is time. It is also useful to underline the semi-parametric nature of the model which does not require a particular assumption for the "time" variable, but requires the covariates to be parametric.

The mathematical formulation of the model is as follows

$$h(t) = h_0(t) \cdot e^{b1x1+b2x2+\cdots+bkxk} \qquad (1)$$

in which h(t) is the hazard function, the incidence rate of the event (estimated by the model) at time t; *h0(t)* is the baseline risk (i.e., the incidence rate of the event when the risk factor is absent); *x1, x2, …, xk are* covariates or risk factors *e b1, b2, …, bk* regression coefficients.

One of the most important outputs of the Cox model, obviously in addition to the coefficients of the covariates, is the Hazard Ratio (HR), coefficient of expansion or contraction of the risk corresponding to a unit increase of the k-th covariate. We consider the ratio between h(t) and H0(t). In very simple terms, the HR measures the relative risk of an event occurring at a generic time instant t. Nonetheless, it must be interpreted with great caution. An HR=2 does not mean that the event will occur faster, but it does mean that the risk is double the baseline.

$$\frac{h(t)}{h_0(t)} = e^{b1x1+b2x2+\cdots+bkxk} \qquad \begin{matrix} < 1 \; if \; bi < 0 \\ = 1 \; if \; bi = 0 \\ > 1 \; if \; bi > 0 \end{matrix} \qquad (2)$$

4. Results

The Cox model was applied to the LLEs and NLLEs as a function of the time variable measured in terms of months of life, as previously indicated,

contextually considering structural variables and economic indicators.

The main structural variables used are qualitative and related to the location of the firm, its size and the economic activity as defined in Tab. 3. Economic activity was also analysed in terms of more detailed classification by NACE section.

Table 3 – *Covariates: structural variables.*

Territory	North, Centre, Southern Italy
Size class of persons employed	1, 2 – 9, 10-49, 50-250, more than 250 employees
Economic activities	Industry, Construction, Trade, Other services

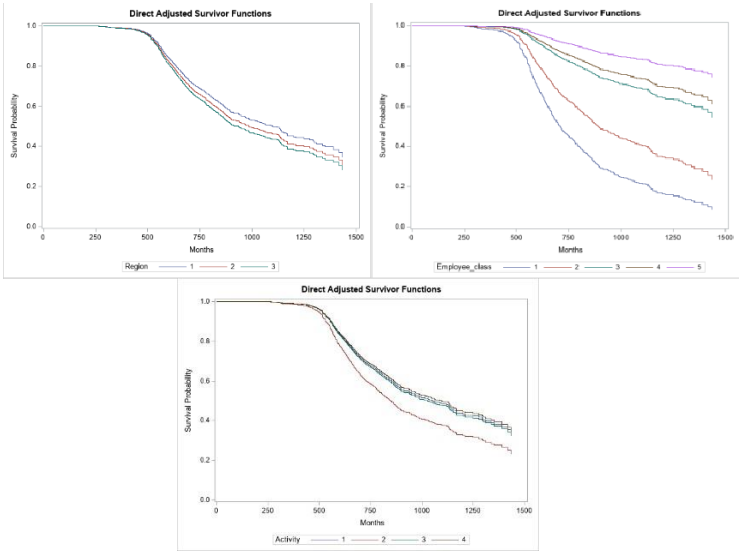
The main economic indicators are shown in Tab. 4 and aim to describe the company's productivity, profitability, propensity for international trade and cost structure. These indicators were standardized before being included in the model.

In the first case a model is proposed with only the covariates distribution, class of employees and macro-class of economic activity, in the second the economic activity has been broken down into NACE sections and in the last one only the quantitative variables have been included (Fig. 5) The survival of companies is certainly different between geographical divisions, companies in the North have by far a greater probability of survival than companies in the Centre and the South. The distance between the curves tends to increase with the age of the firm. In terms of size, the probability of survival is higher in companies with more employees and the distance between the curves increases significantly as the age of the firm increases. Among the economic activities we note an almost homogeneous trend between the curves except for the construction sector that records a lower probability of survival and whose gap widens in correspondence with the older companies compared to the other sectors.

Table 4 – *Covariates: economic indicators.*

Value added per employed	Value added/Employees
Personnel costs per employee	Wages and salaries/Employees
Export on revenue	Exports of goods/(Revenue from sale of goods and services+Others operative revenues)
Personnel cost on total cost	Personnel costs/ (Purchases of goods and services+Costs for use of third-party assets+Personnel costs+Other operative revenue)

Figure 5 – *Survivor functions by territory, size and economic activity.*



Elaborations on ISTAT data

Table 5 – *Parameter estimation, Cox regression first model.*

	Parameter estimate	Pr>ChiSquare	HR
Territory = North	-0.14434	<.0001	0.866
Territory = Centre	-0.00823	0.0001	0.992
Size class of persons employed = 1	1.94105	<.0001	6.966
Size class of persons employed = 2 – 9	1.41899	<.0001	4.133
Size class of persons employed = 10 – 49	0.82189	<.0001	2.275
Size class of persons employed = 50 – 250	0.51705	<.0001	1.677
Economic activities = Industry	0.08932	<.0001	1.093
Economic activities = Construction	0.43692	<.0001	1.548
Economic activities = Trade	0.22483	<.0001	1.252

Elaborations on ISTAT data.

The HR, proposed in Tab. 5, confirms the trend of the survival functions, since the higher the risk ratio, the lower the probability of survival. The value 1 can be considered as a boundary value as values lower than 1 indicate a positive relationship with the probability of survival, while values greater than 1 indicate a negative relationship with survival. Given the heterogeneity of the economic

activity we carried out an in-depth analysis of the companies classified according to the NACE economic activity. The highest probability of survival is recorded in sections L - real estate activities, Q - health and social assistance, B - extraction of minerals from quarries and mines and S - other service activities while the lowest probability of survival is found for businesses of sections N - rental, travel agencies and business support services, I - accommodation and restaurant service activities and J - information and communication services (Tab. 6).

Table 6 – *Parameter estimation, Cox regression second model.*

	Parameter estimate	Pr>ChiSquare	HR
Territory = North	-0.13583	<.0001	0.873
Territory = Centre	-0.00978	<.0001	0.99
Size class of persons employed = 1	2.09959	<.0001	8.163
Size class of persons employed = 2 – 9	1.51578	<.0001	4.553
Size class of persons employed = 10 – 49	0.87135	<.0001	2.39
Size class of persons employed = 50 – 250	0.5635	<.0001	1.757
Economic activities - B	-0.23552	<.0001	0.79
Economic activities – C	0.14092	<.0001	1.151
Economic activities – D	0.28577	<.0001	1.331
Economic activities - E	0.03128	0.1118	1.032
Economic activities - F	0.47546	<.0001	1.609
Economic activities - G	0.17071	<.0001	1.186
Economic activities - H	0.12863	<.0001	1.137
Economic activities - I	0.67311	<.0001	1.96
Economic activities - J	0.62333	<.0001	1.865
Economic activities - L	-0.43094	<.0001	0.65
Economic activities - M	0.01496	0.0003	1.015
Economic activities - N	0.73529	<.0001	2.086
Economic activities - P	0.5147	<.0001	1.673
Economic activities - Q	-0.25532	<.0001	0.775
Economic activities - R	0.45583	<.0001	1.577

Elaborations on ISTAT data.

In terms of economic indicators, the probability of survival increases significantly with the increase in average wages and less significantly with the increase in value added per employee and the propensity to export, while it decreases with the increase

of the weight of personnel costs on total costs (Tab. 7).

Table 7 – *Parameter estimation, Cox regression third model.*

	Parameter estimate	Pr>ChiSquare	HR
Value added per employed	-0.02832	<.0001	0.972
Personnel costs per employee	-0.30630	<.0001	0.736
Export on revenue	-0.08427	<.0001	0.919
Personnel cost on total cost	0.04221	<.0001	1.043

Elaborations on ISTAT data.

5. Conclusion

The results of this study have highlighted the possibility of building company diagnostic models on the basis of the SBS Frame data. Even in the absence of balance sheet data, the application of Cox-type regressive models has highlighted a particularly interesting forecast potential, especially due to the incomparable information capillarity in terms of "surveyed" companies represented by the frame.

In particular, it was possible to estimate how company longevity can be explained with the diagnostic model presented, highlighting how it can depend on variables such as the territory to which they belong, the number of employees, the sector of activity as well as a set of statistic balance sheet indices including the added value per employee, the average cost of personnel, the incidence of the value of exports on turnover, the incidence of personnel costs on total costs.Since there were no data prior to 2012, it was possible to estimate the average age of the company only as a proxy from the date of commencement and cessation of activity without taking into account any corporate "transformations" and the absence of financial information. Nevertheless this analysis, easily replicable for the future, can constitute a valid tool for entrepreneurs and public decision makers. We have also tried to outline the ideal characteristics of companies operating in the area and, conversely, the factors that need to be corrected for existing companies so that their continued operations can be facilitated. Finally, future research could enhance the diagnostic capacity that emerged by implementing the results with the identification of the cut-off levels to discriminate companies based on the probability of survival through the use of a ROC model that checks for first and second kind errors at the same time.

References

ALTMAN, E. I. 1968. *Financial ratios, discriminant analysis and the prediction of corporate bankruptcy*. The Journal of Finance, Vol. 23, No. 4, pp. 589-609.

BALCAEN, S., OOGHE, H. 2006. 35 years of studies on business failure: an overview of the classic statistical methodologies and their related problems. British Accounting Review, 38:63-93.

BEAVER, W. 1967. *Financial Ratio as Predictors of Failure, Empirical Research* in Accounting Selected Studies 1966. Journal of Accounting Research, 4, 71-111.

OHLSON, J. A. 1980. Financial ratios and the probabilistic prediction of bankruptcy. Journal of Accounting Research. 18(1), 109.131.

AA.VV. 2020, *Il trattamento delle fonti amministrative per la costruzione del sistema informativo sui risultati economici delle imprese italiane (Frame SBS),* Istat working paper n. 6

CASSIS Y. 1997. *Big Business. The European Experience in the Twentieth Century*. Oxford University Press

COX D.R. 1972. *Regression Models and Life Tables*. Journal of the Royal Statistical Society: Series B, 34, 187-220

DOSSENA G., Magno F. 2022. *Family firms' longevity: evidence from the italian experience*. Corporate Governance and Research & Development Studies, n. 1/22

Agata Maria Madia CARUCCI, Istat, carucci@istat.it
Roberto Antonello PALUMBO, Istat, palumbo@istat.it
Giovanni VANNELLA, Università degli Studi di Bari, giovanni.vannella@uniba.it