Impact of Sector and Region on Survival and Closure

Brajaballav Kar [1]
Piyusa Pritiparnna Das [2]

Abstract

The objective of the study was to explore the mortality of companies across sectors and regions in India. Using a public dataset available from the Ministry of Corporate Affairs of India, we explored the survival and closure age distribution of Indian companies, specifically the variation of closure across different sectors and regions. First, the study found that the age distribution of companies' surviving and closed had no significant difference. Secondly, the closure age distributions of different sectors and regions had significant differences. The number of companies and the span of ages is sufficiently large to claim the generalizability of the findings for India. The article contributes to the literature by extending the industry life cycle theory.

Keywords : **firm, age, survival, mortality, life cycle theory**

JEL Classification Codes : L00, L60, L70, L80, L90

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It is essential to understand the survival and mortality of firms in an economy. However, such literature is lacking in the Indian context. Though the age of surviving and closed firms is not investigated in extant research, few related concepts such as firm resiliency, survival, firm exist, sustainability, crisis, insolvency, bankruptcy, closure, and sickness have been investigated. The survival of firms is related to the policies of the regional government (Pole et al., 2014). Altman's *Z* score is a popular model to determine the bankruptcy of firms (Ahuja & Singhal, 2014; Chitta et al., 2019). The broad market conditions, such as a pandemic, also influence the survival of the firms (Narender & Kumar, 2021). It was also found that the textiles, apparel, and luxury goods sectors are more resistant to a financial crisis (Jain & Bothra, 2016). These studies have alluded to the reasons, but the exact age distributions have not been investigated.

Moreover, geographical factors contributing to firms' survival or closure have not been fully explored. Additionally, the existing research has not focused on small and medium enterprises (SMEs) that this study attempts to address. The differences of the closure age by sectors and regions of India are investigated and compared with the findings from other studies.

In the last few years, both the Central government and State governments in India have put a lot of effort into making India a center of in-house innovation and manufacturing. Therefore, a study focusing on the age distribution and differences across sectors and regions is expected to provide a different perspective on policy directions and investment decisions. Also, comparing the age distribution of survival and closure of companies will augment the industrial life cycle theory.

[1] *Associate Professor (Corresponding Author),* School of Management, KIIT Deemed to be University, Patia - 751 024, Bhubaneshwar, Odisha. (Email : brajkar@gmail.com) ; ORCID iD : https://orcid.org/0000-0002-2127-1147
[2] *Assistant Professor, Marketing,* School of Management, KIIT Deemed to be University, Patia - 751 024, Bhubaneshwar, Odisha. (Email : piyusa.das@ksom.ac.in) ; ORCID iD : https://orcid.org/0000-0002-7027-9452

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The main objectives of our study are to compare and contrast the age distribution of surviving and closed companies and find regional and sectoral differences in the age distribution for company closure. The novelty of this research hinges on attempting to explain survival or closure based on age distribution, large data sets, and the focus on SMEs.

Literature Review

Dimensions of Closure of Companies

All companies start with the intent to operate indefinitely (going concern). However, a significant number of companies fail to do so. As there are multiple dimensions (operations, ownership, solvency) to the concept of firms' survival and failure, a better approach is to consider survival as a continuation of the firm in any single dimension (Josefy et al., 2017).

As of July 2019, 683,317 companies shut in India out of a total of 1,894,146 companies registered under the Registrar of Companies ("Over 6.8 lakh Indian companies," 2019). A firm can cease to exist in many ways. Mergers, acquisitions, and amalgamations create a new entity by subsuming one entity. As per the Limited Liability Partnership Act 2008, a private or unlisted public company can be converted to a limited liability partnership firm, causing the entity's closure. Similarly, striking-off or winding-up is how the companies can be dissolved as per the Indian Companies Act, 1956 (Ministry of Corporate Affairs, n.d.b). The Indian Companies Act, 2013 also has a provision of declaring a company without significant accounting transactions as dormant or inactive (Ministry of Corporate Affairs, n.d.a). These legal provisions and processes indicate the complexities of the age of the companies and may vary from country to country. A study considered the delisting from the exchanges as cessation and found a rise in mortality over the last 50 years independent of size, sector, and age (Reeves et al., 2016).

Factors Affecting Closure of Companies

External and internal factors can be responsible for a company's closure (Aguilar Rascón & Velázquez, 2019). Several studies have linked fundamental factors with firms' survival rates. Policymakers should focus on neo-natal policies as founding conditions (firm size, human capital, entry rates, and GDP growth) that significantly impact survival rates (Geroski et al., 2009). Location parameters impact business firm survival rates (Manzato et al., 2011). Older firms have fewer failure rates (Sonmez, 2013). During the young phase, a firm's age is negatively correlated with hazard rates (Esteve-Pérez et al., 2018). The hazard rate has a shape of 'U' with the life cycle of firms, and there are at least two spans of time where the hazard rate decreases (Agarwal & Gort, 2002). The publicly traded companies were indicated to have constant hazard rates independent of age, and the half-life of publicly traded companies was predicted to be a decade (Daepp et al., 2015). Similarly, the argument that the hazard rate increases with size during the economic downturn does not consider age (Amorim Varum & Rocha, 2012).

Apart from the firm performance factors, various other factors influence the firm life cycle. Operational efficiencies were found to have positive relations with age (Kar & Jena, 2019). The dormancy or shutdown can be due to lack of profitability, access to technology, and tax avoidance (Tandon, 2016). The life span also has been related to the lack of differentiation in a commodity sector (Blitz, 2018); insider succession after a long tenure of the founder (Ahn, 2018); if the firm is doing something socially good (Roh, 2015); and involved with the corporate political activity (CPA) (Rudy & Johnson, 2017).

The survival probability is different in the case of for-profit and social ventures (Simón-Moya et al., 2012). In

an interesting study from China, it was suggested that *guanxi* (financial and moral effort to build a reciprocal social relationship) helps in the long-term survival of small firms (Carlisle & Flynn, 2005). A study conducted in the Ivory Coast (Africa) postulated that an increase in GDP growth rate improved the survival probability of firms (Klapper & Richmond, 2011). In a Netherlands-based study, the evidence was that technological innovations by companies, in the first two years of establishment, boosted the company's long-term survival (Cefis & Marsili, 2019).

A study recommended integrating temporal effects and locational effects as need of the hour for future research (Wang, 2017). At the same time, oversimplification of reality by using life cycle models was also expressed as a caveat (Rieckhof, 2017). This study focuses on the survival and closure of companies across regions (states) and sectors in the Indian context. Understanding the sectoral and regional differences in the closure of companies will help entrepreneurs, investors, and policymakers in the region and sector-specific businesses and policy decisions.

Methodology and Data Sources

The Ministry of Corporate Affairs (MCA) regularly publishes data on the survival of companies as on a specific year and the registration date of the companies. The age of the surviving companies was calculated from their registration date till the year 2015. The closure data file reported the following information: company identification number, name, class (public/ private), status (active/ amalgamated/ dissolved/ strike off), type (non-government/government), date of registration and closure, listed (listed/ unlisted in stock exchange), company indicator (Indian), state of registration and location of ROC, 5-digit industrial classification code, and description.

In our study, we have used the data published on the Ministry of Corporate Affairs (MCA) website regarding the registration and closure of companies. Data cleaning and recoding were done after downloading the data. Afterward, the following exploratory and hypothesis analysis was carried out using Microsoft Excel and SPSS 25.0 :

- Age distribution for closure curve was plotted and compared with the age distribution of survival of companies.
- The chi-square test was utilized to understand the relationship between company ownership type (public vs. private) and closure type (amalgamation, dissolved, strike off).
- After suitable data transformation, Welch's test for unequal variances was utilized to test the following hypotheses :
- **H01 :** There is no significant difference in average years to close across regions.
- **H02 :** There is no significant difference in average years to close across sectors.
- Dunnett's C test was carried out to understand the significant sectoral and regional differences for companies' age distribution of closure.

Analysis and Results

Broad Analysis of Survival and Closure

Table 1 indicates the descriptive statistics of the age distribution of companies by survival and closure calculated by the year 2015.

Table 1. ***Descriptive Statistics of the Ages in Years by Survival and Closure***

	Survived	Closed
N	993,953	1,850
Mean	10.6	9.1
Median	7.0	6.4
Mode	3.0	3.3
Std. Dev	12.2	8.6
Minimum	1.0	0.2
Maximum	115	82.5

Figure 1. ***Age-Specific Survival Ratio (Percent Survived/ Closed)***

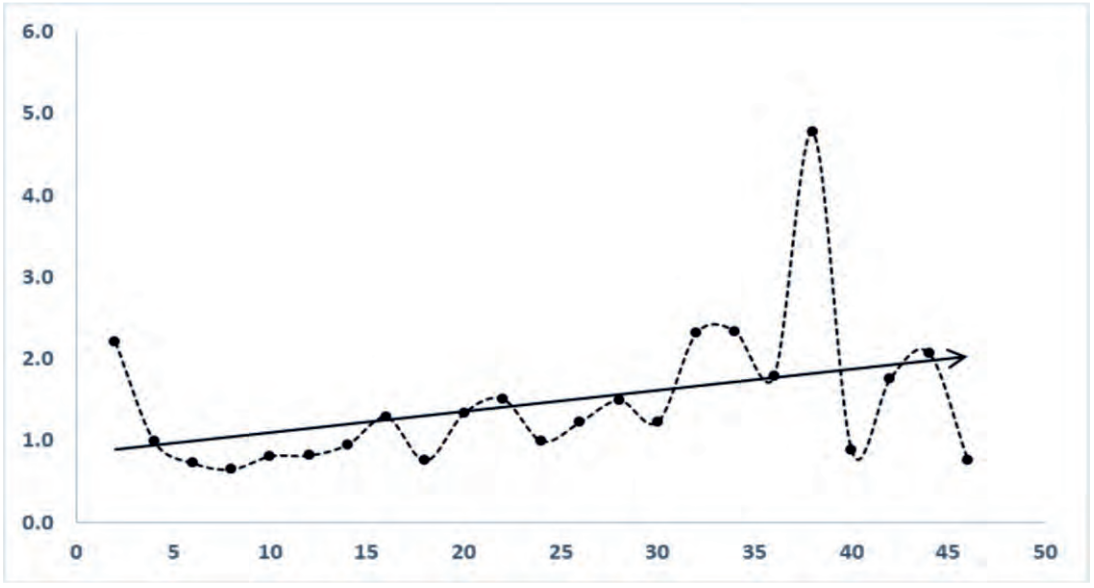
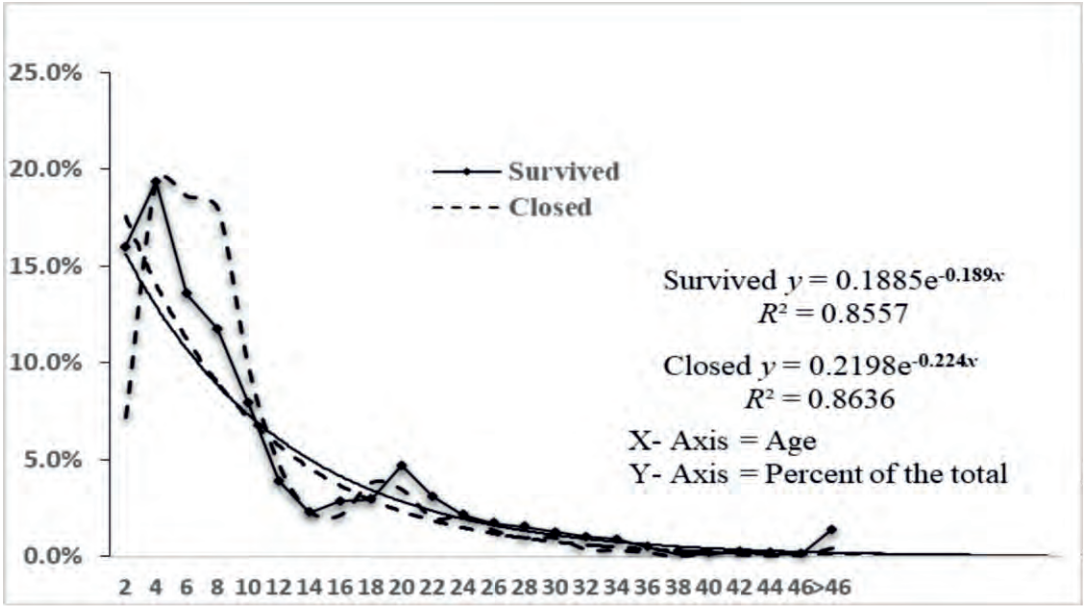


Table 1 indicates a right-tailed distribution for both survival and closure. The mean survival age is higher than the mean age of closure. The Mann-Whitney test was conducted as the test does not demand normality of distribution as a precondition. The independent samples Mann-Whitney *U* test indicates that age distribution across categories of survived and closed companies has no significant difference ($p > .05$).

The age-specific survival ratio (survived/closed) is plotted in Figure 1, which indicates that the survival ratio increases with age. Thus, the higher the age, the better is the survival rate. However, there are some degrees of fluctuations across different ages.

Figure 1 indicates that the ratio remains below one from 6 – 12 years. Again, the ratio drops below one at 18, 40, and 46 years of age. The graph (Figure 1) indicates a cyclicality to the ratio. The analysis can be related to the liability of newness, the liability of adolescence, the *U* shape of the hazard function, and the variation of hazard rate over the life span discussed in the literature review section. The detailed distribution and an exponential curve fit are shown in Figure 2.

Figure 2. ***Age Distribution of Survived and Closed Companies***



The detailed graph indicates that the survival is higher within 4 years of age, but from 6 – 12 years of age, the distribution for closure falls steeper compared to survival. Exponential curve fit for survival ($R^2 = 0.86$, coefficient = 0.19, and exponent = –.189) and for closure ($R^2 = 0.86$, coefficient = 0.22, and exponent = –.224) are found to be satisfactory. The age curve for the survived intersects the age curve of closed companies at age 8, after which the distribution of survived remains at a higher level. Overall, the fall in the closure age distribution is steeper than the fall in the age distribution for the survived companies.

Analysis Based on Closure Data

This section analyzes the closure data concerning geography and sectors. The data indicate that all the companies were non-government and Indian companies. Only two companies in the data set of closed companies were listed on the stock exchange. Maharashtra has two Registrar of Companies offices in Pune and Mumbai. Similarly, Tamil Nadu also has two offices in Chennai and Coimbatore. The RoC office of Chandigarh caters to Punjab and Chandigarh; whereas, the RoC in Delhi caters to Haryana and Delhi.

The closure type and ownership type is given in Table 2, which indicates a significant relationship between the ownership type and type of closure ($p < 0.05$).

Table 2. ***Ownership Type and Closure Type***

	Amalgamated	Dissolved and Others	Strike Off	Total	Chi-Square Test
Private	182	9	1,564	1,755 (94.9%)	Pearson Chi-Square = 39.019,
Public	24	4	67	95 (5.1%)	*df* = 2, *p* =.000
Total	206 (1.1%)	13 (0.7%)	1,631 (88.2%)	1,850 (100%)	

Table 3 gives the average years for closure by region. Table 3 indicates that the Northern region has the lowest average years for closure, with the second-highest number of companies closed. The Western region has the highest number of companies and second-highest average years for closure. The Eastern and Southern companies have a higher average number of years for closure.

Two-digit recoding of the five-digit industrial classification code was done at the first stage. Then, a second level grouping was done based on similarity to get limited but meaningful sector groups (Central Statistical Organization, 2008). Table 4 presents the 19 sectors and their descriptive characteristics.

It is interesting to note that finance and insurance companies have the longest life span. On the other hand, the companies belonging to the services, hotel and restaurant, construction, business services, manufacturing of food and beverages, mining, ITES, education, and real estate reported less than the total average number of years to

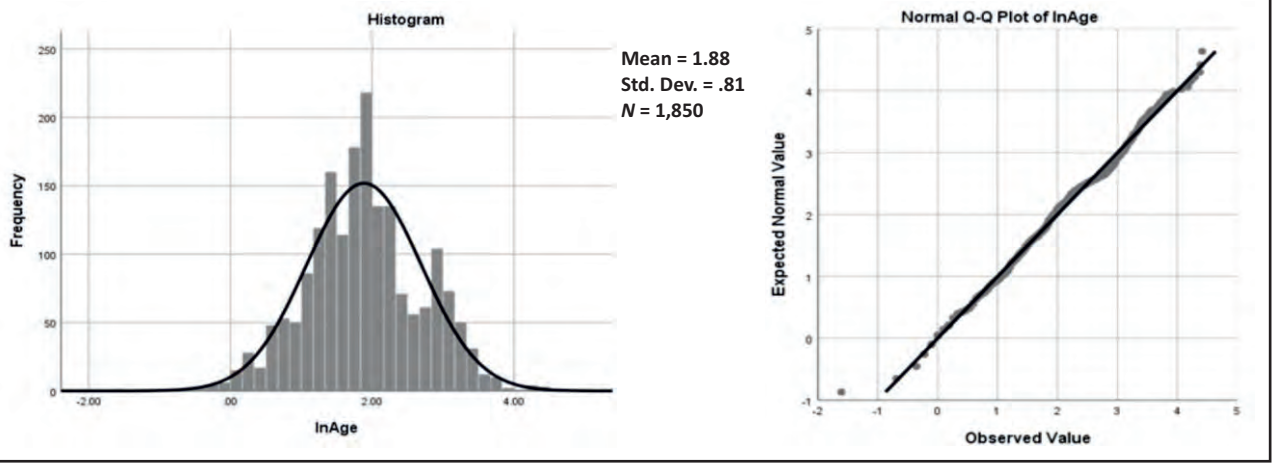
Table 3. ***Average Years for Closure by Region***

Region	Registered State	Number	Mean	Median	Std. Dev	Skewness
Central	Chhattisgarh	27	7.7	6.7	5.9	2.4
	Madhya Pradesh	105	7.8	6.2	5.3	1.6
	Central Total	132	7.8	6.3	5.4	1.8
East	Odisha	3	6.1	4.9	5.2	1
	Tripura	1	3.3	3.3		
	West Bengal	265	11.9	7.0	11.6	2.9
	East Total	269	11.8	6.8	11.6	2.9
North	Chandigarh	40	8.3	4.4	7.5	1.2
	Delhi	348	7.8	6.0	6.2	1.7
	Haryana	33	6	3.7	6.3	2
	Himachal Pradesh	14	17	16.8	5.4	0.7
	Jammu and Kashmir	10	5.9	5.9	1.9	–0.8
	Punjab	37	7.6	5.5	7.7	1.9
	Uttar Pradesh	33	7.3	3.8	11.6	4.2
	Uttarakhand	19	6.4	5.6	3.3	1.1
	North Total	534	7.8	5.7	6.9	2.4
South	Karnataka	60	8.5	5.9	7.3	1.8
	Kerala	42	7.1	6.1	5.4	2
	Pondicherry	7	8.5	6.5	5.4	0.8
	Tamil Nadu	148	11.6	6.9	12.5	2.8
	Telangana	1	19.3	19.3		
	South Total	258	10.1	6.6	10.5	3.1
West	Goa	29	8.2	7.3	5.1	2
	Gujarat	127	11.1	6.8	9.3	0.9
	Maharashtra	443	8.8	6.6	7.5	2.3
	Rajasthan	58	6.1	4.4	5.4	1.8
	West Total	657	9.0	6.4	7.7	1.9
Grand Total		**1,850**	**9.1**	**6.4**	**8.6**	**2.9**

Table 4. ***Average Years for Closure by Sector***

Sector	*N*	Mean	Median	*SD*	Skewness
Agriculture	71	10.3	8.1	7.2	1.2
Business Services	268	8	5.7	7.2	1.7
Construction	150	8.3	6.8	5.6	1.6
Education and R&D	37	6.6	5.4	4.6	1.1
Finance and Insurance	84	15.4	16.0	11.2	2.3
Health	49	10.3	7.2	8.8	1.1
Hotel and Restaurant	50	8.4	7.2	6.3	2.3
Manufacturing (Mfg)	65	10.7	5.6	11.2	2.4
Mfg. Chemical	57	11.2	7.3	9.6	1.4
Mfg. Food & Beverages	37	7.4	4.7	7.1	1.5
Mfg. Machines	87	10.2	7.9	7.7	1.4
Mfg. Metals and non-Metals	42	15	10.8	13.2	1.3
Mfg. Textiles	60	10.4	7.4	8.2	0.8
Mining	28	7.1	5.3	6.2	1.9
Real Estate	142	6	4.1	6.6	5.7
Services (Serv.)	137	8.8	5.8	8.8	3
Serv. ITES	172	6.7	6.1	4.5	2.3
Serv. Trading	255	10	6.8	10.2	3.6
Serv. Transportation	59	10.5	6.3	12.6	3.6
Total	**1,850**	**9.1**	**6.4**	**8.6**	**2.9**

Figure 3. ***Logarithm Transformation of Age and Normality Test Graphs***



close. On the contrary, companies in manufacturing in general, finance and insurance, transportation, agriculture, health, and trading sectors have higher than the average number of years to close.

Tables 3 and 4 raise questions about regional peculiarities or sector specificity in the average age of closure. For example, if there are some implications of region or sector, are some pairs significantly different?

Table 5. ***Test of Homogeneity of Variance by Sector and Region on the Log of Years***

		Levene Statistic	*df1*	*df2*	Sig.
Test of Homogeneity of Variance by Sector					
Log of Years	Based on mean	4.432	18	1831	.000
	Based on median	4.094	18	1831	.000
	Based on median and with adjusted *df*	4.094	18	1705.561	.000
	Based on trimmed mean	4.352	18	1831	.000
Test of Homogeneity of Variance by Region					
Log of Years	Based on mean	2.804	4	1845	.025
	Based on median	2.958	4	1845	.019
	Based on median and with adjusted *df*	2.958	4	1805.519	.019
	Based on trimmed mean	2.823	4	1845	.024

Since the age distribution for closure data is not normal, the normality was tested after logarithm transformation. The tests of normality (Kolmogorov-Smirnov statistic = 0.046, *df* = 1,850, *p* = .000 and Shapiro-Wilk statistic = 0.994, *df* = 1850, *p* = .000) indicate that the distribution is not normal. However, the histogram and Q-Q plot show a near-normal distribution (Figure 3).

Levene's test of homogeneity of variances by sector and region is also tested on the log transformation of years for closure by region and sector.

Table 5 indicates that the variances by sector and region are significantly ($p < .05$) different. The age for closure data and its logarithmic transformation do not conform to the requirements of ANOVA for normality and equality of variances. However, the logarithmic transformation is close to normal. Thus, Welch's test for unequal variances is considered.

The four statistics used to compare the means under heteroscedasticity are the ANOVA *F*-statistics, a modified *F* (with an altered denominator), Welch statistics, and James statistics. It is indicated that the Welch statistic is a better approximation for small sample sizes, and Welch's statistic is robust under the inequality of variances (Brown & Forsythe, 1974). However, there is a chance of an inflated Type I error if the distribution is simultaneously non-normal, the variance is heterogeneous, and the group size is unequal; the error is inflated as the power of the test improves (Ahad & Yahaya, 2014). In this scenario, the Welch test is preferred to the classic ANOVA. Similarly, for the posthoc test, we use Dunnett's C test rather than the Games-Howell test as the former test has better power of test than the latter (Lee & Lee, 2018).

Regional Variation in Survival Years of Companies

The state of registration data was used to group the companies into North, South, West, East, and Central regions of India. The grouping reduces the number of comparisons substantially necessary across states; secondly, the registration state may not be the exact operation state. The region is more or less similar and more indicative of the operational span of companies. Spatial distribution or clusters indicate regional competitiveness, and it influences the creation of new ventures but decreases a place's ability to ensure sustainability (Wang et al., 2018). Hence, the region is taken as a factor of the number of years for closure (log-transformed). The ANOVA results indicate significant variation [$F(4, 1845) = 11.972$, $p = 0.000$] among the regions. The robustness for equality of means (Welch's test) is also tested, which indicates a significant (Welch Statistic 12.573, $p < 0.05$) variance among the regions. Hence, H01 (no significant difference in average years to close across regions) is rejected.

Table 6. *Multiple Comparison Test for the Region (Dunnett's C)*

Multiple Comparisons

Dependent Variable : Log of number years for closure

Dunnett C

(*I*) Region_f	(*J*) Region_f	Mean Difference (*I*–*J*)	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Central	East	–.13219*	.03157	–.2193	–.0451
	North	.04452	.02836	–.0337	.1227
	South	–.04305	.03338	–.1351	.0490
	West	–.01328	.02784	–.0901	.0635
East	Center	.13219*	.03157	.0451	.2193
	North	.17671*	.02534	.1072	.2462
	South	.08914*	.03085	.0044	.1739
	West	.11891*	.02476	.0510	.1868
North	Center	–.04452	.02836	–.1227	.0337
	East	–.17671*	.02534	–.2462	–.1072
	South	–.08757*	.02756	–.1632	–.0119
	West	–.05780*	.02051	–.1139	–.0017
South	Center	.04305	.03338	–.0490	.1351
	East	–.08914*	.03085	–.1739	–.0044
	North	.08757*	.02756	.0119	.1632
	West	.02977	.02703	–.0444	.1039
West	Center	.01328	.02784	–.0635	.0901
	East	–.11891*	.02476	–.1868	–.0510
	North	.05780*	.02051	.0017	.1139
	South	–.02977	.02703	–.1039	.0444

Note. *. The mean difference is significant at the 0.05 level.

Dunnett's C test was carried out to compare all possible group pairings to understand the significant region-wise difference in survival years (Table 6).

Table 6 indicates that the Central region has a significant pairwise difference with the Eastern region. The Northern region has a significant pairwise difference with the Eastern, Southern, and Western regions. The Southern region has a significant pairwise difference with the Eastern and Northern regions. The Western region has a significant pairwise difference with the Eastern and Northern regions. The Eastern region has a significant pairwise difference with all the other four regions.

Sectoral Variation in Survival Years of Companies

In the analysis, we have considered 19 sectors defined in the dataset, considering the sector as a factor and survival years (log-transformed dataset) as metric variables. The ANOVA test with the sector as the dependent factor and log of years for closure as an independent factor indicate significant variation among the sectors

[$F(18, 1831) = 7.456, p = 0.000$]. In addition, the robustness test (Welch's test) for equality of means also indicates significant (Welch Statistic 12.573, $p < 0.05$) variation. Hence, H02 (no significant difference in average years to close across sectors) is rejected.

Dunnett's C test was conducted to compare all possible group pairings to understand the significant sector-wise difference in survival years. As a result, only the significant ($p < 0.05$) pairwise differences have been shown in Table 7.

Table 7. ***Multiple Comparison Test (Dunnett's C)***

Dependent Variable: Log of Number of Years to Close

Dunnett C

(*I*) Sector_f	**(*J*) Sector_f**	**Mean Difference (*I*–*J*)**	**Std. Error**	**95% Confidence Interval**	
Agriculture	Real Estate	.25222*	.04699	.0816	.4229
Business Services	Finance/ Insurance	–.30590*	.04508	–.4688	–.1430
	Mfg. Metals & Non- Metals	–.24912*	.06565	–.4940	–.0043
Construction	Finance/ Insurance	–.22464*	.04521	–.3883	–.0610
	Real Estate	.19136*	.03414	.0690	.3137
Education/ R&D	Finance/ Insurance	–.34505*	.06562	–.5897	–.1004
Finance/ Insurance	Business Services	.30590*	.04508	.1430	.4688
	Construction	.22464*	.04521	.0610	.3883
	Education/ R&D	.34505*	.06562	.1004	.5897
	Hotel/ Restaurant	.23004*	.05535	.0269	.4332
	Mfg. Food & Beverages	.37982*	.07771	.0888	.6708
	Mining	.33336*	.07220	.0589	.6078
	Real Estate	.41600*	.04764	.2437	.5883
	Services	.25114*	.04806	.0773	.4250
	ITES Services	.32232*	.04524	.1586	.4860
	Trading	.20565*	.04500	.0430	.3683
Hotel/ Restaurant	Finance/ Insurance	–.23004*	.05535	–.4332	–.0269
	Real Estate	.18596*	.04674	.0143	.3576
Mfg. Chemical	Real Estate	.24240*	.05786	.0303	.4546
Mfg. Food & Beverages	Finance/ Insurance	–.37982*	.07771	–.6708	–.0888
Mfg. Machines	Real Estate	.23808*	.04568	.0730	.4031
Mfg. Metals & Non-Metals	Business Services	.24912*	.06565	.0043	.4940
	Real Estate	.35922*	.06743	.1080	.6104
	ITES Services	.26554*	.06576	.0201	.5109
Mining	Finance/ Insurance	–.33336*	.07220	–.6078	–.0589
Real Estate	Agriculture	–.25222*	.04699	–.4229	–.0816
	Construction	–.19136*	.03414	–.3137	–.0690
	Finance/ Insurance	–.41600*	.04764	–.5883	–.2437
	Hotel/ Restaurant	–.18596*	.04674	–.3576	–.0143
	Mfg. Chemicals	–.24240*	.05786	–.4546	–.0303

	Mfg. Machines	–.23808*	.04568	–.4031	–.0730
	Mfg. Metals & Non Metals	–.35922*	.06743	–.6104	–.1080
	Services	–.16486*	.03783	–.3005	–.0292
	Trading	–.21035*	.03386	–.3313	–.0894
	Transportation	–.19897*	.05405	–.3967	–.0012
Services	Finance/ Insurance	–.25114*	.04806	–.4250	–.0773
	Real Estate	.16486*	.03783	.0292	.3005
ITES Services	Finance/ Insurance	–.32232*	.04524	–.4860	–.1586
	Mfg. Metals & Non Metals	–.26554*	.06576	–.5109	–.0201
	Trading	–.11667*	.03039	–.2250	–.0084
Trading	Finance/ Insurance	–.20565*	.04500	–.3683	–.0430
	Real Estate	.21035*	.03386	.0894	.3313
	ITES Services	.11667*	.03039	.0084	.2250
Transportation	Real Estate	.19897*	.05405	.0012	.3967

Note. *. The mean difference is significant at the 0.05 level.

Manufacturing in general, health, and textile manufacturing are the three sectors that do not have any significant pairwise difference with any other sectors. As shown above, the balance 16 sectors have significant pairwise differences in means with one or more sectors.

Discussion

We find the highest percentage of the age distribution for closure at age four. It can be contrasted to the finding that the age-specific mortality rates of firms initially increase, peaking at age three, and then decrease with age, implying that the first 3 years of public life are critical and financial intermediaries help to reduce such mortality rates through natal financial care and selection (Bhattacharya et al., 2015). Such an increase confirms Stinchcombe's 'liability of newness' proposition. The age distribution for closure has local minima at age 15 and local maxima at age 18; the survival age data indicates local minima at age 14 and local maxima at age 20. The difference indicates lead and lag between the local minima and maxima for the age of survived and closed companies.

The age distribution curve (Figure 2) captures the impact of economic historicity. The survival to closure ratio (Figure 1) also reflects business or economic cycle changes. The finding is consistent with the earlier finding that GDP growth significantly impacts survival rates (Geroski et al., 2009).

The central tendency of an exponential distribution is better indicated by the median. The median age of surviving companies is 7.0 years, compared to the median of 6.4 years for closed companies. It can be noted here that the median age of the companies listed on the Bombay Stock Exchange was calculated to be 30 (Kar & Jena, 2019). There were significant differences among the number of years for closure by sectors and the regions in India. The median years for closure for companies by sectors were in the range of 5.7 years to 6.8 years; whereas, the median years for closure for companies by regions were 3.7 years to 16.8 years. The median years for closure may be compared with the levels of industrialization in various states.

The exponential curve fit is suggested in the literature for the age distribution and has been used in a few prior studies (Kar, 2016, 2018; Kar & Jena, 2017). The exponential curve generalizes the distribution by removing the variations. The curve fit explains around 86% of the observed values ($R^2 = 0.86$). The closure curve remains higher

than the survived curve up to the age of 8 and falls below afterward, suggesting the survival to be consistently higher after the age of 8. The figure supports the decrease of failure over time for older firms (Loderer et al., 2009; Sonmez, 2013). In addition, the negative correlation between age and hazard rate is supported (Esteve-Pérez et al., 2018).

This research rejects both the null hypotheses of the age of closure being equal by sector or region in India, and the results are significant. Reeves et al. (2016) indicated that the mortality is independent of sectors, and the conclusion does not find support in this study. However, the conclusion supports the finding that the location parameters influence survival rates (Manzato et al., 2011). Similarly, the constant hazard rate inference of Daepp et al. (2015) for listed companies can be contrasted to our findings for primarily unlisted companies.

Implications

Entrepreneurs or business persons can use the findings of this research to narrow down their regions and sectors based on the number of years for closure. The data can act as an additional input for entrepreneurial decision-making. Secondly, the age distribution data can help policymaking as an input to pare off inter-regional or sector differences. The number of years for closure can be used to understand and re-plan the industry growth based on sectors to improve business survival. Thirdly, institutional lenders and investors can use the findings for their decision-making.

This paper contributes to the industry life cycle theory in several ways. First, the number of companies and the age range is substantially large to claim generalizability. The method to assess survival or closure based on age distribution is substantive and straightforward to explain the country's historicity of broad economic conditions. In addition, this research reports on 19 different sectors compared to a few or sector-specific analyses of earlier research. The study shows a significant difference in the age of survived and closed companies based on the region and sector of SMEs in the Indian context.

Limitations of the Study and the Way Forward

It is indicated that any demographic analysis such as the mortality curve should include firm-specific dimensions such as firm size, location, and economic activity (Van Wissen, 2002). However, the lack of data availability limited the analysis beyond sectors. Secondly, the report captures the closure on a particular age than the number of companies surviving at a given point and their subsequent closures to estimate the age-wise hazard function.

Future studies based on the listed companies, age-specific causes of death, and association of various business parameters with different age cohorts in a specific sector will build a comprehensive understanding. A periodic assessment of the companies' survival age or closure age can indicate the change in the median age, thereby influencing the policy need for a particular sector or region.

The time of the registration and closure of the companies may not indicate the actual birth or death. For example, an operational entity may be registered later, or a registered entity may become operational later. Thus, the operational beginning or closure may differ from the reported start or closure. The time can be considered as a pre-start or pre-closure period. In this sense, the exact life period of a company may be debatable. Research is necessary to indicate the duration of such periods.

Authors' Contribution

Dr. Brajaballav Kar conceptualized the idea and collected the data for the study. Piyusa Pritiparnna Das carried out

data cleaning and analysis as per the study requirements. Next, Dr. Brajaballav Kar verified the analytical methods and wrote the manuscript in consultation with Prof. Das. Finally, Piyusa Pritiparnna Das proofread and edited the manuscript.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

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About the Authors

Dr. Brajaballav Kar is an Associate Professor of Production and Operations Management at the School of Management, KIIT University. His corporate experience includes production, enterprise application design, implementation, and support. He takes up consulting engagements, training, and doctoral research projects in the areas of entrepreneurship, healthcare, and supply chain management. He is a life member of The Institution of Engineers of India, Operational Research Society of India, and the Indian Commerce Association.

Prof. Piyusa Pritiparnna Das has 10 years of experience in global program management, strategic marketing & research, business development, and project procurement. Some of his research interest areas are technology adoption/impact in marketing research and consumer behavior and VoC for new product development.