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Firm Survival In India: Impact Of Financial Constraints

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Abstract:
The paper examines firm survival in India by considering financial constraints as a key determinant. In this study, the Cox Proportional Hazard Model is applied to study the impact of financial constraints on firm survival. The data is collected for firms in the Indian manufacturing sector on various dimensions for the time 2000-2018. This study established that 27.6% of firms or 887 firms did not survive during the observation period. At the same time, the risk of failure greatly differs among the region groups and sectors. Furthermore, the survival analysis results reveal that financially constrained firms cannot survive and this effect is consistent across region groups. As a robustness check, alternative parametric survival analysis models are also estimated and their results are quite similar to those estimated through the Cox model. Our results suggest that improving financial health will play a strong role in preventing firm failure.

Keywords: Firm Survival, Financial Constraints, Cox Proportional hazard model, Survival Analysis

INTRODUCTION

Most firms aspire to keep up for long, but only some can manage to survive more than a few years. Firm durability is a clear indicator of its success (Villajos et al.,2018). It is not surprising that firm survival garnered the attention of various scholars a long time ago. Among the variety of factors, the influence of financial constraints on firm survival is a prominent one.

Financial constraints play an important role in numerous aspects of firm dynamics, as they determine investment in fixed capital, research and development, inventories, the ability to enter or survive in a market, internationalization pattern, job creation, and destruction (Bridges and Guariglia, 2008; Bottazzi et al.,2014). Since the late 1980s, a large number of studies have tried to address the issue of financial constraints, mainly to study the relationship between financial development and growth both cross-country and cross-industry (for instance; Beck et al., 2005; Aghion et al.,2007) but very little is known at the microeconomic level of the firm. Financial constraints can impact the firm survival by interfering with the market mechanism and therefore, make it difficult for firms to survive in a competing market environment (Musso and Schiavo,2008).

In India, a restricted and regulated regime was followed till the late 1980s. Various economic reforms were introduced to overcome this crisis and liberalization measures were implemented in various sectors (Padmaja and Sasidharan,2021), but the share of the manufacturing sector in Gross Domestic Product (GDP) was sluggish even after reforms (Bhattacharjee and Chakrabarti,2013). The presence of financial constraints in the Indian manufacturing sector was identified as a key reason for impending growth by various studies (for instance;

Bhattacharjee and Chakrabarti,2013; Khanna,1999; Nagaraj,2005). One of the most visible threats posed by lack of finance is the closure of firms and the resulting employment loss in the economy. From an economic perspective, it becomes important to understand the link between the financial health of a firm and its survival. Thus, financial constraints need to be looked at from a holistic perspective. However, in the context of India, the influence of financial constraints on firm survival has not received much attention. Our study period (2000-2018) chosen for the analysis covers the period following the post-liberalization episode.

The purpose of this paper is to provide, for the first time a systematic analysis of the impact of financial constraints on firm survival after the introduction of reforms in the 1990s by controlling for firm-specific factors. The motive of this research stems from two important considerations. First, the share of the manufacturing sector in GDP has remained stagnant over the years. Second, the presence of financial constraints can increase the risk of firm failure, therefore making firm survival study very relevant.

To this end, we analyze the survival prospects of 3206 Indian manufacturing firms both region-wise and sector-wise. Using detailed firm-level data obtained from the PROWESS database provided by the Centre for Monitoring Indian Economy (CMIE) for the period 2000-2018, we add to the growing body of literature on financial constraints and firm survival in the following ways. First, we analyze firm survival in an under-researched economy i.e., India, where firm survival is an important issue. Secondly, we consider the direct effect of financial constraints on firm survival in addition to firm-specific variables previously considered (i.e., age, size, innovation, and productivity), measured by building a synthetic index instead of using a single variable as there is a limitation on how much a single variable can explain. Thirdly, we estimate firm survival in regional groups and different sectors and we also attempt to assess whether there is an influence of financial constraints on firm survival or not both region-wise and sector-wise.

The remainder of the paper is laid out as follows. Section 2 illustrates the theoretical background of the study. In Section 3, we present the data, introduce the measure of financial constraints, a description of the functionality of other variables, and the methodology adopted. In Section 4 we present we provide summary statistics and empirical evidence. Section 5 concludes the paper.

THEORETICAL LITERATURE

Several studies have tried to determine the factors that contribute to the increase in survival at the firm level, firm age, and size **(**Evans,1987; Hall,1987; Cefis and Marsili,2005; Perez et al.,2018**)**. Further research began by considering other factors as well.

Firm Survival is influenced by several other factors such as the productivity of a firm (Jovanoic,1982; Hopenhayn,1992; Farinaz and Ruano, 2005; Frazer,2005; Wagner,2010; Perez et al., 2018), the firm's innovation intensity (Audrestch,1991**;** Caves,1998; Perez et al.,2004; Helmers and Rogers,2010; Zhang et al.,2018; Ugur and Vivarelli,2021), sector's technological intensity (Audrestch,1995; Aghion et al.,2007), firms' pre-entry experience (Klepper,2002; Thompson,2005; Dencker et al.,2009), as well as founder's experience (Delmar and Shane,2006; DeTienne and Cardon,2012; Honore,2022).

In addition to this, recently, mounting literature began to shed light on how financial constraints may influence the likelihood of firm survival. Financial constraints have been studied in the literature and have been found to play an important role in the understanding of firm aspects such as a firm's investment in R&D, fixed investments, etc (for instance; Bond et al., 2005; Tiwari et al., 2008; Cincera and Ravet, 2010; Brown et al., 2012; Bayratkar,2014; Ding et al.,2022).

Financial constraints can have adverse effects on the firm's ability to grow and sustain in the market (Musso and Sachiavo,2008). For instance, Holtz et al., (1994) found that liquidity constraints have an impact on the survival of entrepreneurial enterprises. Cowling and Mitchell (2003) displayed in their study cost of financing has an impact on business failure and that failure probability increases with the cost of capital of banks. Farinha (2005) in their study found that the probability of survival for small and financially constrained firms was significantly lower. Musso and Schiavo (2008) found that barriers to financing lowered the probability of survival of firms. Bridges & Guariglia (2008) found that the firms that were purely domestic and faced financial constraints faced problems in their survival. Bottazi et al. (2014) in their study found that financial constraints undermined the average firm growth. A recent study by Zhang (2020) also shows that financial constraints influence firm survival.

Financial constraints lower the survival prospects of firms. Since firms in India are facing financial constraints, India being one the fastest growing economies presents a unique setting for testing the relationship between financial constraints and firm survival. However, in the context of India, various researchers have tried to understand the impact of financial constraints on firm productivity (Bloom,2010), investment pattern & and outward orientation (Kumar,2002) investment in R&D (Sashiharan,2015), and efficiency (Bloom et al.,2008) but there are no studies that address the issue of financial constraints and firm survival.

Therefore, this forms the elementary motive of this research, and in this regard, the following hypothesis has been proposed:

Financial constraints have a negative impact on firm survival.

DATA AND METHODOLOGY

Data

The source of data is the publicly available PROWESS database, generated and maintained by Centre for Monitoring Indian Economy (CMIE). Based on the data, firms were identified that fulfilled two sets of conditions: Firstly, they were operating at the end of the year 1999, Secondly, their survival status could be tracked until the end of the year 2018. The data was collected sector-wise. Additionally, firms were also classified state-wise and then grouped as per main regions in India.

To ensure the reliability of firms' exit time, we took the following four steps. Firstly, we removed the firms for which data were missing. Second, firms for which data was initially available but after some time the firm left and then again reappeared were also taken out. Third, failed/exited firms were classified as those firms that were liquidated, bankrupt, dissolved, and/or merged and acquired. In India, firms find it difficult to voluntarily close their business because there is no bankruptcy code and prior permission is required for laying off workers (Dougherty et al.,2010). Hence, merged and acquired firms were also considered exited firms based on the previous studies (for instance; Bennmarker et al., 2009; Saridakis et al., 2013; Fraisse et al., 2018; Cerqueiro et al., 2019). Fourth, the year of exit was the year from which the firm disappeared and did not reappear further, and the survival status for each was cross-verified on the Zauba Corporation website(www.zaubacorp.com). As a result, a total of 3206 firms met the above conditions and were selected for the study.

Variable Definition

The main variable of interest is Financial Constraints (independent covariate), measured by building a synthetic index. The methodology developed by Musso and Sachiavo (2008) has been adopted. It has been adopted in various studies for instance; Bellone et al., (2010), Silva (2011), Ponikvar et.al., (2015); Máñez et.al., (2021); Mukherjee & Chanda (2021). The variables selected are size (measured by total assets), profitability (return on total assets), liquidity (current ratio: Current Assets/Current Liabilities), and operational efficiency (return on capital employed). For each of the variables, the value of the firm relative to all firms is found and then placed in one of the deciles in which the resulting distribution is divided. Hence, for each of the firms, we end up with 4 scores ranging from 1 to 10, where 1 represents the smallest value. The information from these variables is then combined to obtain a synthetic index ranging from 1 to 10, where a smaller value is associated with more constrained firms.

Following the literature (e.g., Cefis and Marsili,2005; Iwasaki and Kocenda,2020), control variables included in the study are firm age, firm size, Innovation, and Productivity.

Table1. Definition and descriptive statistics of covariates used in the analysis

Variable name	Definition [a]	Descriptive Statistics		
		Mean	St. Deviation	Median
Firm Age	Years in operation since the Company's Establishment	17.77	11.27	15
Firm Size	Sales [b]	5.5	2.87	5.5
Innovation	Investment in Research and Development [c]	0.23	0.42	0

Financial Constraints	Synthetic Index ranging from 1 to 10 [d]	5.51	1.95	5.75
Productivity	Measured as return on capital employed [e]	1.41	23.83	2.62

Notes;

[a] Values in 2000

[b] Calculated by converting the data into deciles ranging from one to ten

[c] Computed as an investment in Research &Development

[d] The Index ranges from one to ten

[e] measured as EBIT/Capital Employed

Methodology

In the following section, by estimating the Kaplan-Meier cumulative hazard function and survival function (non-parametric model) related to the survival status of 3206 firms, we will first present the survivability of all manufacturing firms in India for the period 2000-2018, and then region-wise and sector-wise.

The basis of survival analysis is the calculation of time-to-event data and the calculation of the Survival function and Hazard function.

The survivor function S(t) gives the probability that a subject survives longer than some specified time **t**.

$$S(t) = P(T > t) \quad (1)$$

The graphs obtained are step functions rather than smooth curves because the study period is never infinite in length.

The hazard function h(t) gives the instantaneous potential per unit time for the event to occur, given that the subject has survived up to time **t**.

$$h(t) = \lim_{\triangle t->0} P(t \leq T < t + \triangle t \,|T \geq t)/\triangle t \quad (2)$$

h(t) equals the limit, as $\triangle t$ approaches zero, of a probability statement about survival, divided by $\triangle t$, where $\triangle t$ denotes a small interval of time.

The relationship between S(t) and h(t) can be expressed as below:

$$\mathbf{S(t) = exp(-h(t))} \quad \mathbf{(3)}$$

Next, we will perform a survival analysis of 3206 manufacturing firms by employing a semi-parametric Cox proportional Hazard model following the methodology adopted by Iwasaki and Kocenda (2020).

The shape of the hazard function is in principle unknown so to investigate the effects that covariates might have on the distribution of durations, we need to impose certain assumptions. However, these assumptions can cause bias and that might lead to choosing the wrong distribution (Addison & Portugal, 1998). Non-parametric and semi-parametric methods, on the other hand, do not suffer from this drawback. To overcome this issue, one such semi-parametric method was proposed by Cox (1972), who derived a consistent estimation of β without assuming a specific distribution for the baseline hazard. This characteristic is precisely to our needs as our focus is on examining the impact of covariates on firm survival hazard, not baseline hazard (Klein, John P., et al., eds. Handbook of survival analysis, 2016).

In the model, the effect of the covariate on a firm's hazard is supposed to be proportional through the observation period of the study. In the Cox model, the form of hazard function h(t) is assumed to be in the following way:

$$h(t|x_{i1}, \ldots, x_{in}) = h_0(t)\exp(\beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_n x_{in}), \; h(t) > 0 \quad (4)$$

where x_{i1}, x_{i2}, x_{i3}, . . ., x_{in} are covariates associated with the respective ith observation: and here, β_1, β_2, β_3...., β_n are their respective parameters to be estimated. The above equation is transformed into the following linear model:

$$\ln h(t|x_{i1},..., x_{in}) = \ln h_0(t) + \sum_{i=0}^{n} \beta_n x_{in} \quad (5)$$

To deal with right censoring, the Breslow approximation was adopted. Every parameter estimate β is a hazard ratio.

RESULTS AND DISCUSSIONS

Descriptive Statistics

Table 2. Survival status of 3206 manufacturing firms: 2000-2018

	Number of firms operating at the end of 1999 (a)	Number of firms that failed by the end of 2018 (b)	Exit Rate (b/a)	Nelson Aalen Cumulative Hazard Rate	
				Coef.	St. Dev
All firms	3206	887	0.2763	0.3367	0.1000
Breakdown by State group					
North India	734	180	0.2452	0.2871	0.0200
South India	813	223	0.2742	0.3392	0.1000
East India	324	102	0.3148	0.3940	0.1200
West India	1213	349	0.2877	0.3518	0.1100
Central India	122	33	0.2704	0.3229	0.1000
Breakdown by Sector					
Food and Agro	333	108	0.3243	0.3932	0.1100
Chemicals	689	198	0.2873	0.3647	0.1000
Textiles	390	116	0.2974	0.3955	0.1200
Metals	493	115	0.2332	0.2632	0.0800
Machinery	393	89	0.2264	0.2546	0.0800
Construction	181	50	0.2762	0.3916	0.1100
Consumer Goods	209	77	0.3684	0.4815	0.1400
Transportation	317	76	0.2397	0.2724	0.0800
Miscellaneous Manufacturing	172	46	0.2674	0.3080	0.1000
Diversified Manufacturing	29	11	0.3793	0.5208	0.1600

Fig.1 Kaplan Maier survival curve estimate with 95% confidence intervals

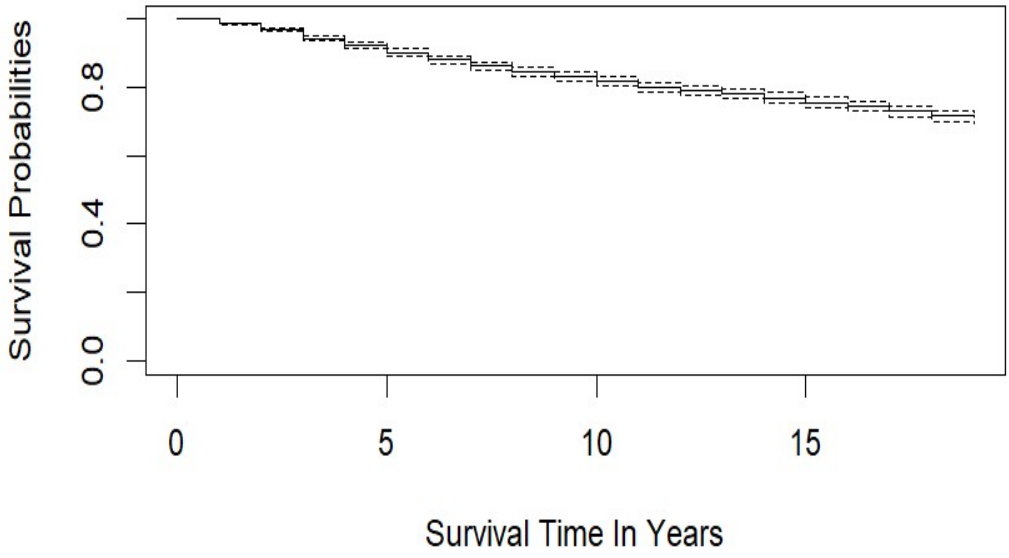

Fig.2 Region Group

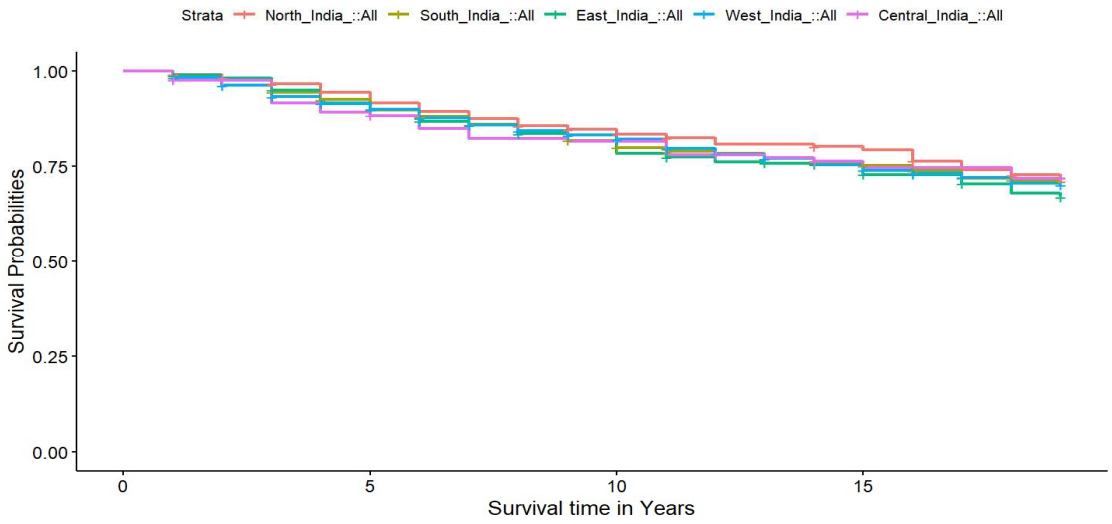

Fig.3 Sector Group

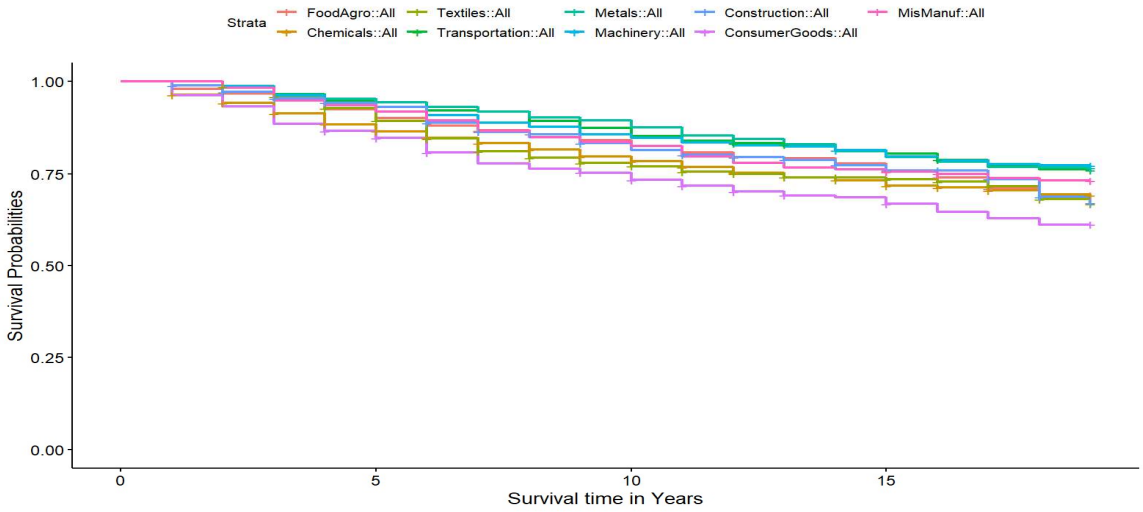

Table 2. provides a basic description of the dataset. Out of the given 3206 firms, 887 firms exited during the period 2000-2018. In this table, the exit rate denotes the ratio of firms that failed by the end of 2018. This exit rate does not represent the real risk of firm failure when data is censored. Hence, we also report the Nelson-Aalen hazard rate that adapts to data subjected to right censoring. From this table, we find that 27.6% of 3206 firms failed during the study period. The Nelson Aalen cumulative hazard rate for all firms is 0.3369.

At the same time, Table 2. and Fig.2 show firm exit rates region-wise. There is a gap in the regional groups from this perspective. The log-rank test for the equality of survivor functions for the region-wise groups rejects the null hypothesis ($\chi^2 = 8$, $p = 0.09$), which backs up the findings.

According to Table 2. and Fig 3, there are remarkable differences in the survivability of manufacturing firms depending on the sector they belong to. The log-rank test for equality of survivor functions for the manufacturing firm sectors rejects the null hypothesis ($\chi^2 = 40.2$, $p = 0.000$), suggesting that firm failure varied within the manufacturing industry also. This could be due to significant differences in the industrial relation environment across Indian states (Besley and Burgees, 2004), and manufacturing activity in India has region-specific characteristics and it continues to be concentrated in a few states despite the trade regime (Babu and Natarajan,2013). Therefore, in the next section, we report results based on the Cox Proportional hazard model by region group and sectors, in addition to aggregate estimates.

Results of Survival Analysis

Table 3. Results of Survival Analysis for manufacturing firms and by region groups

Model						
Target Group	**Overall Manufacturing**	**(1) North India**	**(2) South India**	**(3) East India**	**(4) West India**	**(5) Central India**
Research & Development	-0.8416**	-0.7265	-0.9330	1.1029	-0.8321	-0.2052**
Productivity	1.0409*	-0.6409	-0.8852	-0.2811***	-0.8005	-0.5979
Financial Constraints	0.8561***	- 0.8935***	-0.9058**	-0.8817**	-0.9191***	-0.8186*

Firm Size	1.0014	1.0145	1.0315	1.1494**	1.0579	1.4128***
Firm Age	0.9935**	1.0010	-0.9868**	-0.9932	-0.9926	-0.9993
N	3206	734	813	324	1213	122
Log pseudolikelihood	-6884.64	-1152.1261	-1440.9147	-560.16188	-2402.6031	-146.656
Harrell's C statistic	0.687	0.591	0.574	0.603	0.563	0.692
Wald's Test ($\wp^{2}$)	54.77***	16.79***	15.86***	17.47***	16.5***	11.34**

Notes: Table 1. provides a detailed description and descriptive statistics of covariates. Here, N denotes the number of firms. Regression coefficients are the hazard ratios. Standard errors are computed using the Huber-White sandwich estimator. Z statistics are reported beneath the regression coefficients. Wald test examines the null hypothesis that all the coefficients are zero. ***, ** and * denote statistical significance at 1 %, 5 % and 10 % levels, respectively. (North-east region is omitted due to unavailability of data).

Source: Author's calculations

The regression coefficient is found to be significant for firms in North India (-0.8953), South India (-0.9058), East India (-0.8817), West India (-0.9191) and Central India (-0.8186). A consistent negative sign of regression coefficients across the state groups implies that firms are facing trouble in surviving due to the presence of financial constraints. The way the financial constraints score is built (smaller value associated with a high degree of constraints) is consistent with the negative sign associated with the regression coefficient in all other state groups: the higher the score, the lesser the probability of firm exit; easier access to external funds (hence a higher Score) lowers the probability of firm exiting the market.

Table 4. Results of Survival analysis by sector

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Sector	Construction		Metals	Machinery	Transport	Food	Textiles	Chemicals	Consumer Misc
Research & Development	-0.7144	-0.8452	1.0459**	-0.7705	-0.6637	-0.4141**	-0.6128*	1.3328	-0.6036
Productivity	-0.3967	1.2725	1.6662	2.2129	4.2612	-0.6824	-0.1149***	-0.2048**	-0.3268
Financial Constraints	-0.8756**	-0.577***	1.0045	-0.94159	-0.9781	-0.7384***	-0.9223	-0.8368***	-0.9607
Firm Size	1.0068**	1.191**	-0.9808	-0.8731	-0.8994	1.211***	1.4419***	1.0796	1.0859
Firm Age	1.0139*	1.0131	-0.8728***	-0.9880	-0.9633**	1.0060	-0.9881	-0.9797**	1.0011
N	333	390	689	209	181	493	393	317	179
Log pseudolikelihood	-599.39	-638.70	-1247.30	-389.59	-238.22	-673.81	-512.29	-414.12	-228.10
Harrell's C statistic	0.603	0.679	0.787	0.567	0.614	0.694	0.615	0.666	0.601
Wald's Test ($\wp^{2}$)	16.19**	47.67***	195.5***	5.11	11.15**	53.17***	20.89***	30.35***	5.29

Notes: Here, N denotes the number of firms. Regression coefficients are the hazard ratios. Standard errors are computed using the Huber-White sandwich estimator. Z statistics are reported beneath the regression coefficients. Wald test examines the null hypothesis that all the coefficients are zero. ***, ** and * denote statistical significance at 1 %, 5 % and 10 % levels, respectively. (Diversified manufacturing sector is omitted due to the lesser number of firms).

Source: Author's calculations

The overall picture is presented in Table 3. A significant impact among firms in the manufacturing sector in India is observed as the coefficient is (0.8561) and is below the threshold limit (1.0). This implies that firms with lesser financial constraints have ~14% better survival prospects than financially constrained firms or as the financial

constraint score increases, the firm survival also increases. In other groups also, the effect is comparable. Further, in Table 4, we report results across sectors. On the whole, a high value of Harrell's C-statistic indicates sufficient explanatory power of the fitted models that are reported in the tables. Here, a positive coefficient indicates a higher hazard and, thus worse survival.

Financial constraints play an important role concerning survival rate and are the most important exit preventive measure (Table 3), with its impact well leveled across region groups (Table 3) and some of the sectors (Table 4). The effect of financial constraints on firm survival is not very pronounced sector-wise, among the sectors: Food and Agro, Textiles, Metals, and, Transportation have a significant impact of financial constraints, and the Textile sector has the strongest impact as its regression coefficient is 0.5700 and is way beyond the threshold limit (1.0). The findings underline the significance of the reduction in financial constraints i.e., an increase in financial constraint score on firm survival.

This finding is not only statistically but also economically important and remains robust when the analysis is carried out for sub-sectors and state groups. This supports the notion put forward by various studies (for instance; Zingales,1998; Bunn & Redwood,2003; Clementi & Hopenhyn,2006; Bridges & Guariglia,2008; Musso & Sachiavo,2008; Gorg & Spalira,2014; Liu & Li,2017; Zhang,2020) that firms in bad financial shape are more likely to fail.

The significant relationship between survival and financial constraints in India may be because some industries depend heavily on external finance primarily due to technological reasons and this effect is observed in all of the state groups and some of the sub-sectors. This is also confirmed by a study conducted by Manova (2008) that firms in France belonging to certain industries (Electric machinery, machinery, and equipment, glass, and products, drugs, petroleum, and coal products) required more external finance. Therefore, a similar observation is observed in Indian firms may be due to different external finance requirements for sub-sectors.

Firm Age exhibits significant results (Table 3) only in overall manufacturing but its effect is not consistent across region groups (Table 3) and for some sectors, it is found significant (Table 4). Another firm-specific measure i.e., Productivity exhibits a neutral impact on firm survival but this effect is only seen in the overall scenario (Table 3), for the region group it is highly significant for East India (Table 3), and for Machinery sector and Transport Equipment sector (Table 4). Further, Innovation is found to be a significant factor for firm survival in overall manufacturing (Table 3) but it is not significant for all the region-group except Central India. It is found to be highly significant only for firms in the Metal sector (Table 4).

As a robustness check, we also estimated alternative parametric survival analysis models and found their estimates are quite similar to those estimated through the Cox model (see Appendix 1).

CONCLUSION

Employing firm-level data for the Indian manufacturing sector, we find that 887 firms 27.67% of 3206 firms, had a failure during the period 2000 to 2018. However, there is a remarkable difference in the survivability across region groups and sectors in India. Furthermore, the results of survival analysis revealed that financial constraints impacted firm survivability even after controlling for age, size, innovation, and productivity. We find that as financial constraints decrease, firm survivability increases substantially and this effect is more observed in regional groups as compared to sector groups. This could be due to the lesser number of firms in each of the sector groups. It can be thus concluded that as financial constraints reduce or financial constraint score increases, the chances of firm survival increase.

Appendix 1: Estimation results of Parametric survival models for robustness test

Model	**Cox Proportional** Hazards (Table 3) (Model 1)	(1) **Exponential**	(2) **Weibull**	(3) **Gompertz**
Financial Constraints	0.8561*** (-4.328)	0.8552*** (-4.350)	0.8536*** (-4.370)	0.8559*** (-4.760)
Innovation	0.8416** (-1.939)	0.8401** (-1.960)	0.8385** (-1.98)	0.8406** (-2.13)
Productivity	1.0409* (1.778)	1.0415* (1.800)	1.0426* (1.850)	1.0413* (2.12)
Firm Size	1.0014 (0.104)	1.0013 (0.100)	1.0011 (0.080)	1.0014 (0.020)
Firm Age	0.9935** (-2.014)	0.9934** (-2.020)	0.9934** (-2.030)	0.9935** (-2.130)
N	3206	3206	3206	3206
Log pseudolikelihood	-6884.64	-4422.39	-4418.8	-4681.3
Wald's Test ($\wp^{2)}$	54.77***	55.94***	57.10***	65.46***

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