International Review of Entrepreneurship, Article #1583, 16(3): pp. 289-328.

The Long-Run Impact of Bank Lending Constraints and Other Economically Important Factors on SME Failure

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Abstract. This paper uses a very large French panel dataset, a hazard rate model and a near-exhaustive range of explanatory variables to examine the impact of short and long-term bank lending constraints along with other economically important factors, on small business startup failure. Economically important factors turn out to be a relatively small subset of the original set of regressors and include measures of financial cost (short-term interest rates), bank lending constraints (at startup and later), prior unemployment, labour market experience and financial risk (the share of debts in total assets). Bank loan refusal at startup permanently raises the hazard of closure by a daunting 64-70%, while short-term interest rates and subsequent constraints on bank borrowing related to collateral availability also permanently increase the hazard of closure considerably. Thus, both early *and later* financial constraints seriously affect the businesses' survival prospects, controlling for a very large range of other factors. Finally, financial risk plays an important subsidiary role in startup failure as well, creating a risk that again does not vary over time. Thus, a significant percentage of entrepreneurs are beset by lending constraints into the longer run and do not learn to manage finance significantly better as their business develops.

Keywords: France, entrepreneurship, startups, panel data, failure, closure, survival, lending constraints, collateral, hazard rate, human capital, financial capital, statistical significance, economic significance, economic importance.

JEL Codes: L25, L26, G33

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sector.

Acknowledgement: The authors should like to thank an anonymous referee for excellent constructive criticism that has greatly improved the paper. He or she is of course innocent of any remaining shortcomings for which we alone are responsible.

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1. Introduction

The entrepreneurial startup scene has been known for some time to be characterised by a very high turnover of businesses, a large proportion of which "die young", i.e. cease trading in the first 2-3 years of life; see Brüderl, Preisendörfer and Ziegler (1992) and Cressy (2006a) for some stylised facts. Various explanations have been put forward to account for this remarkable closure rate, such as the founding conditions of the business (Mata and Portugal, 1994; Mata, Portugal and Guimaraes, 1995; Box, Gratzer and Lin, 2017); size of the business (Evans, 1987; Audretsch, 1991; Audretsch and Mahmood, 1995); the immaturity of the business (Jovanovic, 1982; Freeman, Carroll and Hannan, 1983; Evans and Leighton, 1989; Brüderl et al., 1992); the immaturity of the entrepreneur (Preisendörfer and Voss, 1990; Cressy, 1996); the minimum efficient size of the business (Schmalensee, 1981; Audretsch, 1991); the entrepreneurial learning process (Jovanovic, 1982; Cressy, 1999); collateral-based credit constraints (Evans and Jovanovic, 1989; Xu, 1998); entrepreneurial optimism (De Meza and Southey, 1996); family entrepreneurship background (Bates, 1990; Wilson, Wright and Scholes, 2013); lack of education (Taylor, 1999; Parker and Van Praag, 2006); lack of relevant experience (Boden and Nucci, 1993; Cressy, 1996; Cassar, 2004); failure to perceive an entrepreneurial opportunity (Dimov and Shepherd, 2005); lack of human capital (Preisendörfer and Voss, 1990; Bates, 1990; Gatewood et al., 1995; Cressy, 1996; Honig, 1998; Dimov and Shepherd, 2005; Unger, Rauch, Frese and Rosenbusch, 2011); high levels of market competition (Burke, Görg and Hanley, 2008; Audretsch, 1991; Audretsch and Mahmood, 1995); failure to innovate after entry (Audretsch and Mahmood, 1995), and so on. Credit constraints are still widely believed to be a major cause of failure of the average business (e.g. Stiglitz and Weiss, 1981; Holtz-Eakin, Joulfaian and Rosen, 1994; Ayyagari, Beck and Demirguc-Kunt, 2007; Beck, 2007; Beck and Demirguc-Kunt, 2006; Musso and Schiavo, 2008; Mach, 2014), despite a significant body of evidence to the contrary (e.g. Aston Business School, 1990; Cressy, 1996; Cosh, Cumming and Hughes, 2009). The main deficiency of the majority of these studies is the absence of a rich panel dataset over a long enough time period (a recent exception is Box, Gratzer and Lin, 2017, who employ a very rich data base for Sweden).[2] Another pervasively important deficiency is the failure to distinguish economic (marginal impact) from statistical significance. The latter is only a necessary condition for the former, but it is the economic impacts that are important for policy decisions.

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2. Several longitudinal studies of varying degrees of comparability to ours exist. These include Brüderl et al. (1992), which unfortunately has no financial information beyond startup; Mata and Portugal (1994), which deals only with businesses in manufacturing with 5 or more employees and has no information on finance or human capital; Taylor (1999) which has no lending or asset measures; Van Praag (2003) which has few explanatory variables and again no financial information beyond startup. None of these studies moreover have measures of capital constraints either at startup or beyond.

In this paper we remedy these deficiencies by estimating a hazard of failure function on a stratified random sample (panel) of some 5,650 French firms, 63 variables and 2,000 closures over the period 1994-2000.[3] Our most important findings are on capital rationing (loan refusal) in this period, measured both at the startup stage *and later*. Estimates show that startup loan refusal raises the hazard of closure by two-thirds and subsequent lending constraints by a quarter for the firms affected. This latter finding is the result of collateral-based bank lending (first identified in Evans and Jovanovic, 1989) which will be significant in survival only if credit is subsequently constrained or rationed. Finally, although a large financial literature identifies financial risk (leverage) as significant in failure we are able to quantify precisely *how much* this risk affects the closure hazard of the typical startup and to examine its impact over time and whether that impact changes as a result of entrepreneurial learning.

A subsidiary finding of the paper is to identify nine other economically important determinants of survival.[4] These include loan costs (short term interest rates), prior unemployment status, relevant work experience, entrepreneurial opportunism, age of the entrepreneur and managerial effort. Several of these factors have been identifed in the literature as *statistically* significant in survival. However, for the first time we show that *these and only these* are *economically important*. Furthermore, we show that many of the variables identified in the literature as statistically significant are in fact statistically *in*significant once these fundamentals are controlled for.

The rest of the paper is organised as follows. Section 2 provides a sketch of the relevant literature and motivates the inclusion of certain variables. Section 3 introduces the data. Section 4 provides descriptive statistics. Section 5 discusses the concept of economic vs. statistical significance. Section 6 discusses and justifies the methodology to be used and presents the regression estimates. Section 7 summarises and concludes.

2. The Literature

In this section we do not provide a literature review as such; most readers will be familiar with recent surveys of the material on survival (e.g. Cressy, 2006b; Santarelli and Vivarelli, 2007; Parker, 2009; Cressy, 2012). What we do in fact is to firstly provide a summary of the rationale for including variables in the multivariate analysis to follow and secondly to use a table from Parker (2009), our Table 1, which summarises in a useful way the 287 results of academic research published before 2008 on survival determinants.[5]

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3. The sample represents a population of some 52,000 observations over the period.
4. Economic importance is measured by the marginal impact of a variable on the failure hazard.
5. We shall later show how our results differ from those of the literature summarised in this table and elsewhere.

Table 1: Selected findings from the literature on SME survival

	(a) No. +	(b) No. 0	(c) No. -	CB variable(s)
ENTREPRENEUR				
Age	23*	2	5	agef
Education	24*	8	3	nodip, gendip, interdip,supdip
Self-employed parents	4	7*	1	fam,rel,famorrel
Unemployment spell	0	7*	4	unemp
Industry experience	5*	0	0	durexp10plus
Work experience	3*	2	2	durexp10plus
Management experience	2	3*	0	prevman, prevex
Entrepreneurial experience	6*	1	2	novice
Manual occupation	0	0	2*	NA
Married: spouse entrepreneur	4*	4	0	NA
Female	0	1	4*	male
Minority/immigrant	0	2	3*	Francais
BUSINESS				
Business age	26*	3	2	Trading time (not a regressor)
Initial size/capital	30*	6	3	employ_0 ga_0
Business partners	4*	1	0	NA
Multiple establishments	6*	1	2	NA
INDUSTRY & MACRO				
Regional/macro growth	16*	0	1	gdpgrowth
Industry MES	1	2	7*	NA
Innovator/innovative sector	6*	0	1	NA
Intensity of competition	1	1	14*	lherf
Urban environment	0	1	3*	NA
Unemployment rate	1	0	4*	NA
Interest rate	1	2	7*	stintrat, ltintrat

The Table reproduces and augments Table 14.1 of Parker (2009). It reports the number of *findings* (generally more than the number of papers) in the literature prior to 2009, valid at the 5% significance level. 'No. – /+' refers to the number of findings with a negative/positive impact on survival. 'No. 0' refers to the number of findings with no impact of the variables on survival. 'CB variables' refers to the proxies for the literature variables used in the current (Cressy and Bonnet, CB) study. An 'NA' in any cell implies no direct comparison is possible. A star (*) next to a number in one of the first three columns indicates a majority of surveyed papers with that sign. The table also reports proxies for the variables in the literature available in the present dataset (CB variables). See Table 2 for definitions.

As mentioned above, we do not have data on all of the variables in Parker and, contrariwise, we *do* have a large number of variables *not* included in his table (see our Table 1). Also, since only one sign is reported for each variable in Parker it seems that most if not all studies he reports use *linear* modeling procedures. This is again in contrast to our study which allows for a quadratic relationship for all non-dummy variables. Since this last point is important we justify our quadratic specification with some examples.

Following Cressy (1996), life experience is increasing whilst energy is decreasing over the entrepreneur's lifespan; when the latter outweighs the former we get a turning point in the survival curve as a function of entrepreneurial age. Thus the curve is first of all concave increasing then concave decreasing. Likewise, we expect that the (closure) hazard function in age of business will be inverse-U-shaped according to the 'liability of newness' theory (Freeman et al., 1983; Brüderl et al., 1992).[6] The theory of overtrading also makes an argument for a quadratic function in time-varying turnover: at first turnover enhances survival chances but if turnover outstrips cash flow of the business it may fail to meet debt obligations (a cash liability) as they fall due and so decline and bankruptcy may result. Finally, we expect that the hazard of closure is U-shaped in business size either because diseconomies of scale set in after some point or because the attention span of the entrepreneur limits his or her ability to manage resources (Gifford, 1992). Similar arguments can be made for other variables in our dataset. We thus specify a quadratic model for non-dummy variables in the regressions to follow.

3. Data

3.1. Data Sources

The database used in this paper is the set of cohorts of start-ups in the French SINE 94-1 database.[7] This data is derived from a survey of French firms that had been set up or purchased in the first half of 1994 and which had survived for at least one month. Financial and survival data from follow-up surveys with the same firms was then added to the results of the initial survey until the year 2000. Surveys were conducted by the French National Institute of Statistical and Economic Studies and had a response rate of almost 100%. The cohorts of firms (startup loan requesters) consist of a stratified sample of some 5,600 firms and

6. For empirical precedents, though often on a set of much larger firms, see e.g. Evans(1987) seminal contribution and the many papers in the Journal of Industrial Economics and Small Business Economics that followed in its wake.
7. See Abdesselam et al. (2004) for more detail on the database than is provided here. We define a cohort as the set of firms starting trading in a given year. Thus a firm is deemed to start up only when financial data for the firm becomes available.

2,000 closures over the 7-year period with entry mainly in 1994, 1995 and 1996.[8] A range of firm, human and financial capital variables are recorded at startup and in the years following, together with closure information. The data is thus an unbalanced panel with time series for individual firms that vary between 1 and 7 years depending on if and when the firm closes.[9]

3.2. Key Variables

3.2.1 Closure/Failure

Our measure of survival is the variable *cessnow*, a dummy which is equal to one in the year of closure (if the firm closes) and is zero elsewhere. A zero for this variable in the cutoff year for the dataset (the year 2000) indicates a censored observation, one for which the closure outcome is not known. Thus, a one in any period indicates merely that the business has ceased to trade in that year *for whatever reason*. This may be due to bankruptcy or insolvency, or (more frequently) solvent closure due to lack of profitability, or the existence of alternative opportunities for the entrepreneur (e.g. a job) more valuable than what is available in the current business. In the case of limited companies closure may occur because the firm is taken over.

The key point of our definitional agnosticism in the present paper is that it circumvents the issues regarding closure under 'success' or 'failure' as discussed in Bates (2005).[10] However, we believe that closure generally represents an unfavourable outcome for the business or the entrepreneur, a view supported in Coad (2014).

3.2.2. Capital Constraints

Whilst there is a long-standing debate on the definition and importance of credit rationing (see e.g. Cressy, 2002, for a discussion) in this paper we cut the Gordian knot and focus on two *directly measureable* variables, namely loan refusal and collateral availability.

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8. Because the sample is stratified we use sample weights (inverses of sampling probabilities) in the empirical work to follow.
9. This dataset is not virgin territory. Other academics (e.g. Abdesselam et al., 2004, and Cressy and Bonnet, 2015) have already explored different aspects of entrepreneurship using it.
10. This is an important point for interpreting some of our results since e.g. an entrepreneur with managerial experience may close his or her business to move to a more highly remunerated job than the income that entrepreneurship offers, thus increasing the hazard of closure. We leave open the question of whether this means managerial experience increases the chances of failure of the business. Jovanovic (1982), however, might consider this as enhancing failure since it implies the opportunity cost of remaining in business exceeds the return to business.

3.2.2.1. Startup Credit Constraints

The startup loan decision variable in our analysis, *ref_0*, is equal to one if the firm applied for a bank loan *at startup* but was refused, and is zero if it applied and was accepted.[11] Clearly, a firm may not apply for a loan either because it doesn't need one, or because it expected to be refused if it did.[12] Likewise, an applicant firm may have a good (profitable) or bad (unprofitable) project and a rational, risk-neutral, perfectly-informed bank would presumably reject the latter and accept the former. However, if classical credit constraints rule, even 'viable' projects may be rejected. If this occurs systematically we should probably conclude that we have an imperfect credit market.[13]

The mean of the variable *ref_0* in Table 3 shows, in line with the literature, that only a modest proportion (7%) of firms who applied for a loan were refused. Thus at most only 1/14 of applicants were rationed by the bank at the startup stage.

3.2.2.2. Post-Startup Credit Constraints

Our second measure of rationing is collateral availability measured by the variable *collrat*, the ratio of tangible to total assets. This will be statistically significant if bank lending is constrained at the margin by the availability of collateral, as in Evans and Jovanovic (1989). The mean of the variable *collrat* in Table 3 indicates that the typical startup had 55% of its assets available for security against a loan at any given point in time. Whether this is adequate security for a loan applied for as the business matures is what we shall find out. Capital constraints would imply a negative sign of *collrat* on the hazard of failure.

3.3. Other Regressors

Table 2 outlines and defines the other regressors for our models. Many if not all of these variables have been studied in the theoretical and/or empirical literature as mentioned above. We shall discuss their properties and likely signs in the regressions in the next section.

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11. Because we wish to include the loan refusal variable in our analysis we shall focus on the subpopulation of loan applicants.
12. We are not able to distinguish these two outcomes in our data and so cannot address this so-called 'discouraged borrower' phenomenon. See, however, Kon and Storey (2003).
13. Strictly, finance constraints exist under these circumstances only if all possible finance sources have been exhausted. Nonetheless, given customer lock-ins, for most businesses the choice of external finance is limited to a bank loan from a specific bank. See Cosh, Cumming and Hughes (2009), however, for an interesting exploration of finance choice using UK data.

Table 2: Definitions of variables

Category			Variable	Definition
Firm closure			cessnow(it)	=1 in the year of closure (if the firm closed);= 0 else (censored observation)
Firm size			equity(it)	Book value of firm's equity (000Euros)
			employ(it)	Number of full time employees
			ga(it)	Total assets of the business (000s Euros)
Firm operating performance		**profit**	profit(it)	profit of the business in year t (000s Euros) [1]
		Sales	turn(it)	Sales turnover of firm i in year t (000Euros)
		Growth	gturn(it) capex(it)	Proportionate growth (%) in turnover in year t Capital expenditure by firm i in year t (000Euros)
Firm risk	**Market**	**Competition**	herf(it)	Herfindahl index (sum of squared turnover shares in industry turnover of firm i at time t)
	Financial	**Bankruptcy risk**	debtrat(it)	debt/(debt+equity)
Capital	**Financial**		OD(it)	Overdraft (line of credit) drawdown (000Euros)
			bank2m(it)	Amount of bank loan if less than 2 years' duration (000Euros)
			bank2p(it)	Amount of bank loan if more than 2 years' duration (000Euros)
			tradebt(it)	Amount of trade debt (000Euros)
			othdebt(it)	Other finance (e.g. leasing)
			loancost(it)	Capital and interest on loans taken out by the company (000Euros)
	Human	**General**	male(i)	=1 if main proprietor is a man
			francais(i)	=1 if nationality of main proprietor is French
			agef(i)	age of entrepreneur at startup in years
		Labour market experience	unemp(i)	=1 if the entrepreneur had been unemployed prior to startup;=0 else
			prevma n(i)	=1 if entrepreneur was previously a manager of a business
			prevexec(i)	=1 ditto, executive
			durexp10plus(i)	=1 if the entrepreneur had more than 10 years' work experience in the same area as the startup; =0 else
		Entrepreneurial context	famorrel(i) fam(i) rel(i)	=1 if family or close relationships contain managers/sole proprietors =1 if family contains managers/sole proprietors =1 if only close relationships contain managers/sole proprietors
		Entrepreneurial networking	nonet(i)	=1 if entrepreneur is not part of any entrepreneurial network (relatives/friends); =0 else
		Education	nodip(i) gendip(i) interdip(i) supdip(i)	=1 if the entrepreneur had no French Diploma;=0 else =1 ditto, General Diploma; =0 else =1 ditto, Intermediate Diploma;=0 else = 1ditto, University Diploma (Degree);=0 else
		Entrepreneurial opportunism	opportunity(i)	=1 if the main motive of the entrepreneur in starting up was because of a perceived business opportunity;=0 else
Capital constraints		**Startup**	ref_0(i)	=1 if the firm requested a loan at startup and it was refused; =0 if requested a loan and it was offered
		After startup	collrat(i,t)	fixed assets/total assets, a measure of collateral availability

Entrepreneurial professionalism	**Entrepreneurial strategy**	effort(i) otheract(i) price(i) pub(i) subcon(i)	=1 if effort was made to expand the business =1 if entrepreneur is also a manager/partner in another business (portfolio entrepreneur); =0 else =1 if she/he adopted a pricing strategy in the last two years =1 if she/he advertised to promote the business ditto =1 if entrepreneur subcontracted production ditto
Government intervention		depallow(it)	Depreciation allowance provided by the government (000s Euros)
		prodtax(it)	Sales tax (VAT) (000s Euros)
		govaid(i)	=1 if the firm received 'public assistance';=0 else
Entrepreneurial Psychology	**Optimism**	novice(i) optimism(i)	=1 if the entrepreneur had not been in business before =novice*agef, an Interaction term between novice and agef
Legal status of business		ltd(i)	=1 if the firm was a limited company;=0 else
Industry		houseserve(i)	=1 if the firm is located in the Housing Services industry; =0 else.
		food(i)	Ditto Food industry
		manu(i)	Ditto Manufacturing
		construc(i)	Ditto Construction
		commerce(i)	Ditto Financial Services
		transport(i)	Ditto Transport
		busserv(i)	Ditto Business Services
		catering(i)	Ditto Catering
Region		poitou(i)	=1 if the business is located in the Poitou region; =0 else
		bourg(i)	Ditto Bourgogne
Macro		stintrat(%)(t)	Short term French interest rate (3 month Treasury bill rate)
		ltintrat(%)(t)	Long term French interest rate (10 year Government bond rate).
		gdpgrowth(%)(t)	French GDP growth rate
Legend: Some of the variables vary across firms only (i), others across time only (t) and yet others across both firms and time (it). In the statistical analysis we also use squared (x2) values of the variables (x) listed here. For initial values we use the notation x_0 and x_0sq for a variable x and its square. An lx denotes log(x). There are twenty regional dummies but to save space we present only two in the table, namely those that will turn out to be significant in the regressions to follow.			

[1] Note: Profit = (turnover +operating subsidies+financial products) -(consumption of raw materials and services + product taxes + netpayroll + employer's social security payments + depreciation + appropriation to reserves + loan costs)

4. Descriptive Statistics

In this study, as mentioned, we focus on the determinants of closure of firms run by loan requesters, entrepreneurs that requested a bank loan at the startup stage. This enables us to examine the role of startup loan refusal in survival controlling for a large range of other factors. The descriptive statistics for startup loan requesters in the first year of trading (Panel A) and subsequent years (Panel B) are shown in Table 3.[14]

Table 3, Panel A: Year one descriptive statistics (loan requesters)

Variable	N	mean	SD	median	min	max
employ	6307	1.535278	3.467645	0	0	80
ga	6307	73.36681	131.8589	37.8	0	3705.7
equity	6307	13.13491	38.63326	6.4	-366.4	1265
profit	6307	9.276228	31.74935	4.22	-168.48	1821.92
turn	6307	97.14054	317.246	41.7	0	17755.1
capex	6307	26.81968	49.78686	11.6	0	1151.1
herf	6307	.0116386	.0101111	.0100274	.0016269	.0368522
collrat	5788	.5536363	.2789451	.5977227	0	1
debtrat	5794	.8136562	.6635051	.7871382	0	30
bank2m	6307	2.139639	23.55322	0	0	765
bank2p	6307	9.681909	48.44499	0	0	692.5
OD	6307	.8669732	11.82636	0	0	765
tradebt	6307	1.341685	4.300115	.38	0	104.9
othdebt	6307	3.074235	17.95289	0	0	441.9
male	6307	.742984	.437023	1	0	1
francais	6307	.9576661	.2013658	1	0	1
effnonfran	6307	.0107817	.1032817	0	0	1
agef	6307	36.53124	8.477792	37.5	22.5	52.5
ref_0	6307	.0735691	.261089	0	0	1
unemp	6307	.5259236	.4993671	1	0	1
prevman	6307	.0447122	.2066877	0	0	1
prevexec	6307	.1412716	.3483291	0	0	1
durexp10plus	6307	.3350246	.4720365	0	0	1
famorrel	6307	.6507056	.4767849	1	0	1
fam	6307	.4604408	.4984721	0	0	1
rel	6307	.1902648	.3925411	0	0	1
nonet	6307	.2476613	.4316882	0	0	1
otheract	6307	.1029015	.3038543	0	0	1
nodip	6307	.1778976	.3824568	0	0	1
gendip	6307	.6551451	.4753586	1	0	1
interdip	6307	.6909783	.4621268	1	0	1
supdip	6307	.1311241	.3375628	0	0	1
opportunity	6307	.2755668	.4468349	0	0	1
effort	6307	.2665293	.4421792	0	0	1
price	6307	.2834945	.4507301	0	0	1

14. An early working paper version of this paper (Cressy and Bonnet, 2016) presents the descriptive statistics for the wider sample (all firms, not merely loan requesters). In the paper we analyse only those that requested loans because the effects of loan refusal cannot be identified in the sample of all firms. (There are missing values for ref_0 for non-requesters.) Regression model results for the full sample are, however, available from the authors on request.

pub	6307	.2985572	.4576614	0	0	1
subcon	6307	.2352941	.4242161	0	0	1
loancost	6307	2.316204	4.747701	1	0	103.4
depallow	6307	3.342936	6.13447	1.6	0	124.4
prodtax	6307	14.34485	50.70551	3	0	1059
govaid	6307	.4693198	.4990974	0	0	1
novice	6307	.8136491	.389393	0	0	1
optimism	6307	29.36618	15.38914	32.5	0	52.5
ltd	6307	.3559537	.4788392	0	0	1
houseserve	6307	.1005232	.3007202	0	0	1
food	6307	.0723006	.2590056	0	0	1
manu	6307	.127636	.3337105	0	0	1
construc	6307	.1390518	.3460281	0	0	1
commerce	6307	.2430633	.428967	0	0	1
transport	6307	.0713493	.2574278	0	0	1
busserv	6307	.0583479	.2344187	0	0	1
POITOU	6307	.0803869	.2719128	0	0	1
BOURG	6307	.0748375	.2631498	0	0	1
stintrat	6307	5.909196	.6235796	5.848033	2.731939	6.625095
ltintrat	6307	7.217449	.4008596	7.22	4.61	7.54
gdpgrowth	6307	1.998208	.2369358	2.1	1.1	3.2
See footnote of Panel B for description of Table contents.						

Table 3, Panel B: Descriptives year two onwards (loan requesters)

variable	**N**	**mean**	**SD**	**median**	**min**	**max**
employ	29487	2.140842	4.507766	1	0	98
ga	29487	103.9424	201.839	52.3	0	7676.4
equity	29487	20.30084	65.44347	9.7	-1429.6	1764.8
profit	29487	15.47614	37.09292	7.23	-53.43	1225.89
turn	29487	146.6204	367.2108	64.1	0	12593
gturn	28739	26.82023	632.1033	4.381114	-100	77300
capex	29487	63.38648	230.733	7	-75	10866
herf	29487	.0084789	.0067566	.0070801	.0016269	.0368522
collrat	28815	.5828653	.3954806	.6317247	0	1
debtrat	28819	1.016451	4.485921	.7423581	-32.5	343
bank2m	29487	2.106084	18.86411	0	0	709
bank2p	29487	10.08308	50.67931	0	0	1929.3
OD	29487	1.209689	11.22647	0	0	765
tradebt	29487	1.745285	6.091833	.49	0	228.2
othdebt	29487	3.619934	21.79918	0	0	646.3
loancost	29487	2.707956	6.34368	1.2	0	454.9
depallow	29487	4.657093	9.137925	2.5	0	209.9
prodtax	29487	19.1851	52.93301	7	0	1518

stintrat	29487	3.993785	1.198117	3.462882	2.731939	6.625095
ltintrat	29487	5.663171	.9889626	5.58	4.61	7.54
gdpgrowth	29487	2.212483	.7238979	2	1.1	3.2

Table presents descriptive statistics for startup loan requesters both in the initial year of trading (Panel A) and subsequent years (Panel B). SDs are adjusted for the sampling weights, stratification and clustering by firm.

4.1. Gender and Nationality

Several studies have suggested differences in success rates according to gender of the entrepreneur.[15] Parker's table (our Table 1) indicates that the majority of studies (4 out of 5) reported that an entrepreneur's female gender reduced business survival chances. From Table 3 the majority (74%) of startup entrepreneurs in our dataset were male (*male*). Evidence predicts that *male* will have a negative coefficient in the hazard of closure regressions.

Some studies have argued that support networks of immigrant entrepreneurs enhance their survival chances. (see e.g. Portes, Haller and Guarnizo, 2002). However, Bates (1994) shows that the real drivers of success are the greater capitalization of these businesses and the educational qualifications of their owners. Greater use of (i.e. need for) support networks actually identifies *failing* businesses in Bates. Parker reports that 3/5 studies found minority/immigrant status to decrease survival chances. Our Table 3 indicates that 96% of startup entrepreneurs in our data were French nationals (*francais*=1). If immigrant status (*francais*=0) attenuates entrepreneurial survival (increases the chances of closure) we should expect the sign of this regressor in the closure hazard to be positive.

4.2. Optimism and Novice Status

Our statistical handle on optimism is as a multiplicative term (age of the entrepreneur *times* whether he/she is a novice (first timer) at entrepreneurship or *agef*novice*) holding novitiate (*novice*) status constant. Most (81%) entrepreneurs are first-timers (*novice=1*) in our dataset and as might be expected there is a negative correlation of novitiate status and age of entrepreneur. Table 3 also shows that the average age of entrepreneur *given* that he was a novice was 29 years.[16] Optimism is predicted in the literature to reduce survival chances (De Meza and Southey, 1996; Ucbasaran, Westhead, Wright, and Flores, 2010). Thus

15. To be specific, Boden and Nucci (1993) found that in two 1980s US cohorts mean survival rates of male owned businesses were 4-6% higher than those owned by women. Cressy (1996) in a UK study of startups found no effect of gender on survival once a large range of human capital and other variables were controlled for. Kallenberg and Leicht (1991) using US data again found little difference in survival rates between the sexes.
16. A positive sign for the optimism variable is expected in the hazard of closure function.

in our regressions we expect optimism will be positively related to the hazard of closure.

4.3. Firm Size

Firm size is defined here as total employment (*employ*), total assets (*ga*) or the book value of equity (*equity*). These measures are highly correlated and so we provide separate analyses for just two of them (employment and total assets) in what follows.[17]

The mean capitalisation (total assets, *ga*) of a French business startup was €73k (median €38k)[18] with a standard deviation of €132k, which rises to €104k (median €52k) over time (see Table 3, Panel B).

Regarding the employment measure of size, our start-ups were not large: average annual full-time equivalent (FTE) employment (*employ*) in the cohort was between 1 and 2 people.[19]

Parker reports that in 30/39 or 75% of studies initial size/capital was positively correlated with survival. The benchmark hazard rate study of Brüderl et al. (1992) found a negative relation of startup employment size to failure. Thus we expect a negative coefficient of initial employment in the hazard of closure.[20] However, a countervailing argument of Gifford (1992) regarding the span of control of the entrepreneur (limitations on his or her ability to manage a larger workforce) suggests the sign of this coefficient may possibly be reversed.

4.4. Firm Age

Firm age has been shown to be important in a number of studies of SME closure. This is usually measured from the firm's founding date to the present. In our dataset the founding date is the standardized cohort date or event time in the language of survival analysis. Since this is not a regressor we have no coefficient to estimate. We shall see however, that it is extremely important in survival.

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17. The highest correlation is between total assets and equity, registering at 84%.
18. We will abbreviate Euro to € henceforth.
19. This, is in line with evidence from other European countries (ENSR, 1996). We mention in passing, but without further analysis, that the book value of equity capital (equity) is €13.1k in year one (median €6.4k) rising to €20.3 (median €9.7) subsequently. Some firms had negative equity with a maximum negative balance of €366.4k in year one rising to €1430k subsequently.
20. The industrial economics literature on survival (e.g. Audretsch, 1991, and Audretsch and Mahmood, 1995) usually examines the role of firm size relative to the Minimum Efficient Size (MES) of business. However, the seminal paper of Evans (1987) on survival in fact used manufacturing firms for analysis in conjunction with the absolute size of business, our measure.

4.5. Firm Performance

Various measures of performance have been employed in the literature. In our dataset it can be measured by profitability (*profit*), turnover (*turn*) and sales growth (*gturn)*.

4.5.1. Profitability

Panel A of Table 3 shows that average profit for a firm in year one was €9.28k (median €4.22k), with the worst performer turning in a loss of €168k. In later years mean profit rose to €15.5k (median €7.2k) while maximum losses fell to €53.4k. Higher profitability is of course predicted to enhance survival chances.

4.5.2. Turnover

Turnover in the sample at startup was €97.1k (median €41.7k) with a standard deviation of €317k, and rising to €146.6k (median €64.1k) subsequently with standard deviation €367k over the remaining lifespan. Turnover, other things equal, should be positively correlated with longevity, though control over cash flow is also crucial, as noted in the literature.

4.5.3. Growth

Firm growth is defined by an output measure, sales growth (*gturn*) and by an input measure, capital expenditure (*capex*) in year t. The latter may be thought of as measuring the 'intention or decision to grow', insofar as the quantity exceeds that necessary for replacement. Output growth is defined technically as the proportionate annual change in turnover, in line with a large industrial economics literature. Table 3B shows that turnover growth for the years after year one (for which it cannot of course be calculated) averaged at 26.8% p.a. (median 4.4% p.a.). The minimum growth rate is -100%, a figure measuring the decline to zero in the last year of a failing company.

Capital expenditure has a mean at startup of €26.82k (median €11.6k), which rises to €63.4 p.a. (median €7k) over time. Growth is expected on theoretical grounds to be associated with greater chances of survival, as it suggests the successful development of a market for the firm's products, other things equal (Cressy, 2006a).

4.6. Risk

We measure risk by market risk (competition) and by financial risk, the chances of a firm not being able to meet its debt obligations (if there are such) on time. Both are expected to have negative effects on survival (Cressy, 2006a).

4.6.1. Market Risk: Competition

Our measure of competition or market risk is a variant on the well-known Herfindahl-Hirschman (H) index of industrial concentration and is calculated for each industry j in year t, as the sum of the squared shares of a firm's turnover in that industry[21]:

$$H_{jt} = \sum_{i=1}^{n_{jt}} s_{ijt}^{2}$$

where s_{ijt} = share of firm i in turnover of firms in industry j at year t and n_{jt} is the total number of (notionally equal-sized) firms in industry j at time t.[22] The table shows that most firms faced a relatively high level of competition (*herf*) in their chosen industry in the year of entry with overall average n of about one hundred notionally equal-sized companies (100=1/0.01). This figure changes little over the subsequent years of a firm's life. We expect therefore that at any point in time greater competition (smaller *herf* or a larger number of equal-sized firms) may have a negative effect on the chances of business survival.[23] Parker reports that 14/16 studies found a statistically significant negative effect of the intensity of competition on survival of the business.

21. The precise NACE codes are not specified in the SINE database and so we cannot report them here.
22. The H index ranges in value between $\frac{1}{n_{jt}}$ and 1. $H_{jt} = \frac{1}{n_{jt}}$ is associated at one extreme with an industry composed of identical firms ($s_{ijt} = s_{jt}, i = 1,2..., n_{jt}$) which tends to perfect competition as $n_{jt} \rightarrow \infty$ in which case $H_{jt} = 0$, and at the other extreme with monopoly, when $H_{jt} = 1$ and the firm and industry coincide.
23. A perceptive referee has pointed out that less industry competition may not necessarily be correlated with greater chances of survival for the average firm in the industry. Support for this argument would be the fact that monopolisation of an industry might take the form of the dominant firm acquiring smaller firms or driving them out of business, hence bringing about their closure. However, the evidence suggests that takeovers are not a major cause of exit for the typical startup (a high proportion of start-ups are unincorporated businesses which cannot be sold). On the other hand undercutting of a small by a large firm (e.g. a supermarket undercutting a local grocer) would certainly reduce SME survival chances. Thus the sign of this variable is thus strictly indeterminate.

4.6.2. Financial Risk

Our measure of financial risk is the familiar leverage ratio (debt/total assets or *debtrat*), which averages at 81.36% (median € 78.7%) initially, rising to 101.6% (median 74.2%) over time. The vast majority of the firm's assets were therefore financed by debt rather than equity, a tendency not mitigated by growth, and one which presented a significant bankruptcy risk to the average startup over time, generating a greater chance of closure. A large finance literature finds a positive association of leverage and the risk of bankruptcy.

4.7. Capital

Our broad definition of capital encompasses financial and human capital. Financial capital breaks down into debt and equity and human capital into general, labour market experience, entrepreneurial context, networking, education and opportunism.

4.7.1. Financial Capital

4.7.1.1. Debt

a. Bank Loans
As regards debt financing, half (50%) of businesses requested a loan at startup. [24] Of the 6,008 businesses that did so, from Table 3 (Panel A), only 7.4% were refused (*ref_0=1*). Thus credit rationing at startup (for which *ref_0* provides an upper bound) is not a widespread phenomenon amongst French businesses in the period, confirming the Aston Business School (1990), Cressy (1996) and Cosh et al. (2009) findings for the UK.[25]

From Panel A of Table 3 the average startup term loan[26] in year 1, used typically for fixed investment, was €2.14k for short term loans (loans less than 2 years, *bank2m*) and €9.68k for long term loans (loans greater than 2 years, *bank2p*). Median figures in both cases were, however, zero.[27] Mean figures fell to €2.11k and rose to €10.08k respectively over time with medians remaining at zero. In other words the typical French startup in this period did not use bank

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24. This calculation is done by taking the total number of non-missing values for ref_0 (loan requesters) in the first year of trading (6,008) and dividing by the total number of firms in the full sample in the first year (12,003).
25. Bear in mind that we do not have data on discouraged borrowers who may be potentially rationed. By definition these potential borrowers did not apply for a loan.
26. This includes zeros for those not requesting/taking a loan.

finance in the first year of trading and this picture changed little over time. This of course mitigates the risk of bankruptcy for these startups.

b. Overdrafts

Nor did these firms typically use a bank overdraft (*OD*) to smooth short-term cash flows from sales and purchases *at the startup stage*.[28] Overdraft levels averaged at €0.87k at startup rising to €1.2k whilst median values start and remain at zero. The typical startup on the other hand did make use of trade credit (*tradebt*), with a mean value of €1.34k (median €0.38k), rising to €1.74k (median €0.49k) respectively over subsequent years.

The relation of bank borrowing to survival is ambiguous: insofar as debt is used to finance profitable investment/expansion of the business we expect the relationship to be positive. On the other hand if the wrong investments are made as a result, a larger loan with its associated debt servicing obligations may increase the chances of bankruptcy.

c. Other Debt

The *othdebt* variable refers primarily to hire purchase agreements entered into for commercial vehicles averaged at €3.07k but again this was likely to be dominated by specific sectors (e.g. Transport) as the median value once more was zero. Over the longer term mean figures for other debt do of course increase via those that borrow, but for debt other than trade debt (which rises modestly €3.62k), median figures remain at zero.

d. Loan Costs

Loan costs include capital repayments as well as interest on loans. Initial loan costs average at €2.3k p.a. whilst median costs are less than half this at €1k p.a. Furthermore, in the longer run mean and median costs rise only slightly to €2.7k and €1.2k respectively suggesting that little extra debt is being taken on, consistent with the figures for loans discussed above. Again, the sign of this variable is ambiguous in survival.

4.7.2. Human Capital

This consists of general experience, labour market experience, entrepreneurial context, entrepreneurial networks, education and opportunism.

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27. To understand the fact that 92.7% of firms were offered a loan but the median loan was zero note that being offered a loan does not guarantee that the firm will take up the offer. Hence, even when loans were offered (i.e. ref_0=0) 50% of the offerees declined the offer, presumably because the terms were unattractive.
28. This is consistent with Cressy (1996) for the UK. He found that around one third of firms used an overdraft at startup, about one half after 3 years.

4.7.2.1. General

The typical entrepreneur was male (74%) and in the present dataset entered business at 36 or 37 years of age (*agef*).[29] Parker reports that a majority (4/5) of studies indicated that the female entrepreneurs (*male*=0) survived a shorter time than males. From Cressy (1996) survival is expected to be a concave function of entrepreneurial age, first increasing and then decreasing, so that youth is associated with a higher failure rate. In Parker 23/30 of the studies reported a positive (linear) relation of entrepreneurial age to survival.

4.7.2.2. Labour Market Experience

Individuals entering business in our sample were on average well-equipped in terms of work experience: around one third (33%) had over 10 years work experience (*durexp10plus*) in the same area as the startup. Work experience (in the same area as the startup) is expected to unambiguously raise business longevity (Cressy, 1996). Parker reports that 3/7 studies indicated industry work experience of the entrepreneur enhanced survival chances with 2/7 finding the opposite effect.

There is some evidence in our data of unemployment-push into self-employment: around a half (53%) of entrepreneurs in our dataset had previously been unemployed (*unemp=1*). Previous research for the UK (Cressy, 1996) and for France using the present dataset (Abdesselam et al., 2004), found that prior unemployment of the entrepreneur reduced business startup longevity.

Regarding the level of work experience, it is noteworthy that only 4% were previously managers (*prevman=1*) and 14% executives (*prevexec=1*). Hence the vast majority of work experience of those moving into entrepreneurship was at a low or non-managerial level. The typical startup entrepreneur in our data set thus has no managerial experience and must learn from the word Go.

Regarding the relevance of work experience, Cressy (1996) and Abdesselam et al. (2004) found that work experience of the entrepreneur in the *same* area as that of the startup enhanced business longevity. Parker reports that 3/7 studies found work experience to enhance survival chances. Long term labour market experience in the same area as the startup (*durexp10plus*=1) should enhance survival chances, whereas that of unemployment (*unemp*=1) is expected to have the opposite effect. Parker found that 4/11 studies reported a negative effect of unemployment and 7/11 reported a non-significant impact.

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29. This is consistent with Cressy's (1996) findings for the UK in 1990.

4.7.2.3. Entrepreneurial Context

Almost two thirds (65%) of startup entrepreneurs claimed to have family or close friends who were previously in business when they made their startup decision, with a breakdown into family members (46%) and close relationships (19%). Thus role-models for the self-employed at that time abounded. Parker reports that 4/12 studies concluded that there was a positive relation of self-employed parents to business survival of their self-employed offspring. However, the majority (7/12) found no statistically significant relationship and 1/12 even a negative one.

4.7.2.4. Entrepreneurial Networking

Entrepreneurial networking activity (e.g. membership of trade associations and Chambers of Commerce) should in theory support business survival insofar as it leads to mutual business support and enhanced information about the market. Accordingly, in our sample 75% (*nonet*=0) of entrepreneurs were members of some such network at startup whilst only 25% (*nonet*=1) were without network membership. A nurturing environment should have a positive effect on entrepreneurial longevity. Abdesselam et al. (2004) found this indeed to be the case.

4.7.2.5. Education

The typical entrepreneur in this dataset (as in several others) was not well educated. 18% of entrepreneurs had no French Diploma at all (*nodip*), with around two thirds having only a General (*gendip*=1) or Intermediate (*interdip*=1) and a mere 13% having University-level Diplomas (*supdip*=1). Education, reflecting general intelligence, is expected on balance to increase business longevity although, bearing in mind our definition of closure, it may also enhance outside opportunities of the entrepreneur, thus having the opposite effect. Parker, however, reports that 24/35 papers found a positive relation of survival to education.

4.7.2.6. Entrepreneurial Opportunism

Business “nous” is potentially important to business success. We have some indication of this in our dataset by the proportion (28%) of entrepreneurs who cited ‘perception of an opportunity’ e.g. a niche market (opportunity=1) as the primary motivator for startup. It is likely that this feature of the entrepreneurial faculties has a permanent presence and thus may have long term positive effects on survival.

4.8. Entrepreneurial Strategy

We have several variables in this dataset measuring entrepreneurial strategy and a given business may have adopted some or all of these simultaneously. Three potentially important measures of strategy are entrepreneurial effort in attempting to expand the business (*effort=1*), adjustments to prices of products and services in response to market signals (*price=1*) and business promotion (*pub=1*). On average 27% of entrepreneurs at the date of interview had attempted to expand operations whilst about the same percentage (28%) had revised their pricing policy in response to market conditions (*price=1*). Around the same percentage (30%) had attempted to promote the business (*pub=1*). Finally, those adopting a subcontracting strategy to reduce production costs formed about a quarter (23%) of the total (*subcon=1*). If successful, these strategies might all enhance business survival chances.

Portfolio entrepreneurship would seem to be a two edged sword: a way of reducing risk of entrepreneurial wealth whilst simultaneously increasing span of control and thus potentially sapping the energy of the owner. Without measures of entrepreneurial wealth variance it is of course impossible to test these two hypotheses against one another. However, our variable *otheract,* which measures 'entrepreneurial involvement in other businesses' should, if the span of control argument is correct, have a positive sign on the hazard of closure. It has a mean value of 10%, a percentage which however increases with the employment size of the business.

4.9. Government Intervention

4.9.1. Taxes and Subsidies

In our dataset this consists of financial support, as in depreciation allowances, and sales tax imposed on the business (VAT), measured by the variables *depallow* and *prodtax*

Depreciation allowances (*depallow*) averaged at €3.3k in year one (median €1.6k) whilst sales tax or VAT (*prodtax*) averaged at €14.3k in year one (median €3k) rising over time. Depreciation allowances should reduce, and tax rises increase, the hazard of closure as they respectively reduce and increase costs to the firm.

4.9.2. Government SME Support

In-kind government support (*govaid*) was quite widespread for start-ups with almost half (47%) of firms receiving some kind of support at an early stage with the obvious intention of enhancing performance. Abdesselam et al. (2004) using the present dataset established that government assistance did indeed enhance business longevity.

4.10. Legal Type

Several papers have found that choice of legal type influences or is a signal of the survival potential of a business (see e.g. Cressy, 1996). Bank managers will often tell you that limited companies are more "serious" or "sophisticated" businesses than their unincorporated counterparts as they require a formal legal process to set up (Articles of Association, etc.), have protection (of sorts) from unlimited liability and can be readily sold to another party should the conditions require it.[30] Limited company status may thus partly function as a signal of development potential and ultimate sale value. From Panel A in Table 3, the typical startup business in our sample is however, unincorporated (*ltd=0*) rather than being a limited company; only around a third (35%) of the businesses by contrast were incorporated.[31] We expect the latter's survival chances to be higher.

4.11. Industry Factors

As Table 3 shows, sectors of startup entrepreneurs were quite widely dispersed with a degree of preference for Commerce (mean *commerce*=24%) and to a lesser extent Construction (mean *construc*=14%) and Manufacturing (mean *manu*=13%).

4.12. Regional Effects

Regional effects are modeled in this study by a set of 22 regional dummies.[32] All but one of these dummies were included in the regressions but to save space we present data on the only two statistically significant regional dummies in the

30. Examining some key variables supporting this assertion we note that in our sample limited companies have five times the employment of unincorporated businesses and three times the total assets and are eight times as likely to have managers involved simultaneously in other businesses (portfolio entrepreneurship or interlocking directorships).
31. Cressy (1996) found in the NatWest dataset for the UK about one quarter of the sample were limited companies.
32. Due to the number of regional dummies, to save space in reporting the regression we show coefficients only for the two significant dummies.

subsequent regressions, namely for Poitou-Charentes (*POITOU*) and Bourgogne (*BOURG*).

4.13. Macro Factors

Short and long-term nominal (base) interest rates in France (*stintrat, ltintrat*) during the period averaged at 5.9% and 7.2% respectively per annum. Parker finds that as one might expect, rises in these tend (7/10 studies) to reduce survival chances (via business borrowing costs and their effects on the chances of bankruptcy).[33]

Economic growth (*gdpgrowth*) in the period considered, providing information on changing aggregate demand in the economy, averaged at around 2% per annum and varied between 1.1% and 3.2% over the period.[34] Parker records 16/17 studies as finding either regional or macro growth to enhance survival chances. Our period of study allows only limited variation of conditions through the economic cycle. However an early UK study found little variation in overall closure rates over the economic cycle (see Cressy and Storey, 1994).

5. Economic vs. Statistical Significance

The Concept of Economic Significance[35]

As mentioned in the Introduction a key differentiating feature of this study of survival and that of its predecessors is that we distinguish between statistically and *economically* significant determinants of survival. We define for a Cox Hazard rate regression of closure:

Statistically significant variable: the variable coefficient is significantly different from zero at the 5% level (or better), on a two-tailed test.

Economically significant: the hazard ratio (HR) associated with the variable will increase/reduce the hazard of closure by 1% or more (i.e. for an increase we need HR > 1.01 and for a decrease we need HR < 0.99) *given* that it is statistically significant.

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33. Our measures of interest rates are of Base rates whereas Parker's may reflect total interest rates paid (i.e. Base+margin). However, the two are in practice highly correlated.
34. Note that gdpgrowth can vary across firms because different firms often have different first calendar years.
35. We should emphasise that the idea of economic significance is not new: the STATA Manual, for example, contains many definitions of marginal effects used by economists. However, we are not aware of its use in small business economics and economists generally seem to have moved away from using it as part of their assessment of a model's value.

It is clear from our definitions, then, that being statistically significant is a *necessary but not sufficient condition* for being economically significant: a variable can be statistically significant but not economically significant (has little effect on the HR). But conversely, a variable that is economically significant is always statistically significant.

6. Hazard of Closure Estimates

We estimate the chances of a firm closing in year t given that it has not closed prior to t. This *hazard* of closure is a function of variables determined at startup and subsequently and is therefore in general time-varying.

6.1. Hazard Rate

The hazard rate at time t for a company, h(t) , is defined as the probability that the business will close in the next 'instant' given that it has survived to date. Analytically (in continuous time) we have

$$\boldsymbol{h}(t) = \frac{f(t)}{[1 - F(t)]} \tag{1}$$

where f(t) and F(t) are the density and cumulative density of failure time respectively. This model can be fully parameterised in many ways (see Cleves et al., 2010, for details). The hazard function in the Cox model is, however, not prespecified in the estimation (and so is described as semi-parametric rather than parametric) and this lack of specification makes the model very general, and hence very flexible. It takes the form

$$\boldsymbol{h}(t) = \boldsymbol{h_0}(t)\exp(\beta_1 x_1 + \cdots + \beta_k x_k) \tag{2}$$

where $\boldsymbol{h_0}(t)$ is the so-called Cox Baseline hazard function, the x's are explanatory variables (which may vary over time)[36] and the betas are a set of fixed coefficients.

6.2. Hazard Ratios

To understand the concept of a hazard ratio used in this paper, without loss of generality we simplify to the two-variable case. Equation (2) becomes

36. Note however, they are not time functions. Time-functions can be built into the model without violating its assumptions and this approach was explored in an earlier version of the paper. See Cressy and Bonnet (2016).

$$h(t|x_1, x_2) = h_0(t)\exp(\beta_1 x_1 + \beta_2 x_2) \tag{3}$$

If now x_j changes to $x_j + \Delta x_j$ the hazard defined by (3) changes to

$$h(t|x_1 + \Delta x_1, x_2 + \Delta x_2) = h_0(t)\exp[\beta_1 (x_1 + \Delta x_1) + \beta_2 (x_2 + \Delta x_2)] \tag{4}$$

The joint hazard ratio HR_J is then defined as the ratio of equation (4) to (3):

$$HR_J = \exp\{\beta_1 \Delta x_1 + \beta_2 \Delta x_2\} \tag{5}$$

where it is assumed that x_1 and x_2 are functionally independent. Now, if, for example, the variables are left-bounded we can set $\Delta x_1 = 1$, $\Delta x_2 = 0$ in (5) to get what we call the *standard hazard ratio* for variable 1:

$$HR_1 = \exp\{\beta_1\} \tag{6}$$

And similarly for variable 2:

$$HR_2 = \exp\{\beta_2\} \tag{7}$$

These are what STATA outputs for each variable of a Cox regression and are presented in Table 4a below. However, for two variables in our models the hazard ratio is different from those represented by equations (6) or (7). These are the quadratic left-bounded variable *stintrat* and the doubly-bounded variable *collrat.* These variables we say have *complex hazard ratios* for which the following formulae apply.

Reverting to the notation of equation (5), in the case of the quadratic variable where $x_2 = x_1^2$, x_1 and x_2 are no longer functionally independent and the hazard rate is given by

$$HR_Q = \exp\{\beta_1 + 2\beta_2 x_1\} = HR_1 . HR_2^{2x_1} \tag{8}$$

We now need to know the value of x_1 to calculate the marginal effect of the linear and quadratic terms combined. An obvious choice would be its mean and this is what we use in the empirics.

A variable x_1 which we say is doubly-bounded has values that lie in the unit interval [0,1]. Thus a unit increase can only be applied for $x_1 = 0$. However, by setting

$$\Delta x_1 = 1 - x_1, \qquad \textit{subject to } 1 \geq 1 - x_1 \geq 0$$

we can ensure that x_1 is always "legal" and the hazard ratio can then be seen from (5) (setting $\Delta x2 = 0$) to be

$$HR_{DB} = \exp\{\beta_1 \Delta x_1\} = \exp\{\beta_1\}^{\Delta x_1} = HR_1^{1-x_1} \tag{9}$$

The interpretation of this is now straightforward: HR_{DB} shows the effect on the hazard of closure of increasing x_1 from its current value to the maximum value of 1. Again, we assume in practice that x_1 is equal to its mean value. The hazard ratios of equations (8) and (9) form the basis of the calculations presented in Table 4b below.[37]

6.3. Cox Model Estimates

Estimates of linear and quadratic versions of two models with size measured (i) by employment (Models 1 - 3) and (ii) by total assets of the firm (Models 4 - 6) are presented in Tables 4a and 4b.[38] In models 3 and 6 we substitute initial for current measures of size. In all three versions of each size model our aim is to identify variables that are *economically* significant. This enables us to understand the impact of a variable on the closure hazard as well as the probability of wrongly rejecting the Null as given by the p-value. To save space we present only the hazard ratios (rather than coefficients) and corresponding p-values in Table 4a and 4b.[39] A hazard ratio greater/less than one indicates a positive/negative coefficient on the hazard of closure.

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37. We mention in passing that since our definition of an increment in a variable differs between doubly-bounded variables and the rest, comparison of the magnitude of the impact of collrat with say ref_0 is not meaningful. We are grateful to a Referee for making this point.
38. Numerous other versions of the model were estimated in an earlier paper by the authors, including those based on decaying time functions. See Cressy and Bonnet (2016).
39. To be consistent with our economic impact calculations elsewhere we do not use statistically insignificant quadratic terms to calculate the complex hazard ratios.

Table 4a: Cox estimates of standard closure hazard ratios for loan requesters

	Variable	Model 1 Emp Linear Current	Model 2 Emp Quad Current	Model 3 Emp Quad Initial	Model 4 TA Linear Current	Model 5 TA Quad Current	Model 6 TA Quad Initial
1	ga	NA	NA	NA	*1.000* *0.009*	*1.000* *0.015*	1.000 0.140
2	ga2	NA	NA	NA	NA	1 0.179	1 0.234
3	employ	1.030 0.103	1.029 0.245	**1.105** **0.001**	NA	NA	NA
4	employ2	NA	1.000 0.620	*.999* *0.012*	NA	NA	NA
5	turn	*1* *0.000*	*1* *0.000*	*1* *0.000*	*1* *0.005*	*1* *0.001*	*1* *0.000*
6	turn2	NA	*1* *0.000*	*1* *0.000*	NA	*1* *0.004*	*1* *0.000*
7	gturn	*1* *0.000*	1 0.190	1 0.213	*1* *0.000*	1 0.369	1 0.437
8	gturn2	NA	*1* *0.001*	*1* *0.001*	NA	*1* *0.000*	*1* *0.000*
9	capex	.999 0.127	.999 0.052	.999 0.076	.999 0.226	.999 0.076	*.999* *0.034*
10	capex2	NA	1 0.057	1 0.082	NA	1 0.148	1 0.061
11	lherf	1.283 .258	.201 .256	.209 0.266	1.300 .233	.197 .248	.200 0.253
12	lherf2	NA	.813 .121	.817 0.128	NA	.810 .113	.812 0.118
13	**debtrat**	**1.018** **0.000**	**1.207** **0.000**	**1.206** **0.000**	**1.017** **0.000**	**1.164** **0.007**	**1.194** **0.000**
14	debtrat2	NA	*.996* *0.001*	*.996* *0.001*	NA	.997 0.140	*.996* *0.005*
15	bank2m	1 0.571	1 0.833	1 0.886	1 0.525	1 0.687	1 0.849
16	bank2m2	NA	1 0.825	1 0.760	NA	1 0.619	1 0.847
17	bank2p	1 0.118	1 0.381	1 0.493	1 0.611	1 0.216	1 0.366
18	bank2p2	NA	1 0.228	1 0.243	NA	1 0.226	1 0.244
19	OD	*1* *0.032*	1.002 0.328	1.001 0.339	1 0.187	1.001 0.413	1.001 0.360
20	OD2	NA	1 0.455	1 0.465	NA	1 0.499	1 0.456
21	tradebt	*1* *0.000*	*1* *0.002*	*1* *0.006*	*1* *0.000*	*1.001* *0.017*	*1.001* *0.004*
22	tradebt2	NA	1 0.355	1 0.459	NA	1 0.473	1 0.432

23	othdebt	*1* *0.040*	1 0.250	1 0.184	*1* *0.013*	1 0.360	1 0.404
24	othdebt2	NA	1 0.104	1 0.052	NA	1 0.155	1 0.229
25	**ref_0**	**1.659** **0.000**	**1.705** **0.000**	**1.699** **0.000**	**1.642** **0.000**	**1.704** **0.000**	**1.700** **0.000**
26	**collrat**	**.715** **0.024**	**.461** **0.042**	**.452** **0.036**	**.728** **0.033**	**.465** **0.044**	.48439 0.057
27	collrat2	NA	1.653 0.101	1.664 0.097	NA	1.655 0.100	1.596 0.129
28	male	.988 0.878	.979 0.782	.981 0.805	.981 0.810	.976 0.758	.974 0.735
29	francais	1.252 0.187	1.269 0.175	1.233 0.227	1.257 0.180	1.278 0.164	1.260 0.190
30	**agef**	.995 0.631	**.910** **0.010**	**.908** **0.008**	.996 0.711	**.905** **0.006**	**.907** **0.007**
31	agef2	NA	*1.001* *0.012*	*1.001* *0.011*	NA	*1.001* *0.007*	*1.001* *0.009*
32	**unemp**	**1.390** **0.000**	**1.270** **0.005**	**1.273** **0.005**	**1.379** **0.000**	**1.263** **0.006**	**1.262** **0.006**
33	prevman	1.495 0.065	1.548 0.056	1.507 0.070	1.461 0.088	1.521 0.065	1.556 0.053
34	prevexec	.996 0.968	1.012 0.909	1.004 0.966	1.017 0.877	1.026 0.808	1.023 0.830
35	**durexp10plus**	**.780** **0.001**	**.783** **0.002**	**.774** **0.001**	**.775** **0.001**	**.780** **0.001**	**.785** **0.002**
36	famorrel	1.040 0.756	1.014 0.912	1.021 0.867	1.041 0.750	1.011 0.927	1.018 0.888
37	Fam	.887 0.187	.901 0.253	.897 0.231	.884 0.172	.901 0.250	.902 0.256
38	nonet	.966 0.768	.969 0.789	.972 0.804	.967 0.774	.965 0.762	.972 0.806
39	otheract	.879 0.373	.926 0.603	.941 0.677	.875 0.362	.919 0.574	.914 0.548
40	nodip	1.028 0.763	1.043 0.641	1.048 0.605	1.037 0.689	1.050 0.593	1.052 0.577
41	gendip	1.001 0.948	1.009 0.679	1.009 0.692	1.002 0.927	1.009 0.678	1.011 0.619
42	supdip	1.001 0.995	.986 0.918	.974 0.842	.980 0.878	.967 0.807	.959 0.754
43	**opportunity**	**.837** **0.020**	**.832** **0.019**	**.824** **0.013**	**.835** **0.019**	**.833** **0.020**	**.835** **0.022**
44	**effort**	**.845** **0.031**	**.859** **0.047**	.863 0.053	**.850** **0.036**	**.858** **0.043**	.862 0.051
45	price	**.861** **0.032**	.879 0.064	.876 0.057	**.864** **0.035**	.877 0.058	.877 0.060
46	pub	1.012 0.862	1.015 0.837	1.011 0.873	1.009 0.900	1.009 0.897	1.011 0.878
47	subcon	.981 0.807	.993 0.930	1.003 0.964	.972 0.714	.987 0.863	.991 0.905
48	loancost	*1.001* *0.030*	1.002 0.176	1.003 0.140	*1.003* *0.000*	*1.006* *0.014*	1.004 0.076

49	loancost2	NA	1 0.960	1 1.000	NA	1 0.215	1 0.320
50	depallow	*.998* *0.029*	.998 0.122	.997 0.089	.999 0.160	.999 0.388	.998 0.183
51	depallow2	NA	1 0.656	1 0.529	NA	1 0.972	1 0.865
52	prodtax	1 0.833	.998 0.512	.996 0.188	1.002 0.217	1 0.972	1 0.983
53	prodtax2	NA	1 0.090	*1* *0.008*	NA	1 0.079	1 0.077
54	**govaid**	**.798** **0.006**	.856 0.055	.865 0.074	**.793** **0.005**	**.852** **0.048**	.855 0.054
55	novice	.733 0.469	.647 0.298	.622 0.254	.735 0.475	.628 0.271	.630 0.274
56	optimism	1.008 0.458	1.013 0.207	1.014 0.159	1.007 0.481	1.014 0.193	1.014 0.188
57	**ltd**	**.818** **0.019**	**.817** **0.021**	**.775** **0.004**	.851 0.059	**.837** **0.042**	**.836** **0.041**
	indy effects?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
	regnl effects?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
58	**stintrat**	1.113 0.746	**4.311** **0.028**	**4.374** **0.025**	.993 .596	**4.342** **0.028**	**4.276** **0.030**
59	**stintrat2**	NA	**.867** **0.047**	.875 0.060	NA	**.866** **0.044**	.876 0.063
60	ltintrat	.694 0.521	1.302 0.912	2.653 0.686	3.168 0.273	1.128 0.960	2.529 0.702
61	ltintrat2	NA	.960 0.856	.899 0.640	NA	.973 0.902	.903 0.656
62	gdpgrowth	.858 0.704	1 NE	1 NE	.534 0.157	1 NE	1 NE
63	gdpgrowth2	NA	1 NE	1 NE	NA	1 NE	1 NE
	Pr>F	0.0000	NR	NR	0.0000	NR	NR
	Nobs	22,234	22,205	22,205	22,234	22,205	22,205
	Nfirms	5,661	5,653	5,653	5,661	5,653	5,653
	Nclose	2,027	2,025	2,025	2,027	2,025	2,025
	Npop	51,983	51,865	51,865	51,983	51,865	51,865

Table reports Cox proportional hazards estimates of closure for startup loan requesters. Current models (1,2,4 and 5) have all variables measured at their current values; Initial models (3 and 6) have the same except that the size measures refer to startup values. All variables are defined in Table 2. Each cell reports the hazard ratio (exp(beta)) and below it the p-value for the variable in the model identified in the column heading. All coefficients (betas) are adjusted for probability sampling and SEs are adjusted for the sampling weights, stratification and clustering by firm. In some models an F statistic for the whole model cannot be calculated due to a lack of degrees of freedom. This does not invalidate the model, merely makes it impossible to test the Global Null hypothesis. (Other hypotheses can of course be tested). Figures in bold indicate economically significant variables (industry and regional dummies with a Yes in bold indicate that at least one of the dummies in each set is economically significant regardless of control choice). Those in italics, are statistically but not economically significant variables, and those in normal typeface, statistically insignificant variables. We define statistical significance as a p-value < 5% and economically significant as statistically significant and in addition a hazard rate either >1.01 or < 0.99. NA means Not Applicable i.e. refers to a missing quadratic variable in a linear model. NE means not estimated due to collinearity. NR means that STATA does not report the statistic as it may be misleading. (This does not imply there is an issue with the other regression estimates). Emp refers to total employment, TA to total assets. Nobs, Nfirms and Nclose are the *unweighted* numbers of firm-year observations, firms and closures in the sample. Npop is the number of observations in the population obtained by weighting sample strata with the inverse probability sampling weights.

Table 4b: Cox estimates of complex hazard ratios for loan requesters								
Variable	**Mean**	**Haz. rat.**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
collrat	.577	HR_1	**.715**	**.461**	**.452**	**.728**	**.465**	NA
		HR_{DB}	**.868**	**.721**	**.715**	**.874**	**.723**	NA
stintrat	4.377	HR_1	0	**4.311**	**4.374**	0	**4.342**	**4.276**
stintrat2		HR_2	NA	**.868**	0	NA	**.866**	0
		HR_Q	0	**1.248**	**4.374**	NA	**1.232**	**4.276**

Table shows the hazard ratios for collrat and stintrat calculated from equations 8 and 9 and the estimates in Table 4a, using mean values of the relevant variables in the formulae. Variable coefficients that are statistically insignificant have been set to zero. NA means not available (as in the linear models). Numbers in boldface are economically significant.

6.3.1. Summary of Estimation

The simplest way to summarise the results in Tables 4a and 4b and to compare them with expectations is to report tables showing the statistical significance and economic importance of the regressors. This is done in Tables 5a-5c. We start by examining the results on credit constraints in the short and long run, the central interest of this paper.

Table 5a: Economically important variables			
Group	Subgroup	Variable	Fraction of models in which econ sig
Capital constraints	Startup	ref_0	6/6
	After startup	collrat	5/6
Firm Risk	Financial risk	debtrat	6/6
Human capital	General	agef	4/6
	Labour market experience	unemp	6/6
		durexp10plus	6/6
	Entrepreneurial opportunism	opportunity	6/6
Entrepreneurial strategy	Expansion	effort	4/6
Government assistance		govaid	3/6
Legal status		ltd	5/6
Industry factors		7 Industry dummies	Depends on choice of control industry.
Regional factors		19 Regional dummies	Ditto, region.
Macro factors	Short term interest rates	stintrat stintrat2	4/6 2/4

Table shows proporton of variables that are economically significant in models 1-6 of Table 4. Economically *significant* means a variable is (a) statistically significant at the 5% level on a two-tailed test ($p<=0.05$) *and* (b) has HR>1.01 or <0.99 , where HR is the standard Hazard Ratio for that variable. A variable is economically *important* if it is economically significant in a majority of models (i.e. at least half). The economic significance of the industry dummies depends on the choice of control industry - as pointed out by a Referee. Our control here is *catering* and all dummies apart from *food* are economically important.

Table 5a shows that, apart from the important Region and Industry dummies (see below), there are only twelve variables or 19% of the total, including squared terms, out of an original sixty three reported in Tables 4a and 4b, that are *economically important*.[40]

Regarding specifics, the variables that matter economically are measures of short-term loan costs (interest rates), capital constraints (at startup and later), risk (financial rather than market), human capital (general and labour market experience), entrepreneurial opportunism, entrepreneurial strategy (attempts to expand), Limited Company status and government assistance.

From Table 4b a unit percentage-point rise in short-term interest rates increases the firm's hazard of closure by 25% (Model 2). Startup loan refusal again has dramatic effects, increasing the hazard of closure by a remarkable 64%-70% across models and so is also economically important for the firms affected. Subsequent collateral-based lending constraints, measured by *collrat*, are also economically important being economically significant in five out of the six models. From Table 4b *collrat* has a hazard ratio of 71-72% in the preferred quadratic models indicating that a maximal increase in collateral availability from the mean decreases the hazard of failure by 28-29%. Thus, short-term interest rates and capital constraints continue to be economically important well into the startup's future, a result that is empirically novel and our principal finding. Finally, financial risk is revealed to play an economically important role in startup failure for those that borrow, raising the failure hazard in all models, and creating a treatment effect that does not vary over time. Entrepreneurs thus do not learn to manage finance significantly better as their business develops.

Amongst the human capital variables we find relevant labour market experience and unemployment experience to have important economic impacts along with entrepreneurial age (as in Cressy, 1996). We mention lastly a salient feature of these economically important effects on the hazard of closure is that they are *persistent* – their effects last for up to 5 years - although there are trends over time, as Charts 1-3 show (see later discussion).

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40. Since a given variable is not necessarily economically significant in all models we redefine a variable as being economically important if a majority of models (i.e. at least half) for that variable are economically significant. See Table 5a.

Table 5b: Statistically significant but economically unimportant variables				
Group	Subgroup	Variable	Fraction of models in which var is stat significant	Fraction of models in which var is econ significant
Size	Size	ga	2/2	0/2
		employ_0sq	1/1	0/1
Performance	Sales	turn	6/6	0/6
	Sales growth	turn 2	4/4	0/4
		gturn	2/6	0/6
		gturn2	4/4	0/4
Financial capital	Trade debt	tradebt	6/6	0/6
	Overdraft	OD	1/6	0/6
	Other debts	othdebt	2/6	0/6
Financial costs	Loan interest and principal	loancost	3/6	0/6
Government intervention	Depreciation allowance	depallow	1/6	0/6

Table reports variables in models 1-6 of Table 4 that are statistically significant at the 5% level on a two tailed test (p<=0.05) but have hazard ratios that lie between 0.99 and 1.01. Economically unimportant means less than half of the models find it to be economically significant.

Table 5b shows that 11 variables (17% of the total) are statistically significant but economically *un*important. These include measures of firm size and growth, of financial capital (trade debt notably), loan costs and a measure of government policy (*depallow*). Trade debt is statistically significant in all models, despite being economically significant in none. By contrast initial size, measured by employment, is not only statistically but also economically significant. The apparent paradox, however, is that, according to the industrial economics literature, it has the "*wrong*" sign: a unit increase in initial employment *increases* the hazard of closure by 10%! We say "apparent", however, since this outcome is in fact readily explained by the theory of allocation of attention (see Gifford, 1992). Alternatively, a positive impact of initial size on the probability of exit may reflect the higher flexibility and agility associated with a "lean" start-up strategy relative to a resourceful strategy (Burke et al., 2018).

Table 5c: Statistically insignificant variables			
Group	Description	Variable	Fraction of models in which variable is stat. insignif.
Size	Initial total assets Current employees	ga_0 employ	1/1 2/2
Growth	Capital expenditure	capex	5/6
Financial capital	Bank debt	bank2m	6/6
		bank2p	6/6
		OD	5/6
	Other debt	othdebt	4/6
Government policy	Sales tax Deprec'n allowance	prodtax depallow	6/6 5/6
Macro factors	Long term Base rates	ltintrat	6/6
	Ann. % change in gdp	gdpgrowth	2/2
Education	Diplomas	nodip gendip interdip supdip	6/6 6/6 6/6 6/6
Optimism	First time entrep. agef*novice	novice optimism	6/6 6/6
Gender	Male	male	6/6
Nationality	French	francais	6/6
Entrepreneurial strategy	Advertising Subcontracting Portfolio approach	pub subcon otheract	6/6 6/6 6/6
Entrepreneurial context	Family and close relationships	fam famorrel	6/6 6/6
Networks	No entrep. network	Nonet	6/6
Firm risk	Competition	lherf	6/6
Human capital	Executive experience	prevexec prevman	6/6 6/6
Table refers to the hazard ratios of models 1-6 of Table 4. All variables are insignificant at the 5% level on a two tailed test (i.e. p>=0.05)			

Table 5c shows that there are 28 statistically (and so economically) insignificant (linear) variables. 21 of these variables fail to reach statistical significance in *any* of the six models. We find that the employment measure of current (year t) size, unlike the total asset measure, is *irrelevant* both statistically and by implication, economically, to closure.[41] Initial total assets as a measure of size is statistically insignificant but in this case (in contrast to initial employment) has the "right" sign (see Table 4).[42] Finally, the extent of competition measured

41. Since there is little variation in employment numbers over time (93% of firm-years amongst loan requesters have less than 7 employees) this may be one reason the t-stat on employment is insignificant. It should also be noted that our employment coefficient (since it is positive) implies that (if it were statistically significant) at every year a unit increase in employment would (contrary to the literature) increase the hazard of closure.

by the Herfindahl index (*lherf*) contrary to 14/16 studies reported in Parker, is statistically insignificant in all six models.

Financial capital is also, as expected, quite statistically insignificant for survival when measured by bank overdrafts, short- or long-term loans or by asset-based finance, and is a function of the economically important variables as expected; see Bates (1990) for the US and Cressy (1996) for UK comparisons.[43] Finally, and echoing the UK findings of Cressy and Storey (1994), we find the macro variables (other than short-term interest rates, which *are* important and dramatically increase the chances of closure) have *absolutely no statistical effect once the other factors are included*.[44] This goes against the majority findings of the literature summarized in Parker and is prima facie surprising, but may be due to the relatively high correlation of gdp growth and base rates. Portfolio entrepreneurship, which we have argued should increase the failure hazard if the limited span of control is a binding constraint, has in fact the 'wrong' sign, but is in any event statistically insignificant. The same is true of entrepreneurial optimism and entrepreneurial strategy (other than business expansion) together with entrepreneurial context (family, friends and relatives who are entrepreneurs and networked colleagues).

What is not of course shown in Tables 5a-5c but is widely accepted in the industrial economics literature is the role of business age in survival. This is because in our analysis it is not modeled as a regressor but functions, as mentioned above, rather as the "failure time variable". However, we can see the role of business age is a very important "control" by plotting the estimated baseline hazard function of the Cox model. See Chart 1.

6.3.2. Overall Hazard Function

In Chart 1 we can see that the hazard rate first rises to an initial peak at around three and a half years, and rises to a further peak at four and a half years, after which it begins what seems like a major decline.[45] The shape of the curve is

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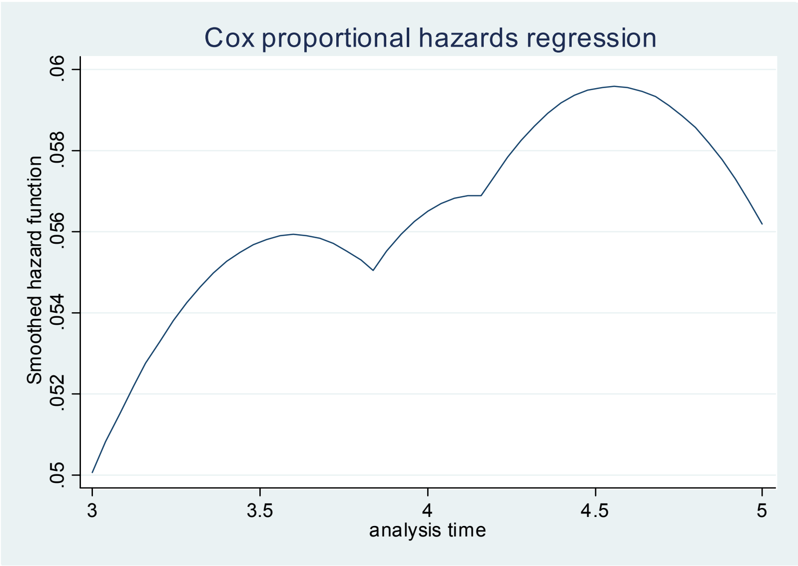
42. Current total assets, as we have seen in Table 5b, are statistically significant but turn out to be economically unimportant.
43. A simple Mixed effects panel data regression of bank2p against these variables (and employment) illustrates this very clearly. Regression results are available on request.
44. We do not claim that closure due to bankruptcy is cycle-invariant and are sure that it is not. However, most closures are not due to bankruptcy in our dataset since the median firm does not borrow, except via trade debt. It is also worth noting that the 6 year time span of the data is of course not long enough to really examine the effects of the economic cycle. (We are grateful to Jane Binner for pointing this out to us.) However, we do have some variation in long term interest rates (4.6% to 7.5%), in short term interest rates (2.7% to 6.6%) and in gdp growth rates (1.1% to 3.2%). It has also been suggested that a better alternative to gdp growth might be growth of industrial production. However, as we are looking to measure aggregate demand effects GDP growth (or GNP growth) is probably the better of the two. There is quite a high degree of collinearity between gdpgrowth and ltintrat making it impossible to include both in all of the regressions.

broadly consistent with the theoretical model of Cressy (2006a) and with several empirical papers (e.g. Brüderl et al., 1992, Cressy, 1996)[46] and reflects (a) the riskiness of survivors to a given age and (b) the process of selection whereby entrepreneurs exit for various reasons over time.

Chart 1: Overall hazard of closure function



Note: Chart is the smoothed Cox hazard estimates from model 3 (quadratic, initial employment). Virtually identical charts apply for models 2, 5 and 6 and are available on request from the authors.

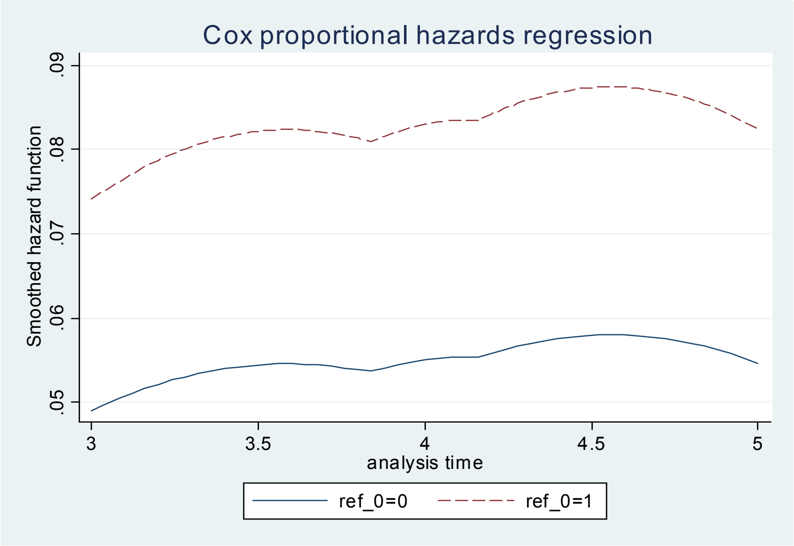
6.3.3. Conditional Hazard Functions

Hazard functions can be plotted for different values of the covariates to get an idea of the impact of a unit or small change in an economically significant covariate on the baseline hazard over time. We call these hazard functions *conditional* hazards as they are conditioned on assumed values of the covariates. Charts 2 and 3 do this for loan refusal and collateral availability respectively. It is noteworthy that the first of these variables has no time variation associated with it but it does in fact seem to have treatment effects which vary with the age of the firm. The hazard of closure for startup loan refusal (Chart 2) and the treatment effect (vertical difference between the curves) of refusal tend to increase over years 2 to 5 and end up some 13% and 33% *higher* respectively at the end of the period over

45. The graph starts at year 3 (rather than year 1) as we need 2 years of data to calculate a hazard rate. Likewise, year 6 is a censored observation for which the risk of failure is unknown.
46. We attempted to provide a suitable parametric formulation of the Baseline hazard function using the Weibull, Lognormal, Gompertz hazards but none (as might be expected from the shape of the Cox hazard function) proved to be plausible.

initial values. This latter implies that rejected startup loan applicants that survive become *more* disadvantaged relative to those offered a loan as time wears on. Regarding collateral availability, a time-varying variable measuring subsequent capital constraints, the hazard of closure and the treatment effect remain roughly constant over time (Chart 3).[47,48]

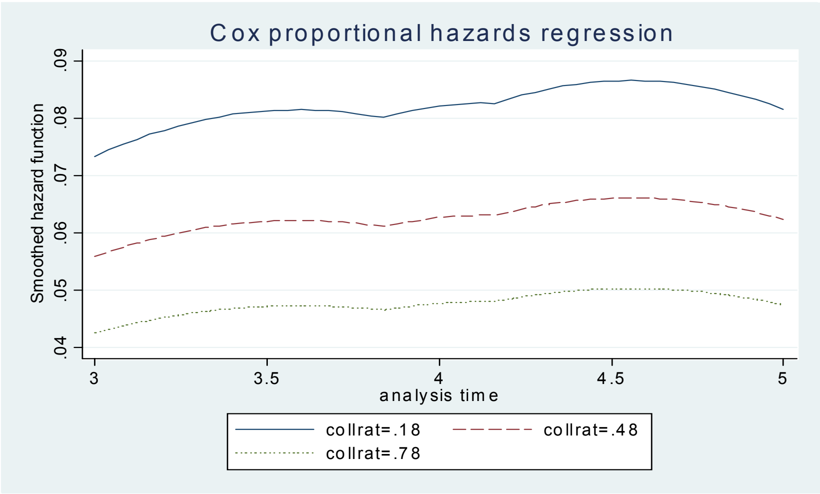
Chart 2: Closure hazard and startup loan refusal



Note: Chart is a smoothed Cox baseline hazard estimate from model 3 (quadratic, initial employment) . Virtually identical charts apply for models 2, 5 and 6 and are available on request from the authors.

47. We plot three curves, with the hazard function evaluated at the mean +/- one standard deviation.
48. Of those variables for which charts are not presented, entrepreneurial age at startup again has a relatively important initial differential effect but subsequently the age effects converge downwards indicating that the effects of age become less important over time as entrepreneurs develop the skills necessary to survive. Financial risk, represented by debtrat has a hazard function and a treatment effect that are virtually constant as the firm ages.

Chart 3: Hazard function and collateral



Note: Chart is the smoothed Cox baseline hazard estimate from model 3 (quadratic, initial employment). Virtually identical charts apply for models 2, 5 and 6 and are available on request from the authors.

7. Conclusions

This paper used a very large French panel dataset, a hazard rate model and a near-exhaustive range of explanatory variables to examine the impact of short and long-term bank lending constraints and other economically important factors in small business startup failure. Economically important factors turn out to be a relatively small subset of the original set of regressors and include measures of financial cost (short-term interest rates), bank lending constraints (at startup and later), prior unemployment, labour market experience and financial risk. A one percentage point increase in short-term interest rates was found to increase the hazard of closure by 25%. Bank loan refusal at startup also turned out to have a major impact on the firms denied a loan, raising the hazard of closure by a daunting 64-70% in each year of the firm's existence. Subsequent constraints on bank borrowing via collateral availability were also found to permanently and substantively increase the hazard of closure. Thus we showed that both early *and later* financial constraints seriously affect the businesses' survival prospects, controlling for a very large range of other factors. Finally, financial risk (as measured by the debt to total assets ratio) was found to play an important subsidiary role in startup failure, with a treatment effect that again did not vary with time. Thus, a significant percentage of entrepreneurs are beset by lending constraints into the longer run and do not learn to manage finance significantly better as their business develops. This latter finding suggests that very little learning about financial prudence by entrepreneurs occurs as time wears on, a novel empirical result, although one anticipated in Cressy (1999).[49]

The remaining economically important variables have been identified in the literature as being statistically significant. In this paper, however, we were able to measure their *quantitative* importance in failure.[50] Regarding the effects of human capital, entrepreneurial talent and strategy on the closure rate, relevant labour market experience, as expected, mitigated the hazard of closure, with ten years relevant work experience reducing the hazard by a substantive 22%. This is in contrast with prior unemployment experience which increased the closure hazard by 26-39%. Entrepreneurial ability, proxied by an 'eye for an opportunity' (what we called *entrepreneurial opportunism*), also paid economic dividends in survival, and, as might be expected, these dividends persisted through time. Spotting a gap in the market at startup lowered the entrepreneur's overall hazard of closure by a nontrivial 16-18%.

Interestingly, only one of the five entrepreneurial strategy variables examined were economically important, namely attempts by the entrepreneur to expand the business (a finding consistent with Cressy, 2006a). Attempting to achieve this objective lowered the hazard of closure by 15-16%. But given the absence of any economic role for the other four strategies we conclude (in line with the literature) that the typical startup entrepreneur is non-strategic in character.

Finally, government assistance to startups and lower short term Base rates turned out to be much more effective than depreciation allowances or reduced product taxes in enhancing business survival. The marginal impact of receiving public assistance reduced the failure hazard by 14-21% whereas the other policies had no economic impact whatsoever.

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49. Cressy (1999) provides an early appreciation of the 'failure to learn' amongst startup entrepreneurs, using UK data from a similar period to the present one. In this paper he associates learning ability with various static measures of human capital. The learning examined is closely akin to the learning-by-doing concept pioneered by Arrow.

50. At the margin of course.

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