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ARE BUSINESS STARTUPS DEBT-RATIONED?*

Robert Cressy

Using a large random sample of UK startups and a rich data set, the paper demonstrates that human capital is the 'true' determinant of survival and that the correlation between financial capital and survival is spurious. Provision of finance is demand-driven, with banks supplying funds elastically and business requests governing takeup. Firms self-select for funds on the basis of the human capital endowments of the proprietors with 'better' businesses more likely to borrow. A reason why others have seemingly identified startup debt-gaps may be the failure to test a sufficiently rich empirical model.

A rich literature on debt gaps under asymmetric information has emerged in the last decade, flowing from the early papers of Jaffee and Russell (1976) and Stiglitz and Weiss (1981).[1] Whilst the theoretical underpinning of this thesis have been questioned (most forcibly in de Meza and Webb (1987; 1989; 1990)) its broad implications seem to have been accepted by policy-makers around the world. Indeed, in many countries, substantial sums of public money have been spent to alleviate debt gaps that are alleged to exist, particularly amongst smaller firms. (See, for example, ENSR (1993)). Only recently, however, has empirical work been able to assess the validity of these claims.

In support of the debt-gaps thesis are the findings of Evans and Jovanovic (1989) (subsequently 'EJ'), Black *et al.* (1990), Blanchflower and Oswald (1990), and more recently Holtz-Eakin, Joulfaian, and Rosen (1994*a*; *b*) (subsequently 'HEJR'). They show, *inter alia*, that the probability of survival is a function of the individual's assets. Under certain assumptions this can be shown to imply credit rationing by banks (see below). Although pioneering works, these studies are characterised by one clear deficiency; namely, the inclusion of only a relatively small set of human and financial capital variables in the survival function, thereby bringing the robustness of their empirical specifications into question. Failure to include the full spectrum of variables may result in the spurious correlation of assets with survival, and to the erroneous inference that credit markets are imperfect.[2]

Clearly finance depends on the perceived characteristics of the business, including those of the owner, since these characteristics affect both parties' returns to the lending contract via the probability of failure. The question commonly addressed in the credit rationing debate, however, has been whether financial assets affect the survival of the business, with a positive correlation

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[1] For a survey of the area see Hillier and Ibrahimo (1993).

[2] Other studies, using different routes, have come to this conclusion, namely the absence of credit rationing. See e.g. Berger and Udell (1992), Cosh and Hughes (1994), Aston Business School (1990), Small Business Research Centre (1992), and Cressy and Cowling (1995).

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taken as indicative of funding deficiency. But even if such a correlation exists, it is still questionable whether it represents a financial deficiency in the business. If, as some recent studies have suggested (e.g. Cressy, 1996), assets are in fact explained by human capital, an observed correlation may indirectly indicate the human deficiencies of the business. On this theory, funds and the assets that seem to underpin them, are entirely 'endogenous' to survival: the bank selects businesses, or businesses self-select for finance to yield maximum returns. If the bank does the selection, the role of the bank is simply that of a racing punter who uses knowledge of 'form' to bet on the winner. Rationing exists, but is human capital-based and reflects the bank's desire to bet wisely. On the other hand, if the firm does the selection, the business bets on itself – but perhaps with the advantage of 'insider' knowledge. In this case there is no rationing, since the bank simply allows firms to decide whether they wish to accept its offers. In both cases, however, the influence of finance on performance is nil and the correlation between finance and survival vanishes once human capital is controlled for.

This, in fact, is a surprising conclusion of the present paper. Using a recent UK bank database of some 2,000 startups, and a rich vector of human and financial capital variables we demonstrate that the correlation between survival and financial capital is in fact spurious. Both financial and human capital 'explain' survival, but once a convincing human capital structure for the firm is specified, the econometric 'marginal product' of financial capital is zero. We conclude that firms self-select for finance (rather than being selected by the bank), those with greater human capital being more likely to take up the bank's offer. Thus there is no credit rationing of startups. In order to explain the data, however, a new utility-based model of human capital and survival is formulated consistent with the evidence.

The plan of the paper is as follows. Firstly, the EJ theory is elaborated. Secondly, a specific human capital theory is developed based on a set of intuitively reasonable hypotheses relating business survival to owner and business characteristics at inception. Thirdly, we establish whether traditional measures of business borrowing, entrepreneurial assets and the value of outside opportunities, 'explain' the data. At the fourth stage we test whether the finance and opportunity cost variables are significant given the fundamental variables included in the model.

I. THE EJ MODEL OF SURVIVAL

An entrepreneur has the choice of either remaining in business or switching to wage employment, choosing the state with the highest expected return. Profits from entrepreneurship net of the opportunity cost of wage employment are:

$$\pi = \theta f(k) - rk - w, \tag{1}$$

where θ is (unobservable) entrepreneurial ability, k capital used in the business, w the wage rate, r the rate of interest on borrowing, and $f(.)$ a concave production function. k is chosen to maximise π, yielding the unconstrained interior optimum capital

$$k = k^*(\theta; r) \tag{2}$$

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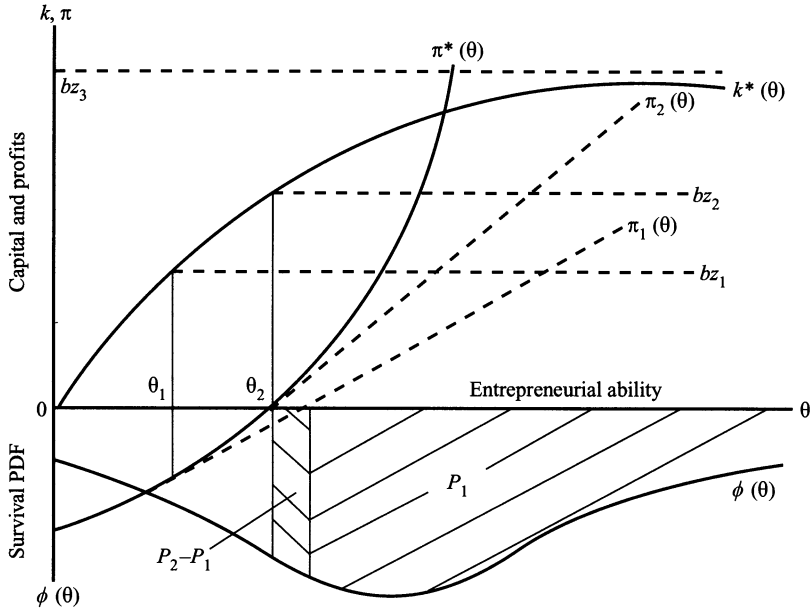

Fig. 1. Survival in the EJ model.

and unconstrained maximum profits

$$\pi = \pi^*(\theta; r, w). \tag{3}$$

If π^* is positive, the entrepreneur stays in business (survives); else (s)he switches to wage employment.[3]

If Fig. 1 the entrepreneur's demand for capital, $k^*(\theta)$,[4] is increasing in entrepreneurial ability, θ. The maximum capital he can obtain from the bank with assets z is, however, bz ($b > 0$). The unconstrained maximum net profit function, $\pi^*(\theta)$, and the constrained profit functions $\pi_i(\theta)$, which fall below $\pi^*(\theta)$ in the constrained region ($k^* > bz_i$), are also increasing in ability. The probability of survival, namely, the probability that maximum net profits are positive, is given by the area under the pdf of θ, $\phi(\theta)$, to the right of the intersection of the relevant profit function (constrained or unconstrained) and the θ-axis.

For capital constraint bz_1, entrepreneurs with ability $\theta > \theta_1$ are constrained; similarly for bz_2 and θ_2. Note, however, that the curve $k^*(\theta)$ will never intersect constraint bz_3, so this constraint is always ineffective: small variations in the constraint cannot influence the probability of survival, which remains fixed at the area $P_2 = (P_2 - P_1) + P_1$. However, the probability of survival is a function of z for sufficiently tight capital constraints. Consider the marginal entrepreneur, θ_2, whose profits are zero in the unconstrained situation. He will find that if capital constraint bz_1 is applied by the bank his profits will become

[3] In EJ the entrepreneur compares the gross profit function $\pi_G = \pi + rz$ with the return to wage employment, $W = w + rz$, and switches if $\pi_G > W$, or $\pi > 0$. Thus the difference is merely one of notation.

[4] In this notation we have for simplicity ignored the dependence of capital on r and of profits on w and r.

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negative (at $\pi_1(\theta_2)$), thus forcing him to switch into wage employment. The probability of survival then decreases from the area P_2 to the area P_1. A testable prediction of the EJ model is therefore that if the probability of survival depends on assets, then capital constraints exist.

Note also that π^* is decreasing in w, the opportunity cost of entrepreneurship. From Fig. 1 survival is therefore decreasing in w, since the effect of an increase in w is to pivot π^* to the right, leaving k^* fixed. Human capital plays a role in survival in this model only through the wage rate w. Since w is increasing in human capital the effect on survival is negative. Survival is also therefore independent of human capital, given w – a rather restrictive result. However, a small change to the EJ model allows the relative marginal products of human capital in wage- and self-employment to determine the role of human capital in survival, though additional assumptions are now necessary to determine its sign. We call this the Generalised EJ model.

II. THE HC MODEL OF SURVIVAL

In this section we outline a human capital model of survival. An unpublished Appendix, available from the author on request, provides a more detailed analysis.

Why should the owner's human capital determine the survival of a business? At first the idea seems implausible. The assumptions that follow, however, lead naturally to such a model. First, assume that positive utility is associated with the exercise of work and business skills, as measured by human capital.[5] Better skilled individuals have more satisfaction from both wage employment and entrepreneurship. Secondly, assume that the human capital stock of the individual is an initially increasing, concave function of age. This is plausible in terms of the lifecycle of the individual whose human capital can be thought of as accumulating with investment – experience, education etc. – and depreciating with age – physical deterioration.[6] Thirdly, appealing to recent empirical evidence, assume that, other things equal, the expected utility return from entrepreneurship for existing entrepreneurs exceeds that from wage employment (Blanchflower and Oswald, 1993). Thus an individual as entrepreneur derives more utility from the exercise of his skills than the same individual employed as wage earner.[7] Fourthly, following the Jovanovic (1982)

[5] It must be emphasised that the term human capital used here is not identical to the usual measure found in the labour economics literature, which treats education as the primary factor. Our emphasis, as will become apparent later, is much more on certain kinds of experience. Also, we regard the exercise of skills, as opposed to the expenditure of 'effort' as yielding utility rather than disutility.

[6] To be more specific, owner maturity brings experience, a form of investment in general 'human capital'. This enhances business skills, the utility of which represents the return to being in business. However, as part of the human ageing process, the capital stock depreciates over time and requires investment to maintain its value. If investment decreases (say) exponentially with age (broadly, 'it is more difficult to teach an old dog new tricks') the relationship between human capital stock and age will be concave with a turning point where depreciation exceeds investment. A full mathematical derivation of the HC stock model is presented in Cressy (1994).

[7] An alternative formulation would have been let the same individual accumulate a vector of human capital characteristics that can only be exercised in different states of the world (wage employment, entrepreneurship, etc.). Then, the utility function of human capital would be state-invariant but skill levels would differ. It can be shown that under certain assumptions the two approaches are formally equivalent.

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view of entrepreneurship as a learning experiment, assume that the knowledge of one's entrepreneurial skill, and hence the utility associated with it, is uncertain but that this uncertainty is independent of (or decreasing in) age. If, finally, the utility of human capital in wage employment is assumed certain, the foregoing implies that older entrepreneurs will find the chances of entrepreneurial utility falling below their reservation utility are lower than for their younger colleagues.[8] Hence they will stay in business longer.

The human capital (henceforth 'HC') theory is illustrated in Fig. 2. Human capital, $K(a)$, is an increasing, concave function of age. The utility of the human capital stock in wage employment (UWE) is also $K(a)$, and the average utility of self-employment in the population of entrepreneurs (USE) is $\mu K(a)$, $\mu > 1$. Thus the self employment expected utility function $\mathrm{E}(USE)$ lies everywhere above that from wage employment. Actual utility from self-employment for entrepreneur 'a', is $USE = \mu K(a) + \epsilon, \epsilon \sim \mathrm{N}(0, 1)$.[9] Therefore the density of USE is $\phi[\mu K(a) + \epsilon] = \mathrm{N}(\mu K(a), 1)$ and an entrepreneur of age $a_2 > a_1$ will be more likely to find the utility of self-employment exceeds that of wage employment (in Fig. 2, shaded area $S_2 >$ shaded area S_1).

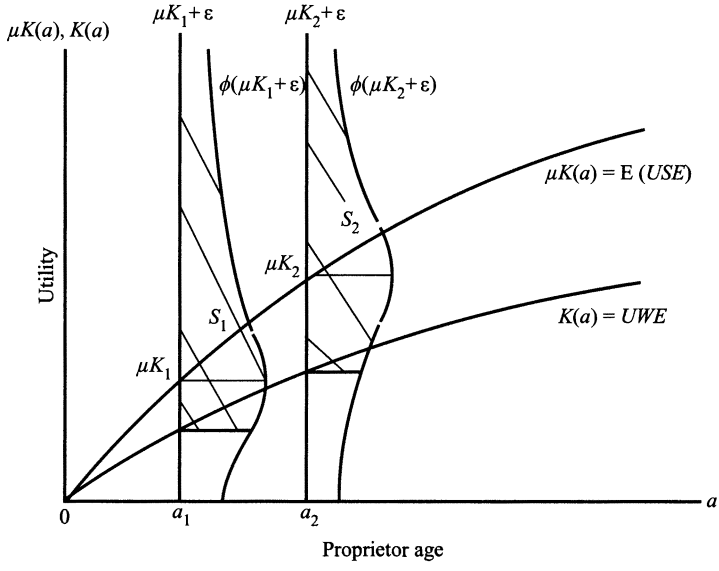

Fig. 2. HC survival model.

Thus we state the first hypothesis of the human capital model:

H1. There is a positive, concave relationship between general human capital of the business' proprietors, measured by age, and the survival of the business

[8] The vast majority of entrepreneurs in this sample will have made the transition from work to self-employment to arrive at their current state. Many will have chosen self-employment precisely to escape the conditions of wage employment they know only too well. Thus we can assume any uncertainty about the utility of exercising human capital in wage employment has been eliminated once the transition to self-employment has been made.

[9] The notation $\mathrm{N}(x, y)$ refers to the Normal density with mean x and variance y.

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Table 1

Predictions of the Two Theories

Variable /vector	Proxies	Effect on survival in the EJ theory	Effect on survival in the HC theory
x_H	Human capital variables	o/?	+
x_{F1} w	Expected wage	o	o
x_{F2} z	Financial assets	+/o	o
X_{F3}	Borrowing variables	o	o
X_I	Industry dummies	?	?

In addition to proprietor age, we can identify three other human capital factors which influence the utility of employment/self-employment.[10]

H2. The number of proprietors in the business is positively associated with 'group' human capital and so with survival

H3. The specific human capital of the proprietors measured by (a) *work experience in the same area as the startup and* (b) *vocational qualifications, enhances business survival*

H4. Business purchases embody 'frozen' human capital and so survive longer than wholly new starts.

We also assert, on the basis of the HC model above,

H5. Financial capital inputs (measured by the startup finance vector), proprietor assets (measured by housing equity) and the return to the alternative occupation (measured by expected income in the alternative state), play no role in survival, once the fundamental factors identified in H1–H4 *have been taken into account.*

This is the sense in which the term 'fundamental' is used in this paper. Finally, we assert that:

H6. Bank finance will be more likely to be used by human capital intensive businesses, and asserts play no role in the lending process once human capital is controlled for.[11]

Table 1 summarises the predictions of the EJ[12] and HC theories for the probability of survival.

III. THE DATA

The empirical work is based on a random sample of some 2,000 startups who opened business accounts with National Westminster Bank in Great Britain in

[10] The detailed reasoning behind these hypotheses is available in the unpublished Appendix.

[11] The reasoning behind this hypothesis is also explained in the unpublished Appendix.

[12] In the original EJ model the dependence of w on x_H makes the equation to be tested a function of either w or x_H. However, EJ actually test a model in which both w and x_H appear. No explanation is provided for this empirical specification. In the generalised version of the EJ model presented above the appearance of both w and x_H is however legitimate, since the productivity of the entrepreneur is a function of the latter. This, as we have noted, makes the sign of the effect of x_H on survival ambiguous.

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1988.[13] The vast majority (80%) of such starts were 'entirely new', only 12% being purchases of existing businesses, with the remainder upgradings from other (e.g. Personal) accounts. Background information on these businesses and their proprietors was obtained from a questionnaire at account opening stage, with bank account and survival information subsequently recorded.[14] Background information includes business legal type, number of employees and industry sector. Proprietor data includes sex, age, education, vocational qualifications, sources of finance, prior income, work and business experience, and so on. The following sets of variables are used in the regressions below, with precise definitions provided in Appendix 2.

Key groups of variables

Survival

Survival is defined in terms of business account status. If the business account, opened in the second quarter of 1988, was still open in the first quarter of 1992, the business was defined as surviving; otherwise as not.

Human capital

HC1. General human capital – the number and average age of proprietors.

HC2. Specific human capital: experience – work and business experience in the area of the start, time the business (if acquiring new management) has traded, and startup mode.[15]

HC3. Specific human capital: education – the fraction of the business' proprietors with 'O' and 'A' levels and degrees.

HC4. Specific human capital: vocational qualifications – trade apprenticeship, HNC, HND and professional qualifications of the proprietors.

[13] It might be argued that the sample of businesses actually opening accounts is itself subject to bias via credit rationing. In other words the bank might allow only those businesses to which it was going to lend, to open accounts. Credit-constrained businesses would then be those that were not allowed to open accounts. At the outset we need to assume of course that finance is not available from other sources to those refused accounts at the bank in question. Even doing this, however, a number of facts run counter to the proposition. First, according to bank officials less than 1% of individuals that requested a business account were in fact refused one in this period, yet only $\frac{1}{3}$ of businesses in the sample actually requested a loan to commence in business. So the notion that the bank selected these businesses because it wished to lend to them does not seem plausible. Secondly, only one third of the accounts that were opened survived three and a half years. This figure is consistent with that for other populations of startups e.g. derived from VAT statistics. The latter incidentally understates closures relative to the present dataset because of the higher proportion of limited companies in the sample. This correspondence makes it implausible to assume the bank selected its sample of clients because of their superior survival chances. Finally, businesses need a bank account for payments and receipts regardless of their borrowing decisions. The bank can profit from this need by charging for chequeing facilities and from the sale of other products (insurance, mortgages, etc.). Therefore, we need not assume that profit maximisation by banks necessarily implies the selection process suggested. In conclusion, there seems little source of bias in the assessment of credit rationing via the sampling process in this study. I am, however, indebted to a perceptive referee for requiring clarification of the issue.

[14] Few accounts closed as a result of account transfers between banks. Thus any potentially spurious effects of account transfer on the business closure data are obviated. (See Cressy, 1993, for details).

[15] A more appropriate term for the business purchase concept might be firm-specific capital rather than human capital. I am indebted to a referee for pointing this out. However, to keep the terminology simple one term has been used to cover purchases as well as the other more obvious human capital elements. The unpublished Appendix contains a discussion of the theoretical role of the business purchase variable.

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HC5. Specific human capital: prior employment status – full-time/part-time work and unemployment experience of the proprietors prior to startup.

HC6. Specific human capital: most recent type of occupation – whether previously employed proprietors were engaged as directors, managers, supervisors, clerical, skilled or unskilled workers.

Opportunity cost of entrepreneurship

F1. Expected wage – the wage the average proprietor can expect to get if he/she quits business, conditional on his/her characteristics including labour market experience.[16]

Assets

F2. Financial assets: collateral availability – the total housing equity of the business' owners.

Finance

F3. Financial capital: borrowing/equity – includes the business proprietors' own money, and borrowings from friends, the bank, Finance Houses etc., used to start the business.

Industry

I. SIC codes are used to define appropriate industry sectors.

IV. EMPIRICAL RESULTS

The method of variable selection used is four-stage.

At the first stage survival probits are estimated as functions of subsets of the financial variables x_{Fi} and industry dummies x_I.[17] At the second stage the human capital model is estimated. A standard stepwise estimation procedure is used with no variables included at the outset and with a 5% significance level for variable addition/removal imposed.[18] The third stage is to test whether

[16] The expected wage is represented by a weighted average of the previous-income of the entrepreneur and the standard annual rate of unemployment benefit, weights being the probability of the individual being employed/unemployed. This average is regressed on the background characteristics of the proprietors, industry dummies, etc. Since this expected income variable (*XINC*) is an estimated value the probit of survival has to allow for the existence of a stochastic regressor, with implied standard errors larger than those produced by the usual probit analysis. See below for details.

[17] The notation is taken from Table 1. Three points should be noted. First, data on interest rates charged on a subset of bank accounts is available, but not for all sources of funds, so a decision had to be made as to whether to include these in the estimation (EJ did not). Overall it was felt that these might bias the results, and they were therefore omitted. Secondly, in each of the Stage 1 equations we included a set of industry dummies. To save space, the t-statistics for these dummies are not presented. Thirdly, we deal with the stochastic regressor problem associated with a probit using the expected wage by specifying a pair of simultaneous equations, the parameters of which are estimated by the two-stage methods discussed in Maddala (1983, pp. 244–5). The Tables below report the second of the two equations, namely that for survival (*PRES921*).

[18] Variables are added one at a time if they satisfy a significance test of 5%. The variable added is that most highly correlated with the dependent variable, given the other variables included in the model. Any variable in the equation no longer meeting the criterion is dropped from the equation. The process of variable addition stops when no other variable meets the inclusion criterion.

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groups of variables, e.g. financial variables as a whole, rather than financial variables individually, add significantly to the model obtained at the second stage. This allows for the possible effect of collinearity, ignored in the stepwise procedure. The fourth stage, conditional on an outcome of the third stage (indicating that the human capital model does indeed provide the best explanation of survival), is to show why the spurious correlation of financial variables and survival has occurred, and involves the estimation of a human capital model of assets, income and bank financing.

Stage 1 : remarks

Probits 1–5 in Table 2[19] provide evidence to evaluate the EJ model. All are significant at well below the 1% level, indicating that the regressors individually and jointly 'explain' the data. Finance and assets seem to enhance survival in general, though some of the finance variable signs are negative.[20] In Model 1 the financial assets variables (*F2: TOTHEQ, TOTHEQ2*) are significant, as predicted by EJ. However, in Model 3 the vector of finance variables (especially own bank finance, *F3: NWBFIN*), shown to be significant in Model 2, remains significant in the presence of assets. This is inconsistent with EJs assumption that finance is endogenous. The expected income variable (*F1: XINC*) in models 4 and 5 is, as predicted by EJ, highly significant, but unfortunately has the wrong sign for the original EJ model, albeit of consistent sign with the Generalised EJ model. The positive sign of *XINC* suggests that it proxies human capital rather than the opportunity cost of entrepreneurship.[21] However, it is difficult to think of other candidates for opportunity cost if the alternative wage is rejected.

Stage 2 : remarks

Model 6 of Table 3 is the human capital model. The chi-squared for the six human capital covariates of this model is highly significant with average age of proprietors (*HC1 : AVAGE, AVAGE2*) the most important individual variable.[22] Conspicuous by their absence, however, are the common measures of human capital, namely, educational qualifications (*HC3: FNOLEV*, etc.) and labour market experience (*HC5,6: FUNEMP, FFTWK, FRECDIR*, etc.). A separate probit on education alone shows that these variables have no effect whatsoever on survival (χ^2 is significant only at the 82% level). In this regression the labour market experience variables, whilst jointly significant at the 6% level, drop out once the 'fundamental' HC variables are included. The explanation

[19] A vector of industry variables was estimated in addition to the variables presented for models 1–5, but the coefficients corresponding to these variables were omitted from the text to save space.

[20] Since we have not included the cost of capital in the equation it is unclear whether negative signs are in fact associated with more adverse contract conditions not included in the equation. There is evidence to show that higher interest margins are associated with less secured loans. This may partly explain the negative sign of *F3: OTHBNKF* since funds offered by the named bank (Nat West) when the business also makes use of a second bank, tend to be at a higher margin. This is because the business has used up some or all of its available security by the time the present application is made (Cressy, 1996).

[21] I am endebted to a referee for pointing this out.

[22] In Model 6 the terms in proprietor age (*HC1 : AVAGE, AVAGE2*) are jointly significant on a chi-squared test with 2 degrees of freedom at the 0·00001 level. Note that whilst EJ did not use the age variable in their equation, HEJR found it to be highly significant.

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Table 2

First Stage Probit Estimates of Business Survival – Finance Models

	Model 1 Industry + assets	*Model 2* Industry + finance	*Model 3* Industry + assets + finance	*Model 4* Industry + income	*Model 5* Industry + assets + finance + income
Variable	Coefficient estimate $P > \chi^2$	Coefficient estimate $P > \chi^2$	Coefficient estimate $P > \chi^2$	Coefficient estimate $P > \chi^2$	Coefficient estimate $P > \chi^2$
Model χ^2 [D.F.]	28·511 [11]	38·603 [16]	43·699 [18]	31·070 [10]	50·485 [19]
$P > \chi^2$	0·27019E-02	0·12404E-02	0·63694E-03	0·57132E-03	0·11116E-03
INTERCEP	−0·55919	−0·52366	−0·58191	−0·678635	−0·71968
	0·00000	0·00000	0·00000	0·00000	0·00000
F2: TOTHEQ	0·14191E-01	—	0·10873E-01	—	0·52074E-02
	0·01161		0·05343		0·36083
F2: TOTHEQ2	−0·12614E-03	—	−0·98576E-04	—	−0·99904E-04
	0·20829		0·27750		0·15339
F3: PERFIN	—	0·11172E-01	0·50559E-02	—	0·23964E-01
		0·87978	0·94559		0·74192
F3: FRIENDF	—	−0·28414	−0·24946	—	−0·19619
		0·03207	0·06211	—	0·13488
F3: NWBFIN	—	0·19184	0·18243	—	0·19963
		0·01106	0·01594		0·00752
F3: OTHBNKF	—	−0·15230	−0·17382	—	−0·20603
		0·45960	0·39956		0·32077
F3: FINHSFIN	—	0·95464E-01	0·71013E-01	—	0·11069
		0·64489	0·73212		0·59382
F3: GOVFIN	—	−0·15916	−0·118981	—	−0·57638E-01
		0·33697	0·47734	—	0·72509
F3: OTHFIN	—	0·36235	0·33792	—	0·39527
		0·03557	0·05128	—	0·02128
F1: XINC	—	—	—	0·265862E-04	0·21284E-04
	—	—	—	0·00071	0·01925
			Tests of restrictions		
Vector:	Assets	Finance	Finance	Income	Assets + finance + income
χ^2 [D.F.]	8·348 [2]	18·440 [7]	15·188 [7]	11·46500 [1]	30·322 [10]
$P > \chi^2$ [D.F.]	0·0153906	0·0101349	0·0336636	0·00071	0·0007587

Note: Sample size = 1,396 observations.

for this seems to be that the regressors driving the equation for *XINC* (not presented here) are precisely these measures of labour market experience.[23] Thus the effect of labour market experience is indirect rather than direct, and operates through the expected income term in the survival equation.[24]

Stage 3: remarks

Models 7–11 in Table 3 show the effects of adding groups of financial and asset variables to the HC model (Model 6), and facilitate comparison of EJ and HC.

[23] The same argument is not, however, valid for the business experience variable (*HC2: FEXSB*) and for other vocational qualifications (including *HC4: FHND*). These explain neither survival nor *XINC*.

[24] Nonetheless, the impact of these variables is not sufficient to 'survive' the addition of the fundamental HC variables to the model, as we shall see.

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Joint tests for these additions (presented at the foot of the Table) accept the Null at the 10% level. The exception is the FINANCE vector which just attains significance at 9·6%.[25] As the HC theory suggests, but contrary to EJ, the presence of human capital variables renders the financial variables statistically insignificant. This is particularly so in the case of assets (*F2: TOTHEQ*), which are critical to the credit rationing hypothesis.[26] (In model 11, for example, a test on the assets variables alone – which is not presented – rejects the Null only at the 91% level of significance.) The income variable (*F1: XINC*), which should on the EJ theory have a negative sign, also becomes insignificant in the presence of human capital, but its positive sign remains. Also, as we move from model 8 to model 10 the ownbank finance variable (*F3: NWBFIN*) remains individually significant despite the fact that the complete finance vector (*F3*) becomes insignificant.[27] This may of course be due either to the correlations of *NWBFIN* with other finance variables or to its own explanatory power. Unfortunately neither outcome is consistent with the EJ theory and the latter outcome is difficult to interpret in a theoretical sense.

Stage 4: remarks

Models 12–14 (available from the author on request) provide estimates of the ownbank finance variable (*F3: NWBFIN*), assets (*F2: TOTHEQ*) and income (*F1: XINC*) against the human capital and industry vector. In particular, the ownbank finance model rejects the Null at the 0·5% level, as does a purely assets-based model. However, assets, whilst correlated with bank finance, add nothing once human capital is included. This confirms the HC model predictions that human capital is significant in explaining the allocation of bank finance to startups, and that financial assets are epiphenomena (Hypothesis 6). Due to the nature of the *NWBFIN* variable this result does not enable us strictly to conclude whether demand- or supply-side factors are at work.[28] However, evidence from the rate of requests for bank finance relative to usage suggests that virtually all (94%) who asked for money got it. Thus, we conclude that the result is demand-driven, with HC-intensive business more likely to accept money offered.

In summary, this set of tests has shown: (i) the preferred survival model is one of human capital with proprietor age and team size the dominant

[25] In EJ these finance variables are 'endogenous' to the switching decision. If, however, financial variables are significant in survival and assets are not (see below), this suggests that if capital constraints exist they are not based on assets; and that lending may have a non-HC component (thus making it significant when HC is controlled for).

[26] Note however, from Table 2, that the assets variables start to lose significance even before HC variables are added.

[27] Note also that the significance levels of ownbank finance are measurably lowered when HC variables are included. (Compare models 2, 3 and 5 with models 8 and 10).

[28] It must be reiterated that the variable *NWBFIN* refers to finance use only. Thus we cannot say with certainty if *NWBFIN* = 0 whether (a) finance was offered and turned down (non-rationing); or (b) not offered at all (rationing). See below for further discussion.

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Table 3

Second Stage Probit Estimates of Survival – Human and Mixed Capital Models

	Model 6 Industry + HC	*Model 7* Industry + HC + assets	*Model 8* Industry + HC + finance	*Model 9* Industry + HC + Income	*Model 10* Industry + HC + assets + finance	*Model 11* Industry + HC + assets + finance + income
Variable	Coefficient estimate $P > \chi^2$	Coefficient estimate $P > \chi^2$	Coefficient estimate $P > \chi^2$	Coefficient estimate $P > \chi^2$	Coefficient estimate $P > \chi^2$	Coefficient estimate $P > \chi^2$
Model χ^2 [D.F.]	81·806 [8]	84·194 [10]	93·929 [15]	81·988 [9]	96·063 [17]	96·243 [18]
$P > \chi^2$	0·00000	0·00000	0·10000E-06	0·00000	0·10000E-06	0·10000E-06
INTERCEP	−2·4351	−2·4202	−2·3942	−2·41729	−2·3981	−2·4023
	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000
IND: AGRI	0·60119	0·60078	0·57939	0·606967	0·57917	0·58530
	0·00633	0·00640	0·00897	0·00596	0·00901	0·00847
IND: TRANS	0·40575	0·40687	0·37398	0·406451	0·37307	0·37048
	0·00970	0·00966	0·01808	0·00967	0·01870	0·01980
HC1: AVAGE	0·78959E-01	0·77442E-01	0·75134E-01	0·770632E-01	0·74923E-01	0·74107E-01
	0·00042	0·00075	0·00094	0·00075	0·00124	0·00147
HC1: AVAGE2	−0·86558E-03	−0·84546E-03	−0·82376E-03	−0·847067E-03	−0·818820E-03	−0·81111E-03
	0·00287	0·00424	0·00505	0·00394	0·00612	0·00672
HC1: N2	0·62329E-01	0·63378E-01	0·59505E-01	0·62175E-01	0·61315E-01	0·62267E-01
	0·00007	0·00009	0·00018	0·00008	0·00016	0·00015
HC2: FWKFLD	0·37736	0·37738	0·37914	0·369305	0·38028	0·37268
	0·00003	0·00003	0·00003	0·00006	0·00003	0·00006
HC4: FTRAD	0·25440	0·25680	0·26401	0·253399	0·26526	0·26397
	0·00726	0·00680	0·00557	0·00751	0·00543	0·00568
HC2: PURCH	0·30824	0·30487	0·28601	0·306909	0·28389	0·28199
	0·00316	0·00352	0·00786	0·00332	0·00836	0·00891

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F2: TOTHEQ	—	0·25761E-02	—	—	0·12199E-02	0·13190E-03
		0·64051			0·82456	0·98275
F2: TOTHEQ2	—	−0·62429E-04	—	—	−0·50875E-04	−0·50441E-04
		0·44668			0·50826	0·52179
F3: PERFIN	—	—	0·42305E-02	—	−0·41628E-02	0·54460E-02
			0·95326		0·95404	0·94000
F3: FRIENDF	—	—	−0·17855	—	−0·17810	−0·17589
			0·17180	—	0·17549	0·18168
F3: NWBFIN	—	—	0·16276	—	0·15949	0·15964
			0·02878		0·03233	0·03242
F3: OTHBNKF	—	—	−0·28996	—	−0·29343	−0·29611
			0·16246		0·15789	0·15399
F3: GOVFIN	—	—	−0·31894E-01	—	−0·32373E-01	−0·24292E-01
			0·84191		0·84025	0·88082
F3: FINHSFIN	—	—	−0·16691E-01	—	−0·19346E-01	−0·19613E-01
			0·93601		0·92591	0·92498
F3: OTHFIN	—	—	0·27504	—	0·27333	0·27677
			0·11098		0·11372	0·11038
F1: XINC	—	—	—	0·337746E-05	—	0·38297E-05
				0·66960	—	0·67210

Tests of restrictions

Vector	HC|Industry	Assets |Industry+HC	Finance |Industry+HC	Income |Industry+HC	Finance |Industry+HC +Assets	Assets+Finance +Income |Industry+HC
χ^2 [D.F.]	73·1694 [6]	2·388 [2]	12·123 [7]	0·1823290 [1]	1·869 [7]	14·437 [10]
$P > \chi^2$	0·00000	0·30301	0·09658	0·66960	0·1715897	0·1539754

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variables; (ii) there is no evidence of credit rationing as defined by EJ;[29] (iii) startup businesses self-select for bank finance (mainly) on the basis of the human capital of their owners, with better endowed business more likely to use funds; (iv) the spurious correlation of survival with financial variables (specifically, assets) is explained largely by their association with human capital.

V. SUMMARY AND CONCLUSIONS

If human capital factors are correlated with both startup survival and assets the false impression may be created that initial finance is a determinant of survival and that (under certain assumptions) startups are finance-constrained. Using a large random sample of UK startups and a rich set of financial and human capital variables, the paper demonstrated that human capital is the 'true' determinant of survival and that the correlation between financial capital and survival is spurious. Decisions regarding the provision of finance were demand-driven, with the bank elastically supplying funds and business requests for funds governing takeup. Firms self-selected for funds on the basis of their proprietor's human capital with better businesses more likely to borrow. We thus conclude that, in addition to sample differences, a reason for the divergence of empirical results in the area may be the failure to test a sufficiently rich empirical model.[30]

This paper has focused on testing two rival theories of small business survival. However, its implications have ramifications beyond the 'academic'; for if bank lending to startup business does indeed not cause the business to survive, and the lack of it does not precipitate failure, an appropriate government policy should be to make business startups more difficult, rather than less, contrary to the official line of a decade or more. This radical departure from tradition would move the UK system closer to the German one by requiring survival-enhancing skills of potential owners as a precondition for entry into self-employment, and the pre-screening of prospective entrepreneurs on the basis of relevant survival characteristics. More long term jobs would be provided by startup firms and borrowing by them would result in a lower

[29] The model tested above is of course not the only way of testing for credit rationing. An alternative specification might be in terms of a direct measure of excess demand for funds, which should influence the survival of the business. It is difficult to test this hypothesis again due to the absence of precise reasons for failing to take up loans. However, data are available in the current dataset on whether a loan was requested at startup and whether the loan was taken up. This enables a crude test of whether excess demand (request and no loan) results in increased closure rates, subject to the limitations discussed in the previous footnote. The results that emerge from a survival on HC and excess demand are (a) that businesses with excess demand for funds are a very small proportion of the sample (some 4%); (b) that excess demand is not correlated with survival (at the 10% level); (c) that the sign of the coefficient is 'right', i.e. negative, but it is only significant at the 15% level. We therefore conclude on this criterion also that there is no evidence of credit rationing. I am grateful to Alan Hughes for suggesting a test along these lines.

[30] Whilst we were unable to test for the effect of windfall gains on survival found to be significant in other studies (Blanchflower and Oswald, 1990; HEJR), to some extent this variable can be expected to be correlated with the same human capital variables identified in the present paper. For example, one important source of windfall gains in the 1980s was the availability of redundancy money. This is clearly correlated with human capital, with more able workers receiving more funds. HEJR, however, deal only with inherited wealth but do not (unlike Blanchflower and Oswald) allow for inheritance associated with inherited businesses. This also is a source of potential bias, since along with an inherited business may go inherited business acumen and a home business environment (there is empirical evidence from several studies to associate 'business in the family' with viability of the entrepreneur from that family).

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proportion of bank write-offs as their default rate declines. Younger entrepreneurs would in turn spend time acquiring skills akin to the German *Meister* qualification rather than taking ill-judged leaps into an entrepreneurial unknown.

Centre for Small and Medium-sized Enterprises, Warwick Business School

Date of receipt of final typescript: December 1995

APPENDIX 1

*Sample Statistics**

Variable	Mean	Std Dev	Min	Max
PRES92I	1·6227†	0·4848	1·000	2·000
HC1: AVAGE	34·719	10·066	15·000	71·33
HC1: N	1·3562	0·5859	1·000	5·000
HC2: FWKFLD	0·6950	0·4251	0·000	1·000
HC2: FEXSB	0·3887	0·4637	0·000	1·000
HC3: PURCH	0·1212	0·3265	0·000	1·000
HC3: FNOLEV	0·3689	0·4621	0·000	1·000
HC3: FNALEV	0·1040	0·2928	0·000	1·000
HC3: FNDEG	0·1019	0·2930	0·000	1·000
HC4: FTRAD	0·1741	0·3666	0·000	1·000
HC4: FPROF	0·1918	0·3760	0·000	1·000
HC4: FHND	0·0738	0·2463	0·000	1·000
HC4: FOTHQUAL	0·0694	0·2446	0·000	1·000
HC5: FUNEMP	0·3000	0·4428	0·000	1·000
HC5: FFTWK	0·6065	0·4612	0·000	1·000
HC5: FPTWK	0·0677	0·2296	0·000	1·000
HC6: FRECDIR	0·1032	0·2916	0·000	1·000
HC6: FRECMAN	0·2108	0·3913	0·000	1·000
HC6: FRECLE	0·1080	0·2915	0·000	1·000
HC6: FRECSUP	0·0887	0·2729	0·000	1·000
HC6: FRECSKIL	0·2727	0·4307	0·000	1·000
HC6: FRECUNSK	0·1255	0·3212	0·000	1·000
F1: TOTHEQ $\times 10^{-4}$	7·8790	12·152	0	270
F1: XINC‡	8959·8	8763·8	969·4	0·1465E+06
F2: PERFIN	0·4682	0·4991	0·000	1·000
F2: FRIENDF	0·0975	0·2967	0·000	1·000
F2: NWBFIN	0·3349	0·4721	0·000	1·000
F2: OTHBNKF	0·0287	0·1671	0·000	1·000
F2: FINHSFIN	0·0279	0·1646	0·000	1·000
F2: GOVFIN	0·0557	0·2294	0·000	1·000
F2: OTHFIN	0·0454	0·2083	0·000	1·000
I: AGRI	0·0231	0·1503	0·000	1·000
I: TRANS	0·0456	0·2087	0·000	1·000
I: RETAIL	0·1768	0·3817	0·000	1·000
I: CATER	0·1072	0·3095	0·000	1·000
I: PROP	0·1205	0·3257	0·000	1·000
I: CONST	0·1332	0·3399	0·000	1·000
I: MOTOR	0·0569	0·2318	0·000	1·000
I: WHOLE	0·0157	0·1245	0·000	1·000

* Sample size = 1,396 observations. This is substantially less than the total sample of some 2,000 businesses due to the requirement for complete observations on all the variables. Deletions appear to be random.

† This variable is coded 1 for survivors and 2 for non-survivors, implying a mean survival rate of 38% over the period.

‡ As discussed in the text, values of reported income of zero were deleted in deriving this variable.

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APPENDIX 2

Definitions of variables used in the empirical analysis

A star (*) after a variable indicates that the variable is used as a control in the analysis.

Survival

PRES921 = 1 if the business account, opened in the second quarter of 1988, was still open in the first quarter of 1992; = 2 elsewhere.

General human capital (HC1)

AVAGE, *AVAGE2* = average age of the proprietors at startup, and its square.
N, *N2* = number of proprietors in the business at startup, and its square.

Specific human capital: experience (HC2)

FWKFLD = fraction of the proprietors with work experience in the same area as the start
FEXSB = fraction of the proprietors who had small business experience.
PURCH = 1 if the business start is a purchase; = 0 else.
TRADTIME = time since the business first started trading.

Specific human capital: education (HC3)

*FNOAC** = fraction of proprietors with no academic qualifications.
FNOLEV = fraction of proprietors with a maximum of 'O' Level academic qualifications.
FNALEV = fraction of proprietors with a maximum of 'A' Levels.
FNDEG = fraction of proprietors with a maximum of a Degree.

Specific human capital: vocational qualifications (HC4)

FTRAD = fraction of proprietors with trade apprenticeships.
FPROF = fraction of proprietors with professional qualifications.
FHND = fraction of proprietors with Higher National Diploma or Certificate.
FOTHQUAL = fraction of proprietors with other vocational qualifications.
*FNOVOC** = fraction of proprietors with no vocational qualifications.

Specific human capital: prior employment status (HC5)

FUNEMP = fraction of proprietors unemployed before startup.
FFTWK = fraction of proprietors in full-time work before startup.
FPTWK = fraction of proprietors in part-time work before startup.

Specific human capital: most recent type of occupation (HC6)

FRECDIR = fraction of proprietors who were previously employed as directors of businesses.
FRECMAN = fraction of proprietors who were previously employed as managers.
FRECLE = fraction of proprietors who were previously employed as clerical workers.
FRECSUP = fraction of proprietors who were previously employed as supervisors.
FRECSKIL = fraction of proprietors who were previously employed as skilled workers.
FRECUNSK = fraction of proprietors who were previously employed as unskilled workers.

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*FRECNON** = fraction of proprietors who had 'no recent occupation.'[31]

Opportunity cost of entrepreneurship variables (F_1)

XINC = expected income of proprietors.

Financial assets: collateral availability (F_2)

TOTHEQ, $TOTHEQ_2$ = total housing equity of the business' proprietors,[32] and its square.

Financial capital: borrowing/equity (F_3)

NWBFIN = 1 if debt finance from the business' own (main) bank was used; = 0 else.

OTHBNKF = 1 if other bank finance.

FRIENDF = 1 if finance from friends and relatives.

PERFIN = 1 if personal money/savings.

FINHSFIN = 1 if Finance House finance.

GOVFIN = 1 if Government finance (e.g. Enterprise Allowance Scheme, Loan Guarantee Scheme).

VENTFIN = 1 if Venture Capital finance.[33]

OTHFIN = 1 if finance other than those listed above.

*NOFIN** = 1 if no finance was used at startup.

Industry dummies (I)

AGRI = 1 if the business was in Agriculture.[34]

RETAIL = 1 if in Retail.

CATER = 1 if in Catering.

PROP = 1 if in Property/Finance/Professional Services.

CONST = 1 if in Construction.

MOTOR = 1 if in Motor trades.

PROD = 1 if in Production/Manufacturing.

TRANS = 1 if in Transport/Distribution.

WHOLE = 1 if in Wholesale.

*OTHER** = 1 if the business was not located in any of the industrial categories listed above.

[31] This category includes individuals previously unemployed and those outside the labour force, e.g. housewives, students, retired individuals.

[32] Housing equity is defined as the difference between the aggregate market value of their houses and the aggregate outstanding mortgage.

[33] This variable is excluded from the probit analysis due to lack of sampling variation.

[34] The sector definitions used here do not exactly match the SIC but were used by the Bank because of conformity to marketing definitions.

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