Initial Conditions and Post-entry Performance: the Case of Indian Software Industry

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Abstract: In this paper we study entrepreneurship and firm survival, using as our empirical backdrop the Indian software service industry. We develop a model that has contrasting predictions about the impact of the scale of entry on firm performance, after conditioning on lagged output. We test predictions of the model. We find that current size positively influences the firm survival but initial size has negative effect on firm survival. We also find that founders' human capital measured by their education reduces annual hazard of exit. The firms with access to market have advantage as also the firms with experience in the software industry.

1. Introduction

We believe that there are observable differences in the "heritage" of the firm. Existing firms diversifying into software bring with them resources of the parents. In particular, foreign firms setting up operations in India have the advantage of a certain (relatively) demand for software development.

A second dimension is the expertise of the founder (for de novo entrants). Here the literature has identified the human capital, both general as well as industry specific experience. Spinoffs from existing firms bring experience and customer and supplier relationships. Firms by the diaspora similarly bring the experience of operating in the market, along with other expertise as well. In this paper, we have measures of resources (existing firm or de novo entrant; foreign or domestic) and of the human capital (education and experience of founder), and we test how these affect survival.

Other than these two, there are unobserved sources of differences as well. These differences imply that firms with similar heritage nonetheless perform differently. These differences may manifest in differences in firm size at the time of entry. In this paper, we lay out a model that nests different explanations for how initial size and unobserved differences are linked. We test these contrasting predictions with a hand collected data set of software exporters registered with the Software Technology Parks (STP) NOIDA, part of the second largest software export cluster in India, between the year 1991 and 2003.

This paper is organized as follows. In the next section we briefly review the literature. In section 3 we develop a stylized model of entry and exit and highlight important predictions of the model. In section 4 we describe the data collection and show some main features of the dataset. In section 5 we present the empirical findings and section 6 summarizes our findings and concludes.

2. Literature

There have been many studies trying to understand the role of initial size in predicting the likelihood of survival. Based on the analysis of several empirical works for manufacturing industries, Geroski stated 'a positive relationship between the firm size and likelihood of firm survival' as one of the stylized fact (Geroski, 1995). However, the effect of initial conditions especially the entry size has been found to have contradictory effect on the firm survival. The positive relationship between firm's start-up size and likelihood of survival is not robust enough to be true in every country and for every industry. Audretsch (1999b) find that the relationship holds for US manufacturing industry but not for Italian manufacturing industry. The firm's start-up size was found to positively influence the firm survival in the Italian tourist industry (Santarelli, 1998).

Jovanovic (1982) develops theoretical model of ‘noisy’ selection that has implication for the relationship between the entry size and likelihood of survival. In this model firms do not know their efficiency at the time of entry but learn about it during their post-entry performance in the marketplace. Whatever they learn about their efficiency in the marketplace is incorporated in the current size. This means that the current size is sufficient to predict survival of firms and once we control for the current size we should find no effect of initial size. Mata et al. (1995) empirically show that the coefficient on initial size is positive even after controlling for current size. They add coefficients on current size and initial size to conclude that the overall effect of initial size is to increase survival probability. However, they do not provide theoretical model to support their empirical findings.

In this paper we address the conflicting role of entry size on firm survival by developing a simple model, with forward looking firms that invest in marketing, and where current sales condition the distribution of future sales (thereby building in a direct advantage to large scale entry). Our model nests several theories of firm entry and growth that have contrasting predictions about the impact of the scale of entry on firm performance, after conditioning on lagged output. If efficient firms choose larger output at the time of entry, then it follows that, in a model where current sales also condition future sales, both initial and current output should reduce exit. On the other hand, a model in which initial output is exogenously given (for instance, by the size of the initial export contract the firm was able to get), the prediction is the opposite: More efficient firms would be willing to enter even with a small scale of initial output.

This paper also contributes to the understanding of the role of founders’ human capital in the survival of the firm. We specifically investigate the role of general human capital which we measure by the entrepreneur’s education. Our data allows us to measure the founders’ human capital by the discipline of undergraduate degree and graduate degree. This method of measuring founder’s education has benefits as undergraduate degree in liberal arts does not have the same labor market outcome as undergraduate degree in engineering at least in India. The effect of general human capital on firm survival and growth has not been consistent. It was found to influence both survival and growth (Cooper et al., 1994, and Gimeno et al., 1997) but in case of Spanish service industry companies it has no effect on firm survival time (Arribas, 2007). In another study college education was found to have greatest effect on business continuance (Bates, 1990). However, in our study we find that for de novo firms certain type of college education has positive influence on firm survival.

Many such studies have focused mainly on manufacturing industries, and very few to date are for services industry (Audretsch, 1999a). This study enriches the literature by adding one more study of services industry. As our empirical setting is services industry in India, we can also compare our results with similar studies for services and manufacturing industry in other countries. Not only this, this study is also a study of new industry. Though software firms have existed in other countries, but these were new to India and replication from other countries to India involved different environment, people, etc.

3. Model

We develop a simple model of firms' entry in the export market for software services and exit from it. The model has predictions that guide our empirical analysis. In this model firms invest in marketing and current sales condition the distribution of future sales (thereby building in a direct advantage to large scale entry). Firms enter with initial size Q_0 . After entering, firms invest M_0 in marketing, which conditions the first period output, Q_1. The firm's output is assumed to be function of its marketing effort and its ability to retain some of its customers to the next period, along with a stochastic shock. Thus, firm's first period output equals $\lambda Q_0 + \alpha\psi(M_0) + \varepsilon_1$, where ε_1 denotes iid shocks that has zero mean, distributed $\Phi(\cdot)$. All firms face the same price, p . Whenever firm produces, it incurs a fixed cost of F . The marginal cost of firm is c. We assume that the marginal cost varies across firms. More precisely, we assume that the price cost margin, X = p-c, varies across firms.

The firms are not fully forward looking. Instead, we assume that firms, though potentially long lived, make decisions by looking forward only one period. This assumption is made to keep the model tractable, since our objective here is to understand the impact of initial entry conditions (see below also) on subsequent firm performance. In other words, we model the dynamics of firm investment and growth as a series of two-period decisions, where the firm takes its current output, Q_t, as given, decides on an optimal investment, M_t, observes the stochastic shock, ε_t, and then decides whether to exit, or to remain in the market and produce $Q_{t+1} = \lambda Q_t + \alpha\psi(M_t) + \varepsilon_{t+1}$. We assume that the firm exits if its current profits are negative i.e., if $(p-c)(Q_t + \varepsilon_t) - F < 0$. Once again, this myopic decision ignores the option value of staying on in the market. The advantage of the assumption is that it greatly simplifies the analysis and we conjecture that our principal result would not be materially changed if the assumption were relaxed.

We next analyze in detail the initial two period decision problem immediately after a firm has entered the market. After entering, the firm chooses M_0 at the beginning of first period. Having entered, firms produce in first period if $(p-c)(\lambda Q_0 + \alpha\psi(M_0) + \varepsilon_1) - F \geq 0$. This means firms will produce in first period only when $\varepsilon_1 \geq K$, where K equals $\frac{F}{(p-c)} - \lambda Q_0 - \alpha\psi(M_0)$. The firm chooses optimal value of M_0 by maximizing first period profit, but before observing the stochastic shock ε_1. The optimality condition for M_0 can be written as

$$E(\pi_1 | \varepsilon_1 > K) = \underset{M_0}{\arg\max} \int_K^\infty ((p-c)(\lambda Q_0 + \alpha\psi(M_0) + \varepsilon_1) - F)\phi(\varepsilon_1) d\varepsilon_1 - M_0 \tag{1}$$

We solve equation (1) for first order condition to find the optimum value of M_0 (see appendix 1). The optimum value M_0^* can be expressed as

$$M_0^* = M_0(Q_0, \alpha, (p-c), F) \tag{2}$$

Determination of initial size:

We analyze three separate cases. We analyze the traditional case where firms optimally choose Q_0. We also analyze the case where Q_0 is exogenously determined (though it may vary across firms). In the latter, we separately analyze where the firm observes Q_0 before it decides to enter and when Q_0 is observed only after entry.

Since the assumption of exogenously determined output unconventional, it merits further discussion. Traditionally firms are thought to choose their output. The output, in software exports, consists of contract software development for overseas clients. However, firms typically enter the industry with a single contract, and frequently, merely with potential leads, which could materialize into orders. Moreover, most software development contracts relate to software used by firms to run their internal operations, such as billing, human resources, production, sales and so on. Although cost is a consideration, potential problems resulting from failure or delays are a much bigger concern. In such cases, clients are unlikely to increase the size of the contract in response to lower prices. Simply put, under-bidding for a software development contract is unlikely to be very fruitful, and may even be counterproductive in that it may lead the client to doubt the ability of the vendor. More generally, the nature of software development is such that the clients' requirement frequently changes during the execution of the project. These changes cannot be contracted upon properly ahead of time and typically require re-negotiation (Banerjee and Duflo, 2000).

The incompleteness of the contract, the possibility of re-negotiation and concerns about the final quality of the delivered output made it difficult for newly started Indian firms to increase the size of contracts by underbidding. This is especially true of a newly started firm. Indeed, there is ample anecdotal evidence that American firms outsourcing to India would typically outsource a small project to a new vendor, and only outsource larger projects if the initial experience was satisfactory (Arora et al., 2001).

Increasing the number of contracts is also difficult. Newly started Indian firms, particularly early in the history of the industry, faced considerable challenges in terms of gaining access to clients. Frequently, clients were obtained through personal connections, either directly or through diasporic Indians living overseas (Kapur, 2000; Athreye, 2005). Price cutting is unlikely to be a viable way for a startup to increase business, without very credible signals about its ability to deliver good quality in a timely fashion on a large scale. Such conditions may well apply to other industries as well, particularly those where firms cannot rely upon mass marketing or large lumpy investments to provide such signals to potential buyers. At the very least, it seems reasonable to entertain the possibility, with a view to testing its implications for subsequent firm outcomes.

The reason the assumption about initial conditions is potentially important has to do with what entry size reveals about the unobserved firm efficiency (proxied here by the price-cost margin, X). If firms choose Q_0, then firms that have large size at entry will also be more efficient. Exit depends upon firm efficiency, but also upon the growth of the firm, with the latter not perfectly correlated with X. Thus, even controlling for current output, exit will be lower for firms that entered with higher initial size, Q_0. The reverse is true if initial output is exogenous. In this case, if firms observe their initial output prior to entry, a small entry size implies a higher average efficiency. Simply put, only a very efficient firm would choose to enter at a small scale, because only then could it expect to be profitable. (This effect would carry over even with fully forward looking firm, because in our model, current output conditions future output as well, and hence, future profits.) Finally, if firms do not observe Q_0 prior to entry, there is no association between X and Q_0, and hence initial entry size is not associated with the future performance of the firm. This intuition (formalized below) can be summarized as follows:

Conditional on lagged output, i) if initial size is exogenous but not observed prior to entry, there is no association with the probability of survival :ii) if initial size is exogenous and observed before entry, initial size is negatively associated with firm survival. iii) if initial size is endogenously chosen, it is positively associate with firm survival.

Case I: Q_0 is exogenously determined and observed prior to entry.

We first analyze the case where Q_0 is exogenously determined. We assume here that the firm observes Q_0 before deciding whether to enter or not. We assume the firm enters if given its cost structure, its profits are positive. We derive the expressions for the effect of initial size on the exit probability in subsequent periods, conditioning on the lagged output. For simplicity, consider the probability of exit in period 2, given X and Q_1. (Probabilities of exit in period t, given X and Q_{t-1} can be analogously derived.) In what follows we assume that X is distributed with distribution function G() over some compact domain.

Probability of exit in period 2, given X, Q_1 is

$$\Pr(Exit|X, Q_1) = \Phi(\frac{F}{X} - \lambda Q_1 - \alpha\psi(M_1)) \tag{3}$$

To take expectation over X, we need to introduce the conditioning even, $X \geq \frac{F}{\lambda Q_0 + \alpha\psi(M_0) + \epsilon_1}$, $X \geq \frac{F}{Q_0}$

This conditioning events tells us the firm enters if entry size is big enough, given its price cost margin, X, to cover its fixed cost, F, and will similarly produce in period 1, if its output is big enough to cover the fixed cost.

Let $Z = Max(X \geq \frac{F}{\lambda Q_0 + \alpha\psi(M_0) + \epsilon_1}$, $X \geq \frac{F}{Q_0})$

The Z is random variable distributed $H(\cdot)$. Then,

$$H(\theta) = \begin{cases} 0, & \theta < 0 \\ 1 - \Phi(\frac{F}{\theta} - \lambda Q_0 - \alpha\psi(M_0)), & \theta \geq \frac{F}{Q_0} \end{cases}$$

Also, let minimum value of $Q = \underline{Q}$, by assumption.

Then exit probability in period 2 given Q_1 is

$$= \int_{F/Q_0}^{F/\underline{Q}} \int_{Z}^{\overline{X}} \Phi\left(\frac{F}{X} - \lambda Q_1 - \alpha\psi(M_1)\right) g(X|X \geq Z) dX\, h(Z) dZ$$

$$= \int_{F/Q_0}^{F/\underline{Q}} A(Z; Q_1) h(z) dZ$$

We can write this as nothing depends on Q_0 inside the inner integral. To find the effect of initial size Q_0 on the exit probability, we differentiate above equation w.r.t. Q_0 using Leibniz integral rule. This equals

$$= -A\left(\frac{F}{Q_0}; Q_1\right) h\left(\frac{F}{Q_0}\right)\left(-\frac{F}{Q_0^2}\right)$$

$$= A\left(\frac{F}{Q_0}; Q_1\right) h\left(\frac{F}{Q_0}\right)\left(\frac{F}{Q_0^2}\right) > 0$$

Case II: Q_0 exogenous but not observed:

The firm does not observe its initial size (Q_0) before entry. After entry firm realizes its Q_0. In this case Q_0 gives no information about firm's efficiency, i.e., Q_0 and $X(= p - c)$ are unrelated. The exit probability is given by

Probability of exit in period 2, given X, Q_1 is

$$\Pr(Exit|X, Q_1) = \Phi(\frac{F}{X} - \lambda Q_1 - \alpha\psi(M_1))$$

$$\Pr(Exit|Q_1) = \int_{F/Q_1}^{\overline{X}} \Phi(\frac{F}{X} - \lambda Q_1 - \alpha\psi(M_1)) g(X\ |X\ > F/Q_1) dX$$

$$\left.\frac{\partial \Pr(Exit)}{\partial Q_0}\right|_{Q_1} = \int_{F/Q_1}^{\overline{X}} \frac{\partial \Phi(\frac{F}{X} - \lambda Q_1 - \alpha\psi(M_1(Q_1, X)))}{\partial Q_0} g(X \mid X > F/Q_1)dX \tag{4}$$

$$\left.\frac{\partial \Pr(Exit)}{\partial Q_0}\right|_{Q_1} = \int_{F/Q_1}^{\overline{X}} 0.\, g(X \mid X > F/Q_1)dX = 0 \tag{5}$$

Thus if the firm's initial size is exogenous and not observed by firms before entry, then conditioned on lagged output, we will find no effect of Q_0 on firm survival.

Case III: Q_0 is endogenously chosen:

In this case firm endogenously chooses its initial size (Q_0). It can be shown that if firm faces no entry cost, then the then the profit π will be convex in Q_0. This means firms should be choosing the highest value of Q_0. We use entry cost $E(Q_0)$ to make profit π concave in Q_0. The profit π is concave in Q_0 as long as $\Psi'' < 0$, where $\Psi = \pi - E$.

Probability of exit in period 2, given X, Q_1 is

$$\Pr(Exit \mid X) = \Phi(\frac{F}{X} - \lambda Q_1 - \alpha\psi(M_1(Q_1, X))) \tag{6}$$

We are interested in finding the effect of Q_0 on exit probability conditioned on the lagged output, Q_1. In this case we cannot differentiate exit probability with respect to Q_0 as Q_0 is endogenously determined in the model. However, we can find the relationship between Q_0 and exit probability by determining the sign of covariance between them. In this case firms choose their initial size Q_0 depending upon their X. We have shown in appendix I that Q_0 is increasing function of X, i.e., $\partial Q_0/\partial X > 0$. We have also shown in appendix I that $\partial\psi(M_0)/\partial X > 0$. The firm uses same optimality condition to make investment of M_1 in the beginning of second period in the second window, and therefore M_1 is increasing in X. Thus it is obvious from equation (6) that conditioned on Q_1, $\Phi(\cdot)$ is decreasing function of X. According to Theorem 236 of Hardy, Littlewood and Polya, the covariance of an increasing and a decreasing function of a random variable is negative' i.e. $\mathrm{cov}(\Pr(\mathrm{Exit}|\mathrm{X}), \mathrm{Q}_0(\mathrm{X})|\mathrm{Q}_1) < 0$ (Eckel, 1992).

4. Data

We hand collected data on software exporters registered with Software Technology Park of India (STPI)[1] NOIDA, part of the second largest software export cluster in India, between the year 1991 and 2003. We track these firms from the year they register till 2006. Each firm submits an application to the STPI at the time of registration and subsequent to this STPI maintains detailed dossier on each firm. I had to go through each dossier manually for collecting information on founding background of these firms. We collected data on year of entry, export revenues, background of founders, type of activity, etc.

Table 1 shows classification of firms based on the background of founders.

Table 1
Firm Type and Background of Founders

Foreign branch	foreign firms using India as a platform for software development
Diaspora	founded by Indian diaspora, typically based in America
Diversifying	existing Indian firms diversifying into software production
Spinoff	set up by founders with experience in software industry
Startup	set up by founders with no experience in software industry

The types of entrants have changed over time. We divide them into three entry cohorts, years before dot.com boom, and years after that. These entry cohorts are: 1991-1998, 1999-2000, and 2001-2003. Table 2 shows number of firms of each type for three entry cohorts. Foreign branch are largest group in cohort 1991-1998, diversifying firms are larges in 1999-2000, and spinoffs are largest in 2001-2003, though foreign branch and diversifying entrants are about the same in number. If we combine diaspora and foreign branch, as they are essentially software development platforms of foreign firms, then they are the largest group in cohort 1991-1998 and 2001-2003. The foreign branch and diaspora together have 40 percent share of total firms.

[1] The Software Technology Parks (STP) scheme started in 1991 by Government of India provided reliable internet connectivity and single window clearance for various government permissions to software export firms. There were other schemes like export processing zones which offered similar incentives to firms locating in such zones. However, STP scheme offers much higher level of flexibility to firms in their location choices and was targeted to software export firms. Firms could locate anywhere and were required to register with designated STP office to avail various incentives.

Table 2
Timing of Entry and Type of Firms

Entry cohort	Foreign branch	Diaspora	Spinoff	Diversifying	Startup	Others	Total
1991-1998	38	20	17	12	8	14	109
1999-2000	14	6	13	17	6	5	61
2001-2003	49	29	44	40	16	25	203
Total	101	55	74	69	30	44	373

We treat the firm has having exited if it does not report the export revenue, as the regulations require that any export made be certified by the STPI. Entrants in a year *t* are those firms that registered with STPI in that year for the first time. Similarly, exits in a year *t* are those firms that report export in year *t-1* but not in year *t*. The Table 3 shows number of firms exiting for different types of firms. The startups have the highest fraction of firm exiting followed by diversifying firms. The diaspora have the lowest fraction of firms exiting the industry.

Table 3
Exits by Type of Firm

Type	Firms	Exits	Percent Exiting
Foreign branch	101	22	22
Diaspora	55	8	15
Spinoff	74	20	27
Diversifying	70	29	41
Startup	30	13	43
Others/non-traceable	44	18	41
Total	374	110	29

Table 4
Educational Background of Founders of De novo firms

	Undergrad in Engineering	Undergrad in Engineering, and MS or MBA	Undergrad/grad in liberal arts/science	Education missing	Total	Undergrad in Engineering, and MS or MBA from foreign country
Diaspora	8	35	8	4	55	34
Spinoff	25	25	18	6	74	13
Startup	4	2	19	5	30	2
Total	37	62	45	15	159	49

The educational background of founders of de novo firms is shown in Table 4. There are 99 founders who have at least undergraduate degree in engineering and 62 of these founders have enhanced their education by obtaining graduate degree either in science or business administration. There is interesting subset of these 62 founders who have graduate degree in science or management from foreign country. As one would expect the largest number of such founders are from Indian diaspora. We have coded education as missing if we could not obtain information on educational background of founders.

The initial size of the firm varies by type of the firm (see Table 5). The foreign branch firms on an average enter with biggest size. The diversifying firms' mean initial size is reduced to 215 if an outlier is excluded. The startups enter with lowest mean size.

Table 5

Initial Size by Type of Firm

(in '000 of US $)

	Obs.	Mean	Std. dev.	Min	Max
Foreign branch	88	1074	1840	0	13072
Diaspora	44	457	737	0	3386
Spinoff	59	349	467	0	2339
Diversifying	58	975	5802	0	44293
Startup	25	149	195	0	613
Others	36	487	703	0	2853
ALL firms	310	687	2730	0	44293

Notes: 1. This table is only for firms which do not have missing initial size. 2. Mean size of diversifying firms is 215 if an outlier firm is excluded.

5. Results

5.1. Initial Size and Firm Survival:

We test the prediction of our model using Cox proportional hazard ratio regression. We treat exit as failure. All types of firms are at risk of failure from the time they enter software exports industry. We control for timing of entry and allow for interaction between time and age of the firm.

The result is shown in Table 6. We find that conditioned on current size, initial size has negative influence on firm survival. A 1% increase in initial size increases annual hazard of exit by 15%. However, a 1% increase in current size has the effect of decreasing annual hazard of exit by 28%. The foreign branch, diaspora and spinoff face lower annual hazard of exit. There are no benefits of being either a diversifier or startup.

These results confirm the prediction of the model that the initial size of the firm is exogenous and observed by firm before they enter the software exports industry. Our results are similar to those found by Mata et al. (1995). However, they add coefficients on current size, which is negative and initial size, which is positive, and interpret this sum of two coefficients. They find that overall effect of initial size is beneficial for firm survival. Our model tells under what condition it is possible to obtain positive coefficient on initial size. This gives us clear idea about what it means to find positive coefficient on initial size. The results mean that firm's initial size is exogenous and is observed by firm before they enter. Our results also tell us about the nature of the industry. What it means is that in this industry firms know their true efficiency but they are not able to communicate it to the market. Firms get contracts and the size of the contract is decided by the contracting party and they cannot influence its size.

Table 6

All entrants: Cox Proportional Hazard Ratio Regression

	Coeff.	Haz. Ratio	P>|z|
Initial Size	0.14	1.15	0.03
Initial size missing dummy	-0.54	0.58	0.18
Current Size	-0.33	0.72	0.00
Current size missing dummy	-0.40	1.50	0.43
Foreign branch dummy	-0.94	0.39	0.02
Diaspora dummy	-1.04	0.35	0.02
Spinoff dummy	-0.69	0.50	0.07
Diversifier dummy	-0.05	0.94	0.87
Startup dummy	-0.09	0.91	0.80
Control for entry timing, age	YES		
N	329		

Cluster corrected standard errors, Non-traceable/others is omitted type

The larger firms face lower annual hazard of exit. There are many benefits of scale especially in the software services exports sector (Arora et al., 1999). It is easier for larger firm to get bigger overseas contracts.

The diaspora, foreign branch, and spinoffs face lower annual hazard of exit. Though diaspora have lowest annual hazard of exit, the difference between these three types is not significant. The diaspora and foreign branch have better access to market as these firms are mainly located in overseas country where market is and is therefore easier for them to get contracts. On the other hand spinoffs have experience in the industry. Similarly, diaspora and spinoffs have local knowledge of business environment and labor market in India where they are setting up operations.

In other industries spinoffs have been found to exhibit better performance than the startups (Klepper ICC, Agarwal et al., 2004). However, our finding that diversifiers[2] do not have any advantage

[2] Though we do not report here, even the established diversifying firms who have some international exposure, were not found to have any advantage.

relative to startups or spinoff is contrary to findings of many studies, though there is some support in literature. In the disk drive industry it was found that only spinoffs have higher survival probability compared to diversifiers and incumbent firms (Agarwal et al., 2004). The diversifiers in the information security industry survive longer than both related startups (spinoffs) and unrelated startups (Arora et al., 2007).

But why diversifiers do not perform better even if they have access to capital, experience of running business, etc.? Perhaps because the software exports business is so different from the typical Indian manufacturing experience. It requires hiring and managing highly trained people, many of whom will work at the client's site. Plus, it may require marketing to foreign clients, meeting tight timelines and quality standards, neither of which is characteristic of the Indian firm experience.

We also find that the earlier entrants do not have any advantage over the later entrants. This is consistent with the finding that in the earlier years Indian firms were experimenting with business models of delivery of services to overseas clients before mixed delivery model was accepted (Athreye, 2005).

5.2. Founders' Human Capital and Firm Survival:

We now focus on de novo firms only. We are interested in finding the effect of founders' general human capital on the survival of firms. We use Cox proportional hazard ratio regression. We treat exit as failure and again as with all entrants all types of firms are at risk of failure from the time they enter software exports industry. We control for timing of entry and allow for interaction between time and age of the firm.

The result is shown in Table 7. Similar to the case for all entrants, the current size has positive effect on firm survival and initial size have negative effect on firm survival. What is now important is that once we control for founders' human capital, the effect of firm type disappears. It does not matter whether firm type is diaspora or spinoff. The firms with foreign educated founders face 77% lower annual hazard of exit.

We can better appreciate the results of Table 7 if we analyze initial size of de novo firms. The results of OLS regression of natural log of initial size on type, education indicator variables with control variables are shown in Table 8. We use only those firms for which initial size is not missing. The omitted category for firm type is startup and is undergrad in liberal arts/science for education. These results show that spinoffs and diaspora on an average enter with bigger initial size compared to startups. These results also show that the firms with founders who have undergraduate degree in engineering and MS or MBA from a foreign country enter on an average with the same size as the startups with undergrad in liberal arts/science. However, it is important to note that 47 out of 49 firms with foreign educated founders are either diaspora or spinoffs. If we had found their size to be smallest, then given the choice of initial size we could have said that they are the most efficient. Perhaps these firms with foreign educated founders are doing something different which explains their superior performance.

Table 7

De novo entrants: Cox Proportional Hazard Ratio Regression

	Coeff.	Haz. Ratio	P>|z|
Initial Size	0.15	1.17	0.09
Initial size missing dummy	-0.18	0.83	0.75
Current Size	-0.37	0.69	0.00
Current size missing dummy	0.50	1.63	0.39
Diaspora dummy	0.27	1.31	0.58
Spinoff dummy	-0.11	0.89	0.80
Education missing dummy	0.06	1.06	0.75
Undergrad in Engineering	-0.25	0.78	0.59
Undergrad in Engineering, and MS or MBA dummy	0.43	1.54	0.41
Undergrad in Engineering, and MS or MBA from foreign country dummy	-1.46	0.23	0.01
Age at entry	-0.18	0.84	0.06
Control for entry timing, age	YES		
N	154		

Cluster corrected standard errors, startup is omitted type, Undergrade/grad in liberal arts is omitted category for education

Table 8

Regression of Log of Initial Size for de novo firms

	Coeff.	P>|z|
Diaspora dummy	1.07	0.04
Spinoff dummy	1.09	0.01
Education missing dummy	0.00	0.98
Undergrad in Engineering	0.17	0.70
Undergrad in Engineering, and MS or MBA dummy	1.12	0.09
Undergrad in Engineering, and MS or MBA from foreign country dummy	-1.12	0.11
Constant	3.67	0.00
Control for entry timing, age	YES	
N	123	

Startup is omitted type, Undergrade/grad in liberal arts is omitted category for education.

In the regression for all entrants we found that diaspora and spinoffs had advantage over startups. The advantage of spinoff lies in the fact that they have direct experience of working in the industry. The diasporas have experience of relevant market. This suggests that experience matters. However, these results suggest that the acquiring higher education in the foreign country, where there is market for software services, is similar to having direct experience.

6. Conclusions:

This study contributes to the literature by developing a model that rationalizes empirical findings. We are able to tell the conditions under which it is possible to get positive coefficient on initial size conditioned on current size. The findings imply that the software exporters in India though knew about their true efficiency but were not able to communicate it to the market. These results are robust even when we limit our analysis to de novo firms and include founders' human capital as additional control. These results thus tell us about the very fundamental nature of the industry. There are limits to contracting in this industry (Banerjee, 2000).

Even though this is technology intensive industry, firms whose founders have only undergraduate degree in engineering do not have any benefit. However, the firms whose founders have undergraduate degree in engineering and MS or MBA from a foreign country have huge benefit. Once we control for the founder's human capital, then firm types do not have independent effect on survival of firm. This suggests that engineer founders with MS or MBA from foreign country are not handicapped because of lack of experience in the relevant industry. This type of human capital facilitates access to market by helping overcome some limits of contracting inherent in this industry.

Our finding that spinoffs have lower annual hazard of exit is similar to the findings in many studies both for manufacturing and hi-tech industry. However, that diversifying firms do not have any advantage is contrary to the many empirical findings. It suggests that the advantages like better access to capital, experience of managing business which diversifiers have is not relevant for success in this industry. What is relevant is the direct experience of working in this industry.

We find that it is advantageous to be foreign branch or diaspora. This suggest that access to the markets is important in the software export industry. However, since diaspora firms perform better than foreign firms, local knowledge is also beneficial.

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Appendix 1:

1. Optimum value of M_0

$$E(\pi_1 | \varepsilon_1 > K\ ) = \underset{M_0}{\arg\max} \int_K^{\infty} ((p-c)(\lambda Q_0 + \alpha\psi(M_0) + \varepsilon_1) - F)\phi(\varepsilon_1)d\varepsilon_1 - M_0$$

Applying Leibniz integral rule[3] to above equation we get the condition for optimum value of M_0^*

$$(p-c)\alpha\psi'(M_0)\int_K^{\infty} \phi(\varepsilon_1)d\varepsilon_1 - 1 = 0$$

$$(p-c)\alpha\psi'(M_0)(1-\Phi(K)) = 1$$

$$\psi'(M_0) = \frac{1}{1-\Phi\left(\frac{F}{p-c}-\lambda Q_0-\alpha\psi(M_0)\right)}\frac{1}{\alpha(p-c)}$$

We plot left hand side and right hand side of above equation to show that there exists a unique value of M_0 that is increasing in Q_0(see Fig. 1).

2. Next we show that$\frac{\partial X^*}{\partial Q_0} < 0$, when $Q_0$is exogenous but observed.

Let profit of firm $\pi = \pi_0^* + V_1$, where $V_1$is expected present value of future profits, and$\pi_0^* = X^* Q_0 - F$. Firm will enter if profit $\pi$is greater than or equal to the entry cost$E$. That is

$$X^* Q_0 - F + V_1 - E = 0$$

On differentiating equation (4') with respect to Q_0

$$X^* + Q_0 \frac{\partial X^*}{\partial Q_0} + \frac{\partial V_1}{\partial Q_0} = 0$$

$$\frac{\partial X^*}{\partial Q_0} = \frac{-(\frac{\partial V_1}{\partial Q_0} + X^*)}{Q_0} < 0$$

We plot $X^* Q_0$ and $F + E - V_1$ as a function of X(see Fig. 2). As entry size increases, the entry threshold decreases, i.e., $\frac{\partial X^*}{\partial Q_0} < 0$.

3. We now show $\frac{\partial Q_0}{\partial X} > 0$, when $Q_0$is endogenously chosen.

From entry condition $\pi - E \geq 0$, we get

$$\frac{\partial \pi}{\partial Q_0} - \frac{\partial E}{\partial Q_0} = 0$$

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[3] Please note that the integrand reduces to zero at lower limit of integration and is zero for upper limit of integration.

Taking *partial derivative* of above equation with respect to price-cost margin $X = (p-c)$, we get

$$(\frac{\partial^2 \pi}{\partial Q_0^2} - \frac{\partial^2 E}{\partial Q_0^2})\frac{\partial Q_0}{\partial X} + \frac{\partial^2 \pi}{\partial Q_0 \partial X} = 0$$

$$\frac{\partial Q_0}{\partial X} = \frac{\frac{\partial^2 \pi}{\partial Q_0 \partial X}}{-(\frac{\partial^2 \pi}{\partial Q_0^2} - \frac{\partial^2 E}{\partial Q_0^2})}$$

We first determine $\partial \pi / \partial Q_0$ and then $\partial^2 \pi / \partial Q_0 \partial X$. The profit πcan be written as:

$$\pi = \pi_0(Q_0, X) + \pi_1\big(Q_1\big(Q_0, M_0(Q_0)\big), M_0(Q_0), X\big) +$$

$$\frac{\partial \pi}{\partial Q_0} = \frac{\partial \pi_0}{\partial Q_0} + \frac{\partial \pi_1}{\partial Q_1}\frac{d Q_1}{d Q_0} + \frac{\partial \pi_1}{\partial M_0}\frac{dM_0}{dQ_0}$$

$$\frac{\partial \pi}{\partial Q_0} = \frac{\partial \pi_0}{\partial Q_0} + \frac{\partial \pi_1}{\partial Q_1}(\frac{\partial Q_1}{\partial Q_0} + \frac{\partial Q_1}{\partial M_0}\frac{\partial M_0}{\partial Q_0}) + \frac{\partial \pi_1}{\partial M_0}\frac{\partial M_0}{\partial Q_0}$$

$$\frac{\partial \pi}{\partial Q_0} = \frac{\partial \pi_0}{\partial Q_0} + \frac{\partial \pi_1}{\partial Q_1}\frac{\partial Q_1}{\partial Q_0} + \left(\frac{\partial \pi_1}{\partial M_0} + \frac{\partial \pi_1}{\partial Q_1}\frac{\partial Q_1}{\partial M_0}\right)\frac{\partial M_0}{\partial Q_0}$$

FOC for M_0:

$$\frac{\partial \pi_1}{\partial M_0} = 0 \qquad (5')$$

$$\frac{\partial \pi_1}{\partial M_0} + \frac{\partial \pi_1}{\partial Q_1}\frac{dQ_1}{dM_0} = 0$$

Using FOCs for M_0, the above equation simplifies to:

$$\frac{\partial \pi}{\partial Q_0} = \frac{\partial \pi_0}{\partial Q_0} + \frac{\partial \pi_1}{\partial Q_1}\frac{\partial Q_1}{\partial Q_0}$$

$$\pi_0 = XQ_0 - F$$

$$\pi_1 = E(XQ_1 - F) - M_0$$

$$\frac{\partial \pi}{\partial Q_0} = X + E(\lambda X)$$
$$= X + \lambda X\big(1 - \Phi(K)\big)$$
$$= X\{1 + \lambda\big(1 - \Phi(K)\big)\}$$

$$K = \frac{F}{X} - \lambda Q_0 - \alpha\psi(M_0)$$

$$\frac{\partial^2\pi}{\partial Q_0 \partial X} = \left\{1 + \lambda\big(1 - \Phi(K)\big)\right\} + X[-\lambda\phi\left(-\frac{F}{X^2} - \alpha\frac{\partial\psi(M_0)}{\partial X})\right]$$
$$\frac{\partial^2\pi}{\partial Q_0 \partial X} = \left\{1 + \lambda\big(1 - \Phi(K)\big)\right\} + \lambda\frac{F}{X}\phi(K) + \ X\alpha\phi(K)\frac{\partial\psi(M_0)}{\partial X}$$

We now show that $\frac{\partial\boldsymbol{\psi}(\boldsymbol{M_0})}{\partial\boldsymbol{X}} > 0$

The first order condition for M_0 can be obtained by differentiating $\pi_1(M_0, X)$ with respect to M_0. This condition is

$$T = \frac{\partial\pi_1}{\partial M_0} = 0$$

$T_{M_0} = \frac{\partial T}{\partial M_0} < 0$, being the second order condition for M_0.

$$\frac{\partial T}{\partial X} = \frac{\partial^2\pi_1}{\partial M_0 \partial X}$$

$$\pi_1 = E(XQ_1 - F) - M_0$$

$$\frac{\partial\pi_1}{\partial X} = E(Q_1) = Q_1(1 - \Phi(K))$$

$$\frac{\partial^2\pi_1}{\partial X \partial M_0} = \big(1 - \Phi(K)\big)\frac{\partial Q_1}{\partial M_0} + Q_1(-\phi)(-\alpha\psi'(M_0))$$

$$= (1 - \Phi(\mathrm{K}))\alpha\psi'(M_0) + \alpha\psi'(M_0)\phi(K_{01})Q_1$$

$$= \alpha\psi'(M_0)[1 - \Phi(\mathrm{K}) + \phi(K)Q_1]$$

Thus

$$T_X = \frac{\partial T}{\partial X} = \frac{\partial^2\pi_1}{\partial M_0 \partial X} > 0$$

$$dT = T_X dX + T_{M_0} dM_0 = 0$$

$$dT = T_X dX + T_{M_0} dM_0 = 0$$

$$\frac{\partial M_0}{\partial \mathrm{X}} = \frac{\mathrm{T_X}}{-\mathrm{T_{M_0}}} > 0$$

$$\frac{\partial\psi(\mathrm{M_0})}{\partial\mathrm{X}} = \frac{\partial\psi(\mathrm{M_0})}{\partial\mathrm{M_0}}\frac{\partial\mathrm{M_0}}{\partial\mathrm{X}}$$

We know that $\frac{\partial\psi(M_0)}{\partial M_0}$ is positive and $\frac{\partial M_0}{\partial \mathrm{X}}$ is also positive, that makes $\frac{\partial\psi(M_0)}{\partial X}$ positive.

This makes

$$\frac{\partial^2\pi}{\partial Q_0 \partial X} = \{1 + \lambda(1 - \Phi(K))\} + \lambda \frac{F}{X}\phi(K) + X\alpha\phi(K)\frac{\partial\psi(M_0)}{\partial X} > 0$$

$$\frac{\partial Q_0}{\partial X} = \frac{\frac{\partial^2 \pi}{\partial Q_0 \partial X}}{-(\frac{\partial^2 \pi}{\partial Q_0^2} - \frac{\partial^2 E}{\partial Q_0^2})}$$

The denominator in above is positive as $\pi - E$ concave in Q_0. We have also shown that numberator is positive. This makes$\frac{\partial Q_0}{\partial X} > 0$.

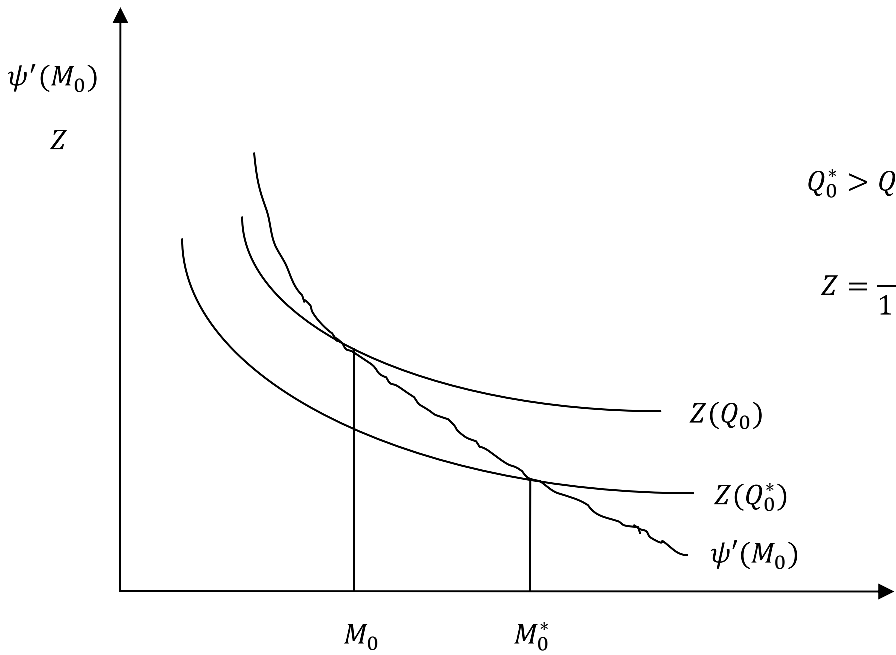

Figure 1: Optimal Value of $M_0$and Q_0

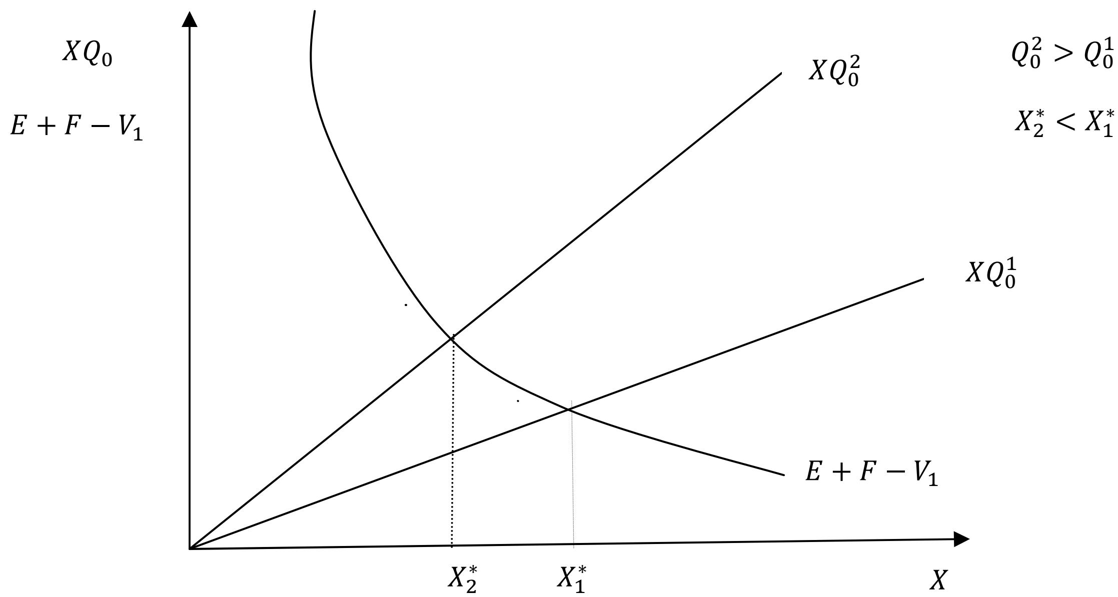

Figure 2: Entry Threshold (X*) and Entry Size (Q_0)

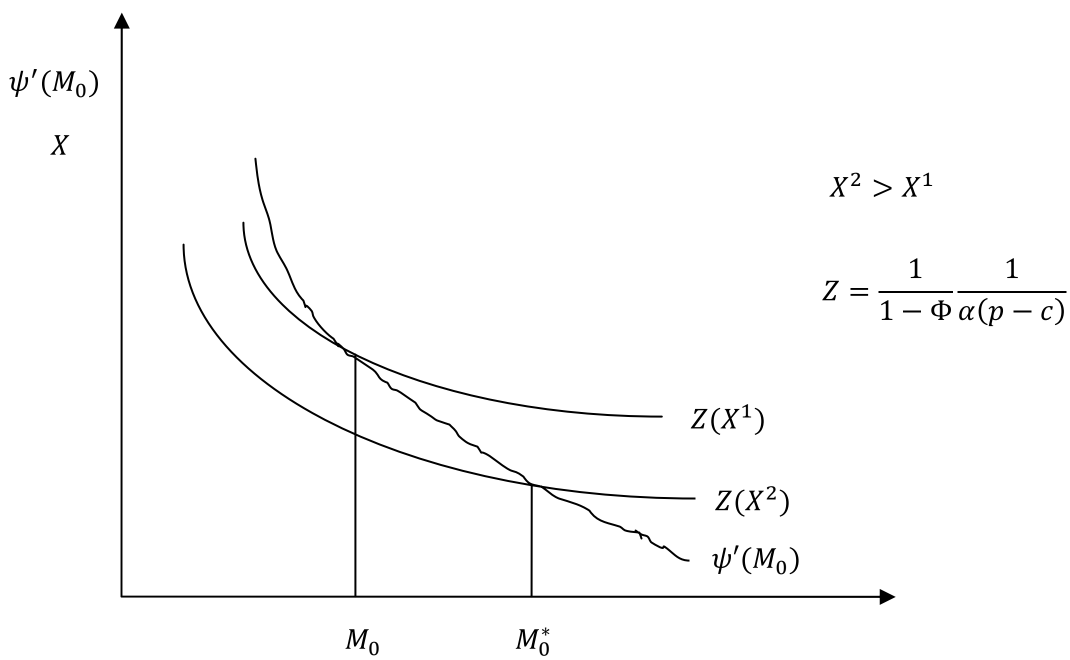

Figure 3: Optimal Value of $M_0$and $X=(p-c)$