Predictors of Business Failure among High-technology firms: A neural networks analysis

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Introduction

There is a growing body of work on business failure; especially among small firms (Campbell, et al., 2012, Martin et al., 2013; Mellahi and Wilkinson, 2004; Thornhill and Amit, 2003; Semrau and Werner, 2012). A closer reading of the works however, shows that the techniques used to analyse the data in relation to the research question are generally rigid and can lead to misleading results as to the factors that actually cause business failure (Campbell et al., 2012). The majority of works rely on standard regression models with very strict assumptions about the normality of the population from which the data are drawn to predict business failure. This inflexibility in the models can lead researchers and policymakers to have the wrong impression about the factors that are most critical in predicting business failure. To overcome this problem, the research presented in this paper has applied a more robust and flexible analysis tool, the neural networks model, to better predict the factors that are most likely to influence business failure among small firms in the high-technology sector.

The extant literature argues strongly that failure among high-technology firms is generally high; due mainly to a lack of resources (Chak, 1998; Almus and Nerlinger, 1999; Calvo, 2006; Colombo and Grilli, 2010). As such a theoretical framework which captures the resources capacity and capabilities of the firm will help to provide significant insights into this hypothesis. Therefore, using the resource-based view of the firm as the theoretical lens through which to view the problem of business failure, the paper draws on a number of variables that are surrogates of resources and use them to predict business failure among the high-technology firms. Applying a rigorous and flexible analytic technique to test this hypothesis will, no doubt, add new insights to the literature on the business failure and moreso, the aspect which focuses specifically on failure among high-technology firms.

Study Aim

There are various analytical frameworks that have been used to determine factors that contribute to business failure. The various frameworks provide differing results in some cases and importantly, are very rigid in their assumptions making it difficult to apply in various research context. This paper therefore, tries to address this methodological weakness by using a more flexible but rigours analytical tool to answer the research question posed. As such, the paper aims to answer the following research question: **Using a rigorous and flexible analytical tool to predict business failure, which factors are most important in explaining failure among the firms in the high-technology sector?**

Method

To motivate this study, a general model which captures business failure among high-technology firms and resources will have to be identified. Following previous works on business failure (Campbell et al., 2012, Martin et al, 2013; Watson, 2007), the theoretical model therefore becomes:

$Y_j = \int (X_1, X_2, X_3 \ldots Xn) + \varepsilon j$ **(1)**

Where:

Y represents Business failure

$_J$ is each individual firm.

$X_1 \ldots X_n$ represent the vector of variables capturing the different types of resources both financial and non-financial that have been found to impact on business failure.

εj is the error term, accounting for all other factors that impact business failure but are not captured in this study.

To capture equation 1 in a form that can make for better operationalization, the non-linear model for estimation using the neural network becomes:

$y=f_2(r_2 f_1(r_1 x))$ **(2)**

Where:

$x = (x_1, x_2, \ldots x_n)$ be an n-vector of the independent variables i.e. the proxies for resources

y is the dependent variable or the output from the network i.e. success or failure of high-technology firms

r_1 and r_2 are the weights of matrices linking input to hidden layer and hidden layer to output respectively

f_1 and f_2 are the transfer functions for the hidden and output nodes respectively.

The form that these transfer functions take is as follows:

$f_1(x) = f_2(x) = (1+e^{-x})^{-1}$

For this study, data were collected from the FAME[1] database which has a total of about 2million firms, which captures the sample frame. The search was narrowed down to firms that are active or inactive in high-technology sector in the UK economy over the period, 1999-2008. In order to control for size, a maximum upper boundary on the number of employees in the firm was placed at 250 employees. This upper bound of 250 employees represents the definition for SMEs in the UK. This search has led to over 1700 firms that were deemed appropriate for the analysis.

Findings

The results from the analysis of the data have shed some new light on the factors that impact business failure. The preliminary results suggest that profit, in the form of retained earnings, is the most significant factor that determines failure among these high technology firms. Other factors of importance are: governance structure, location and firm size. Importantly, the issue of governance structure as a resource has received very little attention in the works on business failure. This study therefore, has made a contribution to the literature by adding governance as an important resource.

Conclusion and implications

The preliminary results suggest that profitability is an important variable that will determine whether or not a firm succeeds or fails. Similarly, other important variables such as location and governance structure do impact on business failure. Using the resources-based lens through which to analyse the problem, it appears that the findings are in concert with other works on the subject which argue that; a higher resource stock will provide a greater buffer for firms to survive changes in their operating environment (Watson, 2007; Chak, 1998). Importantly, the study incorporated governance structure as a resource which is absent from the resource based view discourse. Future research should look at how the results hold-up across different geographic regions as country factors may have a stronger impact on failure in those locations.

[1]FAME means Financial Analysis Made Easy. It is a database with a significant amount of financial and company information on UK firms.

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