Firm growth and the illusion of randomness

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Abstract

This paper shows that randomness can be an artefact of the methods used to examine firm performance. It questions the recent equating of entrepreneurship with gambling based on the assumption of random firm performance. It shows that complexity science provides a useful alternative perspective on randomness in relation to firm performance.

Keywords: firm growth; randomness

1. Introduction

The debate about firm growth and randomness is longstanding, having been initiated by Gibrat in 1931 (Gibrat, 1931). It has received contributions from a diverse set of luminaries, including Kalecki (1945) and Dosi (2007). A useful recent addition to this debate has been made by Coad et al. (2013) when setting out Gambler's Ruin Theory (GRT) in which firm performance is explicitly equated with coin-flipping and entrepreneurship with gambling.

A central motivation for GRT is these authors' view that several decades of research has failed to explain more than about 15 percent of the variation in firm performance (Storey, 2011, p.309-310; Coad, 2009, p.97-98). Their logic is that, because there has been so little success in identifying the resource factors associated with firm performance this means that such factors do not affect firm performance.

In this paper we explore this view. We show that randomness can be an artefact of methodological procedure by presenting an alternative analysis employing an alternative dataset and measure of firm performance. We set out crucial distinctions between indeterminism on the one hand and deterministic chaos on the other, and between risk and uncertainty. We begin below by describing GRT as set out by Coad et al. (2013).

2. Gambler's Ruin Theory

Coad et al. (2013) examine data for 2,184 firms started in the same quarter of 2004 and surviving for four subsequent years. They categorise these firms as either 'growing' or 'declining' depending on whether their sales-revenue growth is above or below that of the median firm for the year in question. Reducing firm performance to the two categories of 'growth' or 'decline' in this way facilitates comparison against the random benchmark of coin-flipping.

For four consecutive flips of a fair coin there are sixteen different possible sequences of outcomes. Following this analogy, over a period of four years there are also sixteen possible 'growth paths' (Fig. 1), each of them occurring approximately 6.25% of the time if firm growth is random. The occurrence of the growth paths in the analysis offered by Coad et al.(2013) is sufficiently close to the coin-flipping benchmark of 6.25% for the authors to conclude that growth occurs in an approximately random fashion.

INSERT FIG. 1 ABOUT HERE

However, using the median sales revenue in this way results in negligible differences between firms categorised as 'growing' and 'declining' and, therefore, a misleading impression of randomness. In the first year of Coad et al.'s (2013) analysis the median sales revenue is just £39,276 and between year 1 and year 2 the median growth of sales revenue is just 6%. Therefore, if the firm with the median sales revenue in year 1 grew at the median growth rate between year 1 and year 2 its sales revenue in year 2 would be £41,633 and it would be considered a 'growing' firm in year 2. However, if it instead only grows its sales revenue by 5.9% between year 1 and year 2, or from £39,276 to £41,593, the firm would instead be considered to be a 'declining' firm in year 2 – yet the difference between the two is just £40.

Sales revenue is an ambiguous indicator of performance because its volatility can be representative of trivial, ephemeral changes in firm performance (Davidsson et al., 2009, p.389). While all measures have disadvantages, employment growth is arguably more representative of genuine, long-lasting changes in performance and is less subject to volatility (Garnsey et al., 2006). It is easier to compare than are sales figures and is generally taken as the standard measure of firm growth (OECD, 2002; Davidsson et al., 2009).

Reducing firm performance to just two categories using sales revenue as an indicator removes the third possible growth outcome of 'stasis', or no change in performance. In the subsequent analysis, we instead use change in employment as the indicator of performance to show that the randomness identified by Coad et al. (2013) is an artefact of a measurement approach designed to eliminate stasis as a growth outcome.

3. Data and analysis

3.1 Data

The Beta Model (TBM) is a database of 2.6m UK firms whose creation, performance (in terms of employment change) and survival have been tracked over a ten-year period. The existence of a firm is registered on the database through its entry in one of two (or both) major UK business directories, The Yellow Pages or Thomson Local. Because of this method of data capture, the point at which the firm's existence is captured is closer to its actual inception than in the official VAT data and the problem of so-called 'left truncation' (Yang and Aldrich, 2012) is reduced. For this reason, in 2010 TBM had 2.6m firms registered on it compared to the UK government's VAT dataset which had approximately 1.5m. The cohort of firms examined in the following analysis is for the fourth quarter of 2005, during which 79,427 firms were created across the UK. A total of 39,825 of these survive for four subsequent years to become part of this analysis of employment 'growth paths'.

3.2 Analysis

If, like Coad et al. (2013), we exclude from the 39,825 firms any firm with a period of stasis (no change in employment) in any of the four years under analysis, we are left with just 187 firms. From 39,825 firms 39,638, or 99.5%, have at least one period of

stasis over the four-year period. If we instead include stasis as an additional category, the number of possible 'growth paths' increases from sixteen to eighty-one as shown in Table 1.

INSERT TABLE 1 ABOUT HERE

Table 1 shows that, when using employment change as the measure of firm performance, and when including stasis as a specific category of outcome, firm growth is decidedly not random. 56% of firms have a growth path characterised by four consecutive periods of stasis. Of the other growth paths, those which are dominated by stasis (i.e. those including three periods of stasis) tend to be followed by a larger percentage of firms (around 1-5%) than those dominated by either growth or decline. Given this dominance of stasis as a growth outcome, it is not legitimate to exclude it from the analysis by focussing on negligible changes in sales revenue simply in order to facilitate a comparison with coin flipping. This illustrates the extent to which randomness can be an artefact of method. We next consider the issue of randomness from a complexity science perspective.

4. A complexity perspective

4.1 Indeterminism and deterministic chaos

Complexity science can provide an explanation for the perceived failure of decades of research to identify factors associated with firm performance. This explanation is based on the crucial distinction between indeterminism and deterministic chaos.

Indeterminism implies an absence of cause, and therefore an absence of agency. By contrast, under deterministic chaos outcomes have causes but these are initially so small that we cannot measure them and for convenience they may be called random (Byrne, 2002). A chaotic system exhibits long periods of stability (or stasis) punctuated by sudden qualitative changes as a result of amplified positive feedback originating in these initially small causes, leading to 'path dependence'. Envisaging firms as Complex Adaptive Systems subject to deterministic chaos provides an explanation for the path dependence and stasis exhibited by the firms in Table 1.

The perceived failure to identify factors associated with firm performance sufficiently to allow prediction is reflective of deterministic chaos in firm performance and not indeterminism as Coad et al. (2013) imply. Gambling is reflective of indeterminism and is not, therefore, an appropriate analogy for entrepreneurship.

4.2 Risk and uncertainty

The related distinction between risk and uncertainty also suggests that gambling is not an appropriate analogy for entrepreneurship. Risk exists where it is possible to calculate the probability of a particular outcome. An example is the throwing of a fair die with six sides, for which all possible outcomes are known, and for which the probability of each is therefore calculable and equal to 1/6. Coin-flipping also falls into this category of processes.

By contrast, uncertainty exists where it is not possible to calculate probabilities for particular outcomes, perhaps because a full set of possible outcomes is not known, or because of the absence of an appropriate reference class of events of the same type. Each new firm represents a variation in a business model, implemented in a constantly varying economic context, by an entrepreneur with idiosyncratic knowledge and skills. The creation of a new firm is therefore representative of uncertainty, not risk as in gambling.

Because they deal with uncertainty not risk, entrepreneurs adopt 'effectuation' strategies - iterative processes of matching the firm's internal resources to constantly evolving external opportunities - leading to improvisation and adaptation (Sarasvathy, 2001). While this does *not* imply that entrepreneurs are fully in control of outcomes, it *does* imply that they have some influence over them. Opportunities may arise randomly, but skill and agency are present in the iterative process of matching resources to them as they arise. This contrasts with the implication drawn by Coad et al. (2013, p.7) that entrepreneurs have little or no agency and are simply 'corks [bobbing] in a sea [of chance] driven by a range of factors beyond their control'.

5. Summary

A central motivation of GRT is its originators' perception that several decades of research has failed to identify the factors associated with firm performance, allowing for the prediction of growth *and* decline. However, as shown by May (1976), even in a deterministic model in which all parameters are correctly and fully specified outcomes still appear random and prediction is impossible. In complexity science this is known as deterministic chaos.

We therefore have two competing explanations for purportedly random outcomes in relation to entrepreneurship. The first is that it is an indeterminate process equivalent to gambling. The second is that it is a deterministic process involving the iterative matching of internal firm resources to external opportunities, requiring entrepreneurial skill and effort but subject to deterministic chaos rendering prediction impossible.

The first interpretation is not only incorrect, it is counter-productive. It implies that there is little to be gained by further research effort other than to understand how policy can better facilitate entrepreneurs' gambling by reducing the costs of business failure, thereby shortening the length of time between gambles (Storey, 2011). The second explanation, by contrast, offers a large number of fruitful avenues for further research, but requires a whole new set of methods and theoretical logic.

It is indeed impossible to predict the growth and decline of new and small firms as the originators of GRT imply. However, this is not because running a new firm is analogous to gambling, it is because the performance of new firms is subject to deterministic chaos. This does not imply that variations in firm resources and entrepreneurial skill do not affect performance.

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Figure 1: Possible outcomes from a sequence of four years of firm growth or decline

G-G-G-G					
G-G-G-D	G-G-D-G	G-D-G-G	D-G-G-G		
G-G-D-D	G-D-G-D	G-D-D-G	D-G-D-G	D-G-G-D	D-D-G-G
G-D-D-D	D-G-D-D	D-D-G-D	D-D-D-G		
D-D-D-D					

G=Growth D=Decline

Table 1: Growth paths for 39,825 firms started in 2005 and surviving four years

Growth Path	No. of firms	% of firms	Growth Path	No. of firms	% of firms
D-D-D-D	1	0.00%	G-G-D-S	40	0.10%
D-D-S-D	1	0.00%	S-D-G-D	44	0.11%
D-D-D-G	2	0.01%	D-S-S-D	60	0.15%
S-D-D-D	2	0.01%	G-S-D-G	65	0.16%
G-G-G-G	3	0.01%	S-G-S-G	66	0.17%
G-D-D-D	3	0.01%	D-S-G-G	68	0.17%
D-G-G-G	3	0.01%	D-G-S-D	69	0.17%
D-S-D-D	5	0.01%	G-D-S-G	79	0.20%
D-G-D-D	5	0.01%	D-D-G-S	80	0.20%
S-G-G-G	5	0.01%	D-S-D-S	83	0.21%
G-G-D-D	5	0.01%	D-G-D-S	86	0.22%
G-G-G-D	7	0.02%	S-G-G-S	94	0.24%
G-D-D-G	8	0.02%	G-S-S-G	106	0.27%
G-G-S-G	8	0.02%	G-D-G-S	110	0.28%
S-D-D-G	9	0.02%	D-S-G-D	112	0.28%
S-G-D-D	12	0.03%	S-S-D-G	123	0.31%
G-G-D-G	13	0.03%	D-D-S-S	129	0.32%
G-D-G-G	14	0.04%	S-D-S-G	130	0.33%
D-D-D-S	14	0.04%	G-G-S-S	148	0.37%
G-G-G-S	18	0.05%	G-S-G-S	156	0.39%
D-G-G-D	18	0.05%	S-S-G-G	157	0.39%
D-G-D-G	18	0.05%	S-G-S-D	172	0.43%
G-S-G-G	19	0.05%	G-S-S-D	246	0.62%
D-S-D-G	19	0.05%	D-S-S-G	253	0.64%
G-S-D-D	21	0.05%	S-D-G-S	263	0.66%
D-G-S-G	23	0.06%	S-G-D-S	277	0.70%
D-D-S-G	25	0.06%	S-S-G-D	341	0.86%
G-D-G-D	26	0.07%	G-S-D-S	385	0.97%
D-G-G-S	26	0.07%	D-G-S-S	413	1.04%
S-S-D-D	26	0.07%	G-D-S-S	432	1.08%
S-G-G-D	26	0.07%	D-S-G-S	614	1.54%
G-D-D-S	27	0.07%	S-S-S-D	780	1.96%
S-D-G-G	28	0.07%	S-S-D-S	845	2.12%
D-D-G-D	29	0.07%	S-D-S-S	887	2.23%
G-D-S-D	29	0.07%	S-S-S-G	1162	2.92%
D-D-G-G	32	0.08%	S-G-S-S	1254	3.15%
G-G-S-D	33	0.08%	S-S-G-S	1960	4.92%
S-D-S-D	33	0.08%	D-S-S-S	2161	5.43%
S-D-D-S	38	0.10%	G-S-S-S	2199	5.52%
S-G-D-G	39	0.10%	S-S-S-S	22463	56.40%
G-S-G-D	40	0.10%	**Grand Total**	**39825**	**100%**

G=Growth; S=Stasis (no change); D=Decline