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Abstract: This paper examines the theory and evidence in support of entrepreneurial leaning (EL). Under this theory entrepreneurial performance is argued to be enhanced by EL which itself is enhanced by business experience. However, if business performance is strongly influenced by chance then evidence of EL will be difficult to identify. We test for EL using a large scale data set comprising 6671 new firms. We choose business survival over three years as our performance measure and then formulate three tests for EL. None of the three tests provide compelling evidence in support of EL.

Keywords: start-up, survival, learning, chance.
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1. Introduction

Those familiar with the classic, tightly theorised, text by Casson (1982), will recall that author's efforts to link entrepreneurship theory with the fictional Jack Brash. Casson says:

> "*Jack Brash starts with very little information. But information is generated continuously as a by-product of his trading activity, and Jack uses this information to the full. He learns from the deals that he makes, and he learns from the deals that fall through. By analysing his experience he is able to turn adversity to advantage",* page 386-7.

In his later writing Casson (1999) sees the key role of the entrepreneur as being to process information when that information is both costly and volatile. Casson postulates that the economic environment is continuously disturbed by shocks, which may be either transitory or persistent. The entrepreneur who runs a business has to respond to these shocks by making decisions – whether or not to invest in new plant and machinery, develop new products or services or shed labour. To make such decisions the entrepreneur is assumed to require costly information.

But not all entrepreneurs choose to collect the same amount of information and, even if they all had the same information, some make better decisions than others. Casson views the former as better entrepreneurs because of their greater skill in processing information. In terms of Jack Brash, if all individuals start with little information, then it is the ability of some to learn faster than others that distinguishes the successful entrepreneur from the less successful, so EL is then best captured in the phrase "by analysing his experience he is able to turn adversity to advantage"

However there are also powerful reasons for believing the opportunities for entrepreneurial learning (EL) may be limited or even non-existent. The first develops the Casson notion of shocks and asks: what if these shocks are

persistent but bear little resemblance to previous shocks that the entrepreneur has experienced? In this case learning cannot take place because each shock is different. The second is the role of chance in influencing entrepreneurial outcomes. Where outcomes are wholly stochastic then, by definition, this excludes entrepreneurial learning (EL). This is most clearly reflected in the limited extent to which a lottery player can 'learn' from past experience to be more successful in the future. That individual may enter a second time with more tickets and so increase their chance of a win, but it does not imply they have 'learnt to play the lottery'. The third combines the two and emphasises that, in a risky environment in which shocks rarely repeat themselves precisely, the entrepreneur has difficulty in deciding ex-post whether the decision was correct or incorrect. Here again learning is problematic, but it implies that the larger the chance component, and the greater difficulty of linking actions and outcomes, the lower the opportunity for EL.

So, despite its beguiling plausibility, EL is a concept that requires empirical support. Curiously, however, much of the testing of EL has relied, as De Clerq and Sapienza (2005) point out, on asking the entrepreneur "how he or she [the entrepreneur] has gained new insights or broader understanding". They justify this on the grounds that "objective learning is nearly impossible to verify".

This paper rejects that assertion. Instead it argues, following Casson, that if learning takes place, it has to be reflected in enhanced entrepreneurial performance and that reliance on self-report data is particularly problematic. The paper formulates three tests for the presence of EL, two of which are novel but all three rely on examining the **outcome** of learning rather than the **self-reporting** of learning. Our chosen outcome measure is the survival/non-survival of a new enterprise. The three tests assume that if learning takes place then an individual's entrepreneurial talent, θ, would be expected to increase with time in business

and/or with prior business experience and so raise the likelihood of new firm survival.

The key contribution of the paper is therefore to interrogate the concept of EL using an economic lens. It takes the survival of a new enterprise as the metric of success and concludes that, far from learning, the business owner continues to take ‘life-threatening’ actions for at least three years after start-up.

We do not infer from this that the owner is incapable of learning. Instead our inference is that the opportunities for learning are in fact modest because of the range and diversity of situations faced by the owner of a new business. This means that the “same situation” rarely recurs in the first two years of a firm’s lifespan, so clear learning opportunities are also rare. Superimposed on this is the key role of chance. By this we mean that business owner A can make the ‘wrong’ decision many times and still survive, whilst business owner B makes a bad decision only once and has to close. We conclude that it is the absence of repeat learning opportunities, together with the greater role played by chance in new firm survival, that explains why EL is less likely to be present in such enterprises than in large established ventures.

The remainder of the paper proceeds as follows. Section 2 reviews and develops the theory of entrepreneurial learning and then assesses the extent to which such theories are supported by empirical evidence. Section 3 summarises some key empirical studies of firm survival. Section 4 derives our empirical tests from the literature review. Section 5 sets out the data used to conduct these tests and Section 6 presents our findings. Section 7 summarises the paper and offers some concluding points relating to theory development, policy practice and areas for further work.

2. Theory and Evidence on Entrepreneurial Learning (EL)

Harrison and Leitch (2005) provide a helpful and comprehensive review of the Entrepreneurial Learning (EL) literature, linking the organisational with the entrepreneurial literature from a cognitive perspective. This literature sees the core of entrepreneurship as the study of opportunities – their origins, nature and evolution. In practice, however, it emphasises that empirical testing relies almost exclusively upon self-report data.

Our review, instead, will concentrate upon an economic approach that sees entrepreneurship as an exercise in constrained choice, albeit under conditions of imperfect information. The focus is upon clear outcomes – starting or closing a business, and it places little weight upon self-report data. We provide a brief review of the more general economic literature relating to learning, and then seek to apply it to EL.

A distinction may be drawn between two forms of EL. The first is that of learning by doing. The review by Thompson (2009) of the economics of learning by doing shows that learning through repetition enhances performance, although diminishing returns set in quickly. In an entrepreneurial context it implies that the longer that an individual has been in business the more they are likely to have learnt and therefore the better their performance. A second distinction is learning that took place prior to starting a business – most notably the experience of having previously owned a business. Here again evidence of EL would be if prior business ownership enhanced the performance of a current business[1].

As Casson (1982) implies, if an individual begins a new enterprise with little, or perhaps no, knowledge one simple inference is that those individuals that either

[1] A third possibility is learning from industry-specific experience which implies that those with previous work-experience in the industry in which they begin their enterprise out-perform others. This is emphasised by Klepper and Simons (2000) and by Helfat and Lieberman (2002). However no such relationships emerged in examining new firms over three decades in northern England – either in terms of growth Greene et al (2008] or survival Saridakis et al (2008).

begin with more knowledge, and/or those that add fastest to their stock of knowledge, will have better performing businesses.

However, even this simple linkage has been questioned. Jovanovic (1982) argued that the entrepreneurial ability of new entrepreneurs (translating into a profit function) is drawn from a known distribution, but that individual entrepreneurs are unable to discern their own ability prior to entry. Instead they form (and modify) a judgement of their ability based on actual performance. The result of this ongoing evaluation is the expansion of some new firms and the contraction of others, with ultimate closure occurring when an opportunity cost threshold is breached. Although there is a stochastic element, the model implies that those entrepreneurs with higher ability trade for a longer period, and that the conditional probability of exit declines with time. The crucial element of Jovanovic's theory is that it does not assume that entrepreneurial talent θ increases with time. Time only enhances the ability of the individual to assess that talent. The value of greater accuracy is to enable the individual to reach a better informed judgement about whether or not to continue in business – the so-called "stay or quit" decision (Taylor, 1999). Nevertheless there remain few tests of Jovanovic learning primarily because of the difficulties of validly testing the concept, other than by using cognitive measures[2].

An alternative is the 'active' learning model proposed by Ericson and Pakes (1989), where several key assumptions of Jovanovic are relaxed[3]. Here a new entrepreneur is aware of their (and their competitors) level of ability. Unlike the passive learning model, the entrepreneur can influence the likelihood of higher profits in the future by undertaking investment, or by shifting sectors or markets.

[2] One notable exception is Fraser and Greene (2006).
[3] Such as product homogeneity and entrants being able to adjust size according to sector.

The theoretical base provided by the 'trading as learning' concept has subsequently been developed in a number of ways, as reviewed by Santarelli & Vivarelli (2007). These include the introduction of financial resources and possible credit rationing (Evans and Jovanovic, 1989), and an explicit role for human capital (Cressy, 1996). A further recent extension has been to include the scope for the entrepreneur to choose their market position (Cressy, 2006a), defined in terms of selecting an optimal risk/return trade-off based on both their ability and their preferences.

The above work implies that entrepreneurial learning (EL), in some form, both takes place and that it either helps the stay or quit decision, or directly enhances the individual's entrepreneurial talent. However, four plausible reasons why entrepreneurs either do not learn or are able to learn only very modestly are set out below:

- Entrepreneurship is risky[4] and chance plays a key role[5]. The most valid analogy here is that starting a business can be compared with purchasing tickets to a lottery. The gambler buys tickets for this chance event because s/he observes that some people win a large sum of money and assumes that s/he may do likewise. Of course, if the lottery is truly a chance event, then either the winners are lucky and/or they have bought more tickets than the non-winners. It does not imply that those who win have "learnt" how to play the lottery. The empirical question therefore is the extent to which business performance reflects θ and the extent to which it reflects chance[6]. If

[4] Depending on the measure, between 35% and 51% of new firms in England and Wales fail to survive for two years. See Charts A and B in this paper.

[5] The justification for this is based on the weak explanatory power of models seeking to explain survival/ non-survival of small firms, and the inconsistency of key explanatory variables. For example see Bruderl et al (1992) or Cressy (1996). In his work on self-employment Henley (2004) says "over half the unexplained variance in the probability of choosing self-employment is accounted for as unobserved heterogeneity, suggesting that idiosyncratic influences have an important part to play in self employment status". Coad (2009) shows the R^2 values obtained "from regressions obtained where the dependent variable is the growth rate of a firm". Of the 12 studies only four exceed 10%. This is of course compatible with seeing firm performance as a random variable as implied by Gibrats Law – which continues to be broadly dismissed by scholars in management, but with a more agnostic view taken by economists. See for example Lotti et al (2009).

[6] One 'explanation' might suggest that entrepreneurs that succeed attribute this to talent, whereas those that fail, attribute it to chance – specifically bad luck.

entrepreneurial performance is matter of pure chance then EL is no more valid than a punter claiming to have learnt to play the lottery.

- Entrepreneurs are optimists, which may lead them to overestimate their ability to learn. The clear evidence from De Meza (2002) is that the self-employed – entrepreneurs – are considerably more optimistic than employees. He shows that, whilst both groups are optimistic about future levels of income, the ratio of expectations to actual achievement for the self-employed is more than 50% higher than for employees[7]. Interestingly, De Meza also finds that these individuals are most optimistic about events over which they have the least control[8]. So, as demonstrated from experimental evidence provided by Camerer and Lovallo (1999), optimists buy more tickets for chance events – leading to excessive entry. Since optimism is clearly equated with entrepreneurship, the fact that, in such a chancy environment, individuals continue to buy more tickets – start more businesses – reflects their optimistic personality rather than their ability to learn. It certainly does not provide evidence that the probability of winning increases with each ticket purchased – which is the implication of EL[9].
- A third reason to be sceptical about EL is that few business situations are identical. We noted earlier that a key Thompson (2009) finding was that learning took place where (similar) situations were repeated. However, even when an individual has been in business for some time, they may have not experienced, and thus be no more able to deal with, certain business situations than an individual with little or no experience. The analogy here is with the parenting of children. Given that children of the same parents are

[7] Moore and Healy (2008) refer to this as *overestimation*. They distinguish between this and two other forms of overconfidence which they refer to as *overplacement* and *overprecision*.
[8] Cassar and Craig (2009) find optimism to be characteristic of nascent business founders. Astebro et al (2007) obtains very similar findings amongst a group of inventors who received advice that their invention was unlikely to succeed.
[9] Fraser and Greene (2006) combine the Jovanovic learning with the De Meza optimism. Their evidence points to optimism declining with experience.

extremely variable, and the family context in which they grow up is very different, the notion that a parent with, for example, eight children is significantly more knowledgeable in dealing with their ninth child, compared with a 'novice' parent, seems a little fanciful.[10] Equally, the problems facing a new firm on day one are very different from those in month six or twelve of its existence, especially when the external business conditions are also constantly changing[11].

- Finally, but most importantly in this context, the empirical evidence of entrepreneurial learning also looks weak. The cognitive evidence is heavily based, as De Clerq and Sapienza (2005) acknowledge, upon asking entrepreneurs about their learning experiences[12]. Such a methodology seems unlikely to tease out whether learning took place on the grounds that few such individuals would claim to have "learnt nothing and forgotten nothing"[13]. A more formal economic attempt to test for learning was made by Parker (2006). He showed that the self-employed adjust their behaviour only very marginally in the face of recent evidence. Instead, they are much more strongly driven by their 'priors' which, in this context, we can take as their long-term experience and personality characteristics. This also places a powerful question mark over EL.

[10] In a similar vein to the 'entrepreneurial learning' hypothesis, 'parental learning' would imply that children born later, who benefit from more experienced parents, would be expected to have more success in life than first-born children. However, the hypothetical forces of 'parental learning' seem to be overshadowed by other factors, because the available evidence seems to suggest that first-born children have more success in life than later-born children (see for example Black et al 2005).

[11] However Hmieleski and Baron (2009) appear to produce evidence that the number of ventures previously established by an individual is positively correlated with their measures of new firm performance – growth of sales and employment. However their "new ventures" are in practice on average 5.74 years old and contain no closures. They are therefore are very different from the new firms in this study, none of which are more than three years old, and about half of which close within three years.

[12] See for example Cope (2003).

[13] Used by Talleyrand to describe the Bourbon restoration in France in 1815.

So, how can we explain some frequently cited justifications for EL? It is frequently asserted, even in influential public documents,[14] that currently highly successful business owners have previously owned a business that failed. The inference is that, because they are now successful, failure must have been 'a learning experience' for them. Our view is that, at best, the evidence linking prior business ownership with (current) entrepreneurial performance is mixed. For example, Delmar and Shane (2003) and Headd (2003) find support for "start up experience" enhancing new firm survival. Amongst UK studies, however, Cressy (1996) finds no support for this, whilst Taylor (1999) finds it significant for some groups but not for others. Ucbasaran, Westhead and Wright (2006), find no significant performance differences between habitual and novice business owners. They also show no performance difference between portfolio and serial entrepreneurs[15]. Their conclusion is that "it may be difficult to learn from business ownership failures" (p194).

Larger scale evidence is available from Germany (Metzger, 2006). It shows that prior business ownership experience does enhance subsequent performance, except where this was associated with business failure. Those individuals that failed actually have poorer performing businesses if they re-start.

Nevertheless, even if there were evidence that, after beginning many businesses the founder eventually had a "win", this is equally well explained by the lottery argument above. Here, even if business success is a chance event, an individual who continues to buy tickets for the lottery will enhance their probability of a win. It does not mean that they have 'learnt to play the lottery'. It merely means they have bought more tickets.

[14] For example, the EU Green Paper on Entrepreneurship (2003) says "Despite evidence that failed entrepreneurs learn from their mistakes and perform better in their next businesses"p22. Interestingly the "evidence" they quote for this comes from a presentation from Dr Mei-Pochtler from the Boston Consulting Group. This "evidence" then gets repeated in subsequent EU policy documents such as BEST: Restructuring Bankruptcy and a Fresh Start (2003). The original "evidence" was unobtainable to us despite our best efforts!

[15] Ucbasaran et al (2006) Table 7.1

A number of the most high-profile, ultimately extremely successful, entrepreneurs in the United States had a previous business which they closed before they became a success – Walt Disney[16] and Bill Gates being two notable examples. The absence of comparable European examples has been attributed to the 'stigma of failure' in being higher in Europe meaning it incurs an economic loss because failed entrepreneurs are unable to easily re-start[17]. The limitation of this argument is again illustrated by reference to the lottery. An equally plausible reason why individuals in the United States are more prepared to start another business is because the 'price' of the lottery tickets is lower in the United States than in Europe. In European countries there are more restrictions on a bankrupt individual in terms of the minimum time before that individual can re-start, and the resources that they can draw upon to fund the re-start. In short, the 'price' of business failure is lower in the United States. So, if the price of lottery tickets is lower, as in the United States, more tickets will be bought and the chance of a win will increase. However, it does not constitute evidence of greater EL in the US, but rather a different emphasis upon responsibility to creditors, as reflected in the price of the tickets.

Our interpretation of EL studies to date is that many have theoretical and empirical limitations. Underpinning much of the work on EL is the **assumption** that entrepreneurs learn and, as a consequence, their business performance improves. However the evidence for EL is heavily based on self-report data. EL is presented as a "one way bet", linked with "good" performance such as growth or

[16] In 1922, Walt Disney founded his first company Laugh-O-gram Films. He was 20 years old. He had raised $15,000 from investors to fund a new animation business based in Kansas. With the capital, he employed staff and rented space in a new development. He was lucky enough to win a contract from another small company called Pictorial Clubs to distribute his cartoons. The contract was worth $11,100. Disney took a $100 down payment for the cartoons. Six months later, Pictorial Clubs went bankrupt. Disney could no longer afford to pay the rent nor his staff. He borrowed another $2000 against his film equipment and materials from one of his original investors. He still ended up a year later bankrupt owing money to his former employees and investors. By the time Disney was declared a bankrupt, he had already left for Los Angeles.

[17] EU Green Paper on Entrepreneurship (2003).

survival. In practice however new and small firm performance fluctuates over time and, in fact, most small firms even if they survive, decline in size over time (Hull and Arnold, 2008). To make EL a "two-way bet" would therefore require a theory of "un-learning" to explain decline as well as a theory of learning to explain growth. We remain unaware of any theories of "un-learning" except where it points to enterprises having difficulty jettisoning inefficient procedures or routines[18].

The more general lesson is that learning is strongest when situations are repeated – perhaps continually; when the signals are clear and have minimal "noise" so that little interpretation is required; when the external environment is benign and when the learner is alert to the feedback. Our expectation is that probably **only** the latter is clearly applicable to where an individual begins a new business. This emphasises the importance of undertaking empirical testing of EL that avoids the pitfalls of self-report data.

3. Firm Survival: Key Empirical findings

Our central test will be whether EL appears to be a factor influencing new business survival. We view this as a valid test because we assume relatively few individuals establish a new enterprise with the intention of closing it within a matter of months. In this respect new firms differ from well-established small firms where Taylor (1999) found the single most frequent reason given for closure by mature owners was retirement. Our assumption therefore is that, given most

[18] Our view of unlearning would be where the stock of knowledge, for some reason, falls. The examples of un-learning provided by Cope (2005) or by Fiol and Lyles (1985) are of learning to get rid of bad habits which is another form of learning, rather than of a declining stock of knowledge

founders did not start with the intention of closing very quickly, then to some extent they were closing against their (initial) will[19].

Empirical work on business survival has been undertaken across a number of countries (see Bruderl et al (1992), Mata and Portugal (1994), Vivarelli (2007) and Strotmann (2007) for studies outside the UK and US). Despite using a range of analytical bases, several common elements in business survival have emerged fairly consistently. Survival appears positively related to firm size (whether defined by turnover, assets or employee numbers) and to the length of time that a business has been operating. Some studies have also indicated that conditional closure rates take an inverted U-shape, rising up to a peak in the first few years before declining thereafter (Frank 1988, Cressy, 1996).

Aside from size and age, studies differ with regards to the factors influencing survival (or at least their relative importance). Some have indicated that industry-level factors, in the form of minimum efficient scale or the developmental stage of that sector, are relatively important (Audretsch and Mahmood, 1995). Others have found the scale of financial resources available to the firm to be a key element (Evans and Jovanovic, 1989). A third have emphasised individual and collective human capital (Bates, 1990) and the choice of legal form (Harhoff et al 1998). A study linking EL with firm survival therefore has to include all the above variables as controls.

4. Derivation of empirical tests

We assume new firm founders choose to avoid taking actions they know will lead to the closure of their business. However, new firm founders with low levels of talent θ, might be unable to link their actions to the impact this has upon the

[19] Of course we do not imply that all, or even more than a tiny proportion, of those that actually closed did so leaving debts (Watson, 2010).

business. Nevertheless, as their survival duration increases, this provides them with the experience – the learning opportunity – that enables them to make such a link. So, EL implies that even less able business founders become less likely to take actions that they realise endanger the survival of their business. Of course, the business owner can only learn – and change behaviour – if they are aware of the link between their actions and the survival of the business.

The contrasting argument is that learning does not take place for two reasons. The first is that business is a random draw – as in the lottery – from which learning is impossible. The second is that, as the business survives, it encounters very different circumstances and situations from those that it has previously experienced. For example, in the first six months of life of a new firm the skill of its founder(s) may be to generate any orders at all; in the next six months it may be to satisfy those orders; in the third six months it may be to invest wisely in staff and equipment to satisfy the expansion of orders. All these may require different skills to overcome new and distinct challenges, with limited value being derived from any prior experience. Three tests of EL are therefore proposed, all of which are formulated on 'outcomes' rather than self-report information:

> **Test 1:** ***Conditional on their decision to start a new firm, are individuals that previously owned a business more likely to have a new business that survives for three years than otherwise similar individuals without that experience?***

This is a test of EL because those who have been in business previously have had the chance to accumulate knowledge in a way not available to those with no prior business ownership experience. Evidence of EL would be if those without

prior ownership experience had new businesses with lower expected three-year survival rates.[20].

Test 2: *As new businesses gain trading experience, do their owners take actions that lower sales volatility?*

This is a test of "entrepreneurial learning-by-doing" in an entrepreneurial context and is consistent with several theories of business closure. Labour market theories see business survival as a continual choice between the relative utility of self-employment, compared with switching to becoming an employee (Jovanovic, 1982). Lower volatility moves the business away from the threshold for ceasing trading, so reducing the likelihood of closure. Gambler's Ruin Theory also sees volatility as a danger to survival. It sees the business owner as having a stock of liquidity that is enhanced by 'wins', but reduced by 'losses'. When the stock is exhausted, the gambler/ business owner quits (Laitinen and Laitinen, 2001). Clearly where earnings are more volatile there is a greater likelihood that resources will be exhausted and that the owner will quit. Moreover, even where a firm's survival is not directly threatened by high sales volatility, it represents a higher risk that the risk-averse business owner would choose to mitigate if possible. This is likely to be the case even if the business owner has risk preferences such that his/her degree of risk aversion decreases with wealth,[21] because a greater degree of sales volatility will require a greater share of that wealth to be held in the form of liquid assets (cash), which usually have a lower rate of return (as opposed to physical capital). Thus, it is reasonable to assume that, regardless of wealth, controlling sales volatility would be important for the survival of a new business. Of course, the assumption underpinning the test is

[20] We recognise the decision to start a firm may be related to an individual's level of business experience, which could create a problem of self-selection bias. Rather than using the standard Heckman correction we qualify the scope of our results to maintain their robustness.

[21] For instance, if his/her preferences for risk are subject to decreasing absolute or relative risk aversion (DARA / DRRA).

that the owner is aware of this and that the “learning” owner will take steps to reduce this volatility.

Test 3: ***As new businesses gain experience, do they become less likely to borrow from the bank in an unauthorised manner?***

This is a test of EL because borrowing in an unauthorised manner is very expensive – bordering on the penal - and the business owner is informed that borrowing in such a manner is undesirable. The assumption underpinning the test is therefore that the “learning” business owner will, wherever possible, seek to avoid incurring such expenses. This is not to suggest that under extreme circumstances – such as believing this is the only funding that would ensure the continuation of the business- engaging in unauthorised overdraft spending is an irrational behaviour, *per se.* However, using this mechanism is extremely costly and is a true “last resort”. The business owner is therefore strongly incentivised either to find alternative sources of credit and/or learn to manage his/her finances more effectively. Hence, evidence of EL would be for unauthorised borrowing to fall, or at least not to increase, with business experience.

5. Data:

5.1. Deriving the Sample and Defining the Terms

The data used for the three Tests identified above are drawn from the customer records of Barclays Bank. Barclays provides the primary current account facility for just over 20% of all businesses in England & Wales with sales of less than £1 million. Their active customer base in this market is in excess of 500,000 firms.

The data source has several unique qualities which have been previously unavailable to academic researchers. First, it identifies accurately the month and year at which a business actually started trading, defined as the time at which the

business generated its first sales. Second, **all** financial data are then available on a **monthly** basis. Thirdly, there is a commercial incentive to ensure the information is correct. This means the data can be used to look in detail, using monthly information, at survival rates in the early years of the life of a new business. As far as we are aware only the Cressy (1996) data set has these same desirable qualities.

Readers unfamiliar with British bank data need to be aware of how important definitional issues are addressed in this data set. The first is defining firm entry and exit. From the Barclays customer base we drew an initial sample of approximately 23,000 (non-financial) businesses that were start-ups with the Bank during the three months from March to May 2004. This means that all these firms opened their first business current account during this period.

Second, it is important to note that the opening of a business current account is **not** conditional on the provision of any other banking service, e.g. deposit account, overdraft, term loan, etc. It is therefore **not** a sample of bank borrowers, but instead a sample of all new business bank customers. Recalling that Barclays provide business accounts for 1 in 5 businesses in England and Wales and, as with all the other major banks, it does not impose restrictions[22] upon those requiring these account facilities, it appears to constitute a random sample of new firm starts[23].

We then refined our sample by selecting only those firms that showed evidence of trading activity in April to June 2004. This makes allowance for the fact that not all start-ups commence trading immediately. A sample firm was considered to have started in the month prior to the first full month in which trading activity was observed. Crucially therefore this database identifies new

[22] Other than those of clarifying identity.
[23] The only bias is the omission of Financial Services firms.

enterprises immediately they begin to trade. Firms that recorded two consecutive periods of zero turnover (sales) were considered to have closed in the first of these periods. This adjustment makes allowance for any delay in removing inactive accounts from Barclays customer base.

This data set also includes structural variables shown to be significant in previous studies of new firms. These are the (mean) age of the business owner (Cressy, 1996), their educational attainment (Bruderl *et al*., 1992), their gender (Carter et al 1998), prior business experience (Headd, 2003) and the sources of advice/support approached prior to start-up (Meager, Bates and Cowling, 2003). The business variables are the legal form of the start-up (Harhoff et al, 1998), its business sector (Mata and Portugal, 1994) and the number of business owners (Headd, 2003). These variables are not time varying and all were collected prior to the account facilities being granted.

Unique to Bank data there is also a wide choice of monthly information on the trading performance of the new business. Our first trading measure is the size of the firm – measured by credit turnover (sales revenue). Our second measure is any use made of (un)authorised overdraft facilities – borrowing. The latter is split into two variables. The first shows if any use was made of the overdraft during a period; the second captures the degree of use. Our third trading performance measure is that of sales volatility. Monthly data were collapsed into six-month periods, which was necessary to construct our volatility measure (defined as the variance of monthly turnover over six months).

5.2 Defining the Metrics for the Three Tests

The first metric examined in Test 1 is the simple concept of whether the owner or their family, or both, have any prior business ownership experience.

The second metric used in Test 2 is sales volatility. This seeks to capture within-period fluctuations in trading activity, on the grounds that new firms exhibiting high fluctuations will have difficulty managing their cash flows in these extreme situations. To address this we construct a volatility variable. This is the ratio of the standard deviation of monthly turnover to the mean monthly turnover in a six month period. This ratio (with a maximum value of 2.236) provides a standardised measure of cash-flow volatility across the varying firm sizes in the sample base. For those firms with a turnover of zero during a period (and therefore a denominator of zero) the ratio measure is set to zero.

Our third metric used in Test 3 is unauthorised borrowing. This can occur in two ways. The first relates to overdrafts. In Britain, banks may choose to provide firms with an overdraft facility of, for example, £10,000. This enables the firm to borrow up to that amount generally for short periods, to overcome variations in cash flow. The advantage is that interest is paid only on the amount borrowed, rather than on the full £10,000 as would be the case for a term loan. The disadvantage is that, if the limit is exceeded, the bank both charges a penal interest rate and informs the firm that the overdraft contract is breached. The overdraft facility can also be cancelled immediately. In the context of this paper this makes excess use of overdraft a valuable measure for two reasons. The first is its link with closure, but the second is that the business owner is informed shortly after the limit is exceeded. This has the merit that, because the bank writes to the business owner, there can be no ambiguity over a lack of awareness on the part of the owner that they are taking a risky action. In short, the owner is clearly informed and heavily financially penalised if they fail to ‘learn’. The second way unauthorised borrowing takes place is where, although no facility is made available by the bank, the firm makes a payment when it has no resources. Again the firm is informed and charged penal rates on any funds provided.

Of the two financial metrics, the unauthorised borrowing measure – Test 3 – has the desirable quality that, not only is it clearly linked to survival, but it is also one where the business owner is clearly informed, and thus has the explicit opportunity to learn. Its disadvantage is that it does not apply to all firms, as not all businesses borrow in this manner. In contrast, the volatility measure in Test 2 applies to all firms, but their owners are not made aware by the bank of the dangers of a volatile cash flow in the same explicit manner. In this instance the opportunity for learning is less clearly identified**.**

The fundamental idea underlying both tests is that, if EL takes place, new business owners would, with experience (time trading), become less likely to undertake these 'life threatening' actions such as exceeding their overdraft limit or having high volatility in their sales.

5.3 Sample characteristics

The net effect of applying restrictions on the definition of start-up and closure, together with the requirement for completeness of data in the remaining sample, reduced the initial sample of more than 23,000 start-ups to a final sample base of 6671 new firms[24]. Brief descriptions of the variables used in this paper are set out in Table 1 and the simple correlations in Table 2. The characteristics of the sample are provided in Tables 3 and 4 and Charts A and B. The tables set out the structure of the sample at both start-up and over time, while the charts show survival and conditional closure rates.

Chart A shows that the three year survival rate of new firms in our sample is 49.1%. This is, however, is markedly lower than from official data – the IDBR[25] –

[24] The non-UK reader might be interested that the government department with responsibility for small business statistics (Department for Business, Innovation and Skills) lists Barclays as one of the main sources of data for both start-up numbers and business survival. This is to overcome the problem that the main official data source for those years, VAT registered businesses, excludes the majority of firms with annual sales of less than £67,000 (for the tax year 2008/09).
[25] The IDBR (Inter-departmental Business Register) includes firms registered for PAYE (Pay-as-you-earn tax; i.e. firms that have paid employees), as well as those registered for VAT.

where the three year survival rate is 65.3%. (It is also slightly lower than figures from other Barclays samples of new businesses.)[26] This reflects the high threshold for compulsory registration, resulting in many new IDBR firms being both not start-ups and relatively large[27]. Chart B shows the conditional closure rates experienced by the sample in the three years after start-up. This reveals that our sample experienced a closure profile in keeping with the classic inverted U-shape seen in previous analytical work, with closure rates peaking after about 2 years.

Tables 3 and 4 offer important initial insights into the factors associated with business survival. Table 3 shows three significant shifts in the structural variables, two and three years after start-up. First, the proportion of companies increases by five percentage points after two years and 7.5 after three – implying that sole proprietorships and partnerships are more likely to close. Second, there is a slight rise in the average age of the owners,[28] reflecting the higher closure rates for young owners. Thirdly, firms with multiple owners are more prevalent, rising by 4 percentage points – implying that sole owner businesses are more likely to close. Finally, the proportion of firms where a male is involved as an owner (*own_male_inv*) rises by 2.5 percentage points.

Table 4 shows the trading variables for each of the six 6-month periods. It shows the median annual turnover (sales) of a three-year-old firm is a little over £44,000[29], with no indication of continuous growth for a typical surviving firm in each six-month period. Our bespoke measure of volatility (*vol*) shows a decline between periods 1 and 2 (up to 6 months and 6-12 months after start-up), after

[26] We have two other measures of business lifespan, labelled here "Barclays (a/c)" and "Barclays (firm)". "Barclays (a/c)" is the oldest measure, but only tracks the survival of new business current accounts. The Barclays firm measure is restricted to accounts opened at start-up.
[27] This cannot be explained in terms of businesses switching their current accounts away from Barclay's to other banks. Fraser (2005) finds only 2% of all UK SMEs switched banks in the previous three years, while our corresponding figure is slightly higher (6%). Taking these 'switchers' into account does not change our main results.
[28] That is, the age when they started the business.
[29] Note the columns show six month periods, so median values are about £35,000 [2 x £17,448 in period 1], rising to £44,640 in period 6.

which it remains broadly constant.[30] The overdraft excess measure (*odxs*)- the proportion exceeding their limit - is also broadly constant around one third, although number of days "in excess" (*odxs_pc*) does increase.

6. Analysis: Three Tests of Entrepreneurial Learning (EL)

Test 1*: *Are individuals that previously owned a business more likely to have a new business that survives for three years than otherwise similar individuals without that experience?

Chart D graphs the Kaplan-Meier survival estimate for all firms in the sample, distinguishing between those with, and those without, prior business ownership experience. The latter appear to have lower survival rates, which constitutes evidence in support of EL. To confirm the robustness of this observation, however, we must test whether prior business experience remains significant after controlling for other firm-level properties. If the significance of this effect disappears when other controls are added, then support for EL would be spurious.

The conventional approach is to use a conditional hazard model (Santarelli and Vivarelli, 2002), where time enters as an explanatory variable in its own right. Other factors then shift this baseline function, but usually with constant marginal effects over time, an assumption called "proportional hazards." The popular Cox (1972) proportional hazards model has been applied to firm survival (Saridakis et al 2008), but it is questionable in this entrepreneurial context.[31] For example, the review in Section 4 emphasised that the challenges a business owner faces after one month and one year are likely to be very different and require different skills

[30] Further analysis of the cumulative distribution function of volatility reveals that this decrease up to period 3 is not due to a handful of outliers.

[31] The assumption of proportional hazards originated in the biostatistics and epidemiology literature. There, it may be more reasonable to assume that a particular medical intervention has an equal impact on survival rates across all future periods.

and experience, which could have differential impacts on the survival likelihood in each period.

We therefore use a logit duration model to examine the effect of the structural and trading variables on the three-year firm survival rate. Such a model has two advantages. First, it provides a hazard estimate that is robust to non-proportional changes in the hazard rate, making it consistent with the intuition that previous business experience might be more important for firm survival at different points in a firm's lifespan. Second, our time-to-failure data is discrete, whereas most hazard models (Cox included) assume that this data is continuous. A significant advantage of using a logit duration model is that these models are specifically designed to handle discrete data (Jenkins 1995). The basic structure of this model takes the form:

$$\Pr(Op_{i,t} = 1 | Op_{i,t-1} = 1) = F(\beta \mathbf{P} + \beta \mathbf{X_{i,t}})$$

where *Op* takes a value of 1 if firm *i* is alive in period *t* and 0 if otherwise. **P** is a vector of time dummy variables. $\mathbf{X_{i,t}}$ is a vector of structural and trading variables, and *F(.)* is the cumulative distribution function for the logistic distribution. In a model of this form, all "time varying" effects are captured by the time dummies and are separated from the effects of the structural and trading variables.

Building a logit duration model that included *both* structural and trading data necessitated certain considerations to accommodate the limitations of our data. First, the trading variables for a firm in a given period were only observed *if* the firm survived to the end of that period. Consequently, there is no way to accurately measure the effect of the current period's trading data on the survival rate in that period. Our solution was to lag the trading variables by a single period,

which effectively eliminated the first period (first six months) from the model. This reduced the dataset to 5 time periods. Of course, this introduces the possibility of bias. To address this, we also estimated the model for all four periods while examining *only* the structural variables. In both cases, our conclusions were the same (results available from the authors).

In addition, there are two serious issues with the logit approach that require attention. First, the maximum likelihood estimator for logit regression assumes independently and identically distributed (*i.i.d*.) errors. This assumption clearly does not apply to our data if firm owners are learning over time, in which case error terms would be correlated. Unfortunately, non-independence can reduce the efficiency of the regression estimates and introduce bias into the standard errors. However using a model with clustered standard errors makes the standard errors robust to correlation between error terms. With this approach, we assume that each of the error terms are correlated *within* firms across the six time periods, but are independent *between* firms. This is consistent with the intuition that learning, if it occurs, will be cumulative over time but that one firm's learning will not significantly affect the performance of other firms. Using this approach has the added benefit of providing standard errors that are robust to heteroskedasticity and autocorrelation.

The second problem is that of "neglected heterogeneity" not captured in the firms' structural variables, which can significantly bias survival estimates. To correct for this potential problem, we also include a random effects model to control for unobserved differences between firms that are "fixed" across time. These random effects terms should capture cross-firm differences that are not included in the measured structural and trading variables. Using a random effects model has the added advantage of reducing the inefficiency of the regression estimates that arises from having non-independent data. Ideally, we could

combine these approaches into a single logit model. Unfortunately, such an option is only available with generalized least squares regression, not logit regression. Thus, our final model is a fixed effects linear probability model that assumes clustered standard errors.

Results for these regressions are shown in Table 5. Column 1 confirms the Kaplan-Meier survival results: that the absence of business experience significantly lowers survival rates –hence supporting EL. Column 2 then disaggregates the experience variable and shows that personal business experience (*bexp_self*) has a positive effect on survival, whereas the business experience of family members (*bexp_fam*) has no significant effect.

The subsequent columns of Table 5 then include all structural and trading variables and all experience variables becomes statistically insignificant. This is even the case if we drop the trading variables and consider only the structural variables in all four time periods (results not shown here). It is also interesting, but less surprising, to observe that education of the owner has no significant effect on survival.[32]

Age of the owner has a significant non-linear effect on survival, judging by the coefficients for the age and age-squared variables[33] with 'life experience', proxied by age, being more influential on business survival than entrepreneurial experience. Table 2, however, showed that prior entrepreneurial experience is positively correlated with age (0.228), which emphasises the importance of controlling for age in order to avoid spuriously attributing a significant effect to entrepreneurial learning. The presence of males in the start-up team powerfully enhances three year survival. Legal status exerts its expected influence- with companies and partnerships having higher survival than sole proprietorships.

[32] The intuition behind this result is that educated founders have more employment options than those with less education. Education is therefore more likely to influence growth than survival (Storey and Greene, 2010).
[33] Our estimates in columns 3, 4 and 5 of Table 5 suggest that owner age has its largest positive effect on survival at ages 53, 54 and 53 respectively- very similar to that of Cressy (2006a, 2006b)

However the structural variables, as a group, provided only a weak explanation of performance whereas most of the trading variables were much more powerful. The sales of the firm, their volatility, and the proportion of time with excess overdraft strongly influence firm survival. The link between size and survival is well established in prior work, but our findings are also compatible with the theoretical models outlined in Section 4. Additionally, the negative impact of high levels of excess overdraft use on survival is compatible with our theory that this reflects limitations in the financial management skills of (some) owner-managers. It is particularly interesting to contrast the role of excess overdraft use (variables *odxs* and *odxs_pc*) with the absence of any significant impact from using an authorised overdraft facility (variables *odlim_use* and *odlim_pc*). This suggests that it is correct to focus on the former in testing EL.

Test 2: ***As new businesses gain trading experience, do their owners take actions that lower sales volatility?***

We argued above that, with suitable controls, the ability to control sales volatility could be taken as a measure of EL. We also showed in Table 5 that volatility was a significant factor in accounting for short-term survival. So, a good indicator of EL is whether new firms are able to consistently reduce their sales volatility over time. However, testing this requires taking account of changes in sample composition because the observed volatility of firms in period 6 - compared with period 1 - may simply reflect the closure of more volatile (less able) firms. Chart C indicates that there are significant changes in mean volatility between the six periods. The presence of EL implies that volatility would be expected to *decline monotonically* with time, whereas Chart C indicates that these changes are not monotonic.

To address these sample composition biases, we use a Fixed Effects Ordinary Least Squares (OLS) panel regression to separate firm-level fixed effects from any potential learning. The rationale is that the time-invariant properties of firms – such as the previous experience of their owners – would be captured by a random fixed effects term (controlling also for size), while any remaining time-varying effects suggestive of learning would be captured by dummy variables for time periods 2, 3, 4, 5 and 6. If, having controlled for other firm characteristics, these time-effect variables are significant and monotone decreasing in size, then we would have compelling evidence for entrepreneurial learning.

For the OLS model the data were restructured such that each firm-period combination was a distinct observation, i.e. each surviving firm appears six times, one for each period. Using the Breusch-Pagan test for heteroskedasticity, we rejected the null hypothesis of homoskedasticity at the 1% significance level. We addressed this problem by running regressions using clustered standard errors. The results in Column1 of Table 6 indicate that, after controlling for both time-invariant firm-specific heterogeneity and firm size, the “time component” of volatility is significantly lower in periods 2 to 6 than in period 1. However, the picture of relative change in volatility is less clear during these latter periods. The first model includes all observations. Here the time component of volatility decreases in period 2, and again in 3, but rises in period 4 and fluctuates in later periods. Hence, the evidence of entrepreneurial learning is ambiguous even after controlling for time-invariant business-specific heterogeneity.

One reason for this may be the difficulty of capturing the inherent volatility of the period immediately after start-up because establishing the business – building contacts, generating sales etc. – inevitably produces erratic trading. Once the business has ‘settled down’, volatility is expected to fall but what our results do not point to is the continuous improvement implied by EL.

<u>Test 3</u>: *As new businesses gain experience, do they become less likely to borrow from the bank in an unauthorised manner?*

The key limitation in using volatility as a measure of EL is that, although the owner may be aware that sales volatility is life-threatening to their business, it is not something about which s/he is continually reminded. Our third test – the use of unauthorised borrowing – does not have that limitation. When there is excess use of an overdraft facility the business owner is both informed and effectively 'fined' by being charged a substantial penal rate. Furthermore the evidence from Table 5 is that unauthorised borrowing in the previous period is associated with closure in the current period. Therefore, our test is whether, in spite of being reminded of its serious consequences and financially penalised, the new business owner fails to heed the message.

The two variables of interest here are *odxs*, which is a binary variable that takes the value of 1 if the firm had an unauthorised overdraft anytime during the six-month time period, and *odxs_pc,* which measures the proportion of time spent in excess of the authorised overdraft limit. Charts E and F show that, contrary to the EL hypothesis, both the incidence and the magnitude of excess borrowing actually rise over time. Like Test 2, however, we must check whether these differences can be attributed to other factors such as time-invariant firm-specific effects. We conducted random effects regressions for *odxs*, using a logit model, and *odxs_pc* using fixed-effects OLS. Columns 3,4 and 5 of Table 6 shows that, even after controlling for firm fixed effects, the time effect increases in each time period, contrary to the EL hypothesis. In all periods these estimates are statistically significant at the 1% level.

These results are consistent with the summary data in Table 4, which indicates that the proportion of new firms with some unauthorised borrowing **rises**

from 30% in period 1 to 34% in period 6. Similarly, the mean proportion of the period spent in this state **rises** from 3.7% to 8.0%. So, despite receiving warnings from the bank, new firm owners appear equally likely to undertake this form of risky and expensive borrowing, whether their businesses are six months or thirty-six months old. Neither of these results is compatible with EL.

7. Conclusion

This paper reviewed the theory, both in support of, and in conflict with, entrepreneurial learning (EL). It concluded that, on theoretical grounds, the concept could neither be accepted nor rejected and so an empirical test was justified. However, prior tests, using the self-reported responses of entrepreneurs, were far from ideal. Instead three tests, using the survival of a new firm as the key performance measure, were developed on the grounds that few individuals start a new business intending to close it very shortly afterwards.

Test 1 examined whether, conditional on starting a firm, those individuals with prior business ownership/experience begin firms that have higher three-year survival rates than otherwise similar individuals without that experience. We showed that prior business experience as an owner had ***no substantial influence***, positive or negative, on survival rates. This test provides no support for EL.

Tests 2 and 3 were more sophisticated, have not previously been undertaken, and can only be implemented using bank data. Our assumption is that if the business owner could be shown to become less likely to engage in 'life threatening' actions over time this would provide support for EL. The two life threatening actions we examined were allowing sales to be highly volatile and borrowing from the bank in an unauthorised manner. Of the two, we made the case that unauthorised borrowing was the conceptually stronger measure since

the business owner was informed when this happened and charged a penal interest rate.

Our findings were that both measures were indeed strongly associated with subsequent business closure. However, we found no evidence that new business owners become less likely to undertake life-threatening actions as experience is accumulated. So, in contradiction with EL, we found no evidence of sales volatility declining with time trading or any reduction in the use of excess overdraft facilities. If anything, the incidence of excess and its intensity, rise as firms move further from start-up. These results suggest the existence of EL is, at best, unproven.

What is clear from the tests is that EL is not a ‘one way bet’ linked positively to enhanced business performance. Instead the theoretical case we make is that role of chance and the vastly different circumstances facing the new firm founder explains why separating any lessons from the wider noise is tricky for most new firm founders, so inhibiting the opportunity to learn.

So our answer to the question posed in the title of this paper is that we find no evidence that, **as a group**, entrepreneurs – the founders of new firms – learn during the first three years of starting a new business – unless that evidence is based on self-report data. This bold statement, however, is subject to important provisos that could be the basis of further work.

The most important proviso is that our results do not imply that no entrepreneurs learn; nor do our results imply that entrepreneurs never learn; nor that they learn nothing. Instead they suggest that, even amongst those that survive three years, entrepreneurs **as a group**, do not become less likely to engage in “life threatening” behaviour, the more “experience” they accumulate. It also shows that prior business experience is unrelated to survival. This implies

that, even if they learn something – which seems plausible – this does not clearly translate into improved performance.

The questions for further work are firstly whether, even if there is no overall evidence of performance-influencing learning amongst entrepreneurs, there may be both “learners” and “non-learners”. The challenge for further work is whether the characteristics of the “learners” differ observably from other entrepreneurs.

Second, our findings highlight the need for a better understanding of why some individuals may modify their behaviour with experience, whereas others do not. One promising approach might be a theory that assumes the “non-learning” business owner believes there are no financial consequences for them of the business closure. Here it is only the bank which incurs a cost. In that pay-off matrix there may be no returns to the business owner from learning, so the task of the bank is to construct a contract that encourages learning amongst those able to learn so, as to lower its exposure. A better understanding of entrepreneurial contracts is therefore important.

Thirdly, even three years may be too short a period of time for learning to both take place and to influence business performance. Although we do not take this view – since about half of all new firms cease in that time – there is clearly merit in extending the duration of this study to test for EL amongst the non-random entrepreneurs that survive beyond three years.

We end by emphasising that this paper provides no empirical support for the legislation introduced in European countries seeking to ease the re-entry into business ownership amongst those with prior ownership experience – on the grounds that such individuals will perform “better” having learnt from that experience. It also provides no support for those scholars whose prime focus is on **how** entrepreneurs learn without first examining **whether** they learn.

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Table 1: Variables & definitions

Dependent	
open	= 1 if start-up is still open at the end of the period

note: these variables are conditional on the firm being open at start of period *t*

Structural	
leg	legal form of start-up: company (including LLP), partnership or sole trader (recoded into dummy variables)
sic	business sector of firm at start-up: agriculture, manufacturing, construction, motor trades, wholesale, retail, hotels & catering, transport, property services, business services, health, education & social work (hesw) or other services (recoded into dummy variables)
age	age of start-up owner-manager(s)
age_sq	square of *age*
own_xs	= 1 if more than a minimum number of owner-managers of the start-up: company 2+, partnership/LLP 3+
own_male_inv	= 1 if there is at least one male owner-manager of the start-up, 0 otherwise.
educate	highest educational attainment of owner-manager(s): none, GCSE, A-level, Degree or higher (recoded into dummy variables for the summary statistics and regressions tables), according to the UK National Vocational Qualification scale.
bexp	previous business experience of owner-manager(s): none, family, self (recoded into dummy variables)
adv_x	advice/support sough prior to start from: enterprise agency/business link (*entbl*), accountant (*acc*), solicitor (*sol*), college (*coll*), (Barclays) start right seminar (*srs*), the princes trust (*pybt*), family (*fam*), other (*oth*) (recoded into dummy variables)

Trading	
turn	turnover (sometimes expressed in logs)
vol	ratio of the standard deviation of monthly turnover to the mean monthly turnover
odlim_use	= 1 if authorised overdraft used at any time
odlim_pc	mean proportion of authorised overdraft limit used
odxs	= 1 if in excess of authorised overdraft limit at any time
odxs_pc	proportion of period in excess of authorised overdraft limit

Table 2: Correlation matrix. Correlations significant at the 5% level are starred. Observations pooled together across years.

	bexp_none	bexp_fam	bexp_self	age	educate	log_turn	vol	odlim_use	odlim_pc	odxs	odxs_pc
bexp_none	1										
bexp_fam	-0.4971*	1									
bexp_self	-0.6070*	0.1048*	1								
age	-0.0850*	-0.0274*	0.2228*	1							
educate	-0.0725*	0.0642*	0.0658*	-0.0239*	1						
log_turn	-0.0988*	0.0463*	0.1659*	0.0759*	0.0370*	1					
vol	0.0256*	-0.0141*	-0.0310*	-0.0178*	0.0865*	-0.5281*	1				
odlim_use	-0.0522*	0.0303*	0.0816*	0.0161*	-0.0172*	0.2395*	-0.1434*	1			
odlim_pc	-0.0400*	0.0399*	0.0505*	0.0097	-0.0124*	0.1244*	-0.0929*	0.6908*	1		
odxs	-0.0202*	0.0299*	0.0165*	-0.0912*	-0.0634*	-0.0791*	0.0709*	0.1374*	0.2281*	1	
odxs_pc	-0.0063	0.0193*	-0.0054	-0.0770*	-0.0379*	-0.2326*	0.2093*	0.0029	0.0639*	0.5400*	1

Table 3 : Summary data for structural variables, expressed as a percentage of the surviving sample base

	At start-up	After 24 months	After 36 months
leg			
company	0.374	0.425	0.449
partnership	0.133	0.127	0.120
sole trader	0.493	0.448	0.431
Sic			
Agriculture	0.010	0.011	0.011
Manufacturing	0.052	0.055	0.057
Construction	0.146	0.153	0.157
Motor trades	0.035	0.034	0.032
Wholesale	0.023	0.022	0.022
Retail	0.119	0.111	0.109
Hotels & Catering	0.094	0.085	0.077
Transport	0.038	0.036	0.033
Property services	0.035	0.041	0.042
Business services	0.260	0.265	0.273
Health, education and social work	0.024	0.026	0.028
Other services	0.164	0.161	0.159
age	39.045	39.860	40.166
own_xs	0.158	0.184	0.197
own_male_inv	0.810	0.827	0.835
bexp			
none	0.125	0.120	0.116
family	0.634	0.634	0.630
self	0.721	0.737	0.746
educate			
<NVQ2 (none)	0.228	0.224	0.222
NVQ2 (GCSE)	0.331	0.327	0.328
NVQ3 (A-level)	0.171	0.174	0.170
NVQ4 (Degree or higher)	0.270	0.275	0.280
adv_x			
enterprise agency/business link	0.102	0.095	0.095
accountant	0.363	0.372	0.379
solicitor	0.049	0.052	0.051
college	0.040	0.038	0.041
Start-right scheme	0.007	0.006	0.005
PYBT	0.014	0.009	0.009
family/friends	0.459	0.286	0.283
other	0.246	0.060	0.061
Sample size	6671	4231	3278

Table 4 : Summary data for trading variables

	Period					
	1	2	3	4	5	6
turn						
mean	54600.470	60295.860	68312.120	74079.400	85847.490	88682.850
median	17448	17476	20305.5	19821	22031	22320
vol						
mean	0.732	0.701	0.674	0.700	0.669	0.679
median	0.587	0.539	0.498	0.525	0.482	0.497
odlim_use (mean)	0.078	0.184	0.237	0.273	0.280	0.283
odlim_pc						
mean	0.013	0.040	0.069	0.083	0.091	0.090
median	0	0	0	0	0	0
odxs (mean)	0.300	0.313	0.333	0.356	0.359	0.343
odxs_pc						
mean	0.037	0.055	0.062	0.074	0.081	0.080
median	0	0	0	0	0	0
sample size	6403	5598	4892	4231	3710	3278

Table 5: duration models for Test 1

	Logit Clus SE	Logit Clus SE	Logit Clus SE	RE Logit	OLS Clus SE
Dep. Var.	open	open	open	open	open
bexp_none	-0.163**				
	(0.0682)				
bexp_fam		-0.0177	-0.00253	-0.00117	-0.000588
		(0.0482)	(0.0749)	(0.0476)	(0.00442)
bexp_self		0.246***	0.0165	0.0102	-0.000848
		(0.0509)	(0.0819)	(0.0521)	(0.00513)
period2	-1.522***	-1.523***			
	(0.0553)	(0.0553)			
period3	-2.163***	-2.165***	-0.355***	0.0516	0.000739
	(0.059)	(0.0591)	(0.0955)	(0.059)	(0.00558)
period4	-2.624***	-2.627***	-0.828***	-0.0716	-0.0133**
	(0.0607)	(0.0607)	(0.132)	(0.062)	(0.00599)
period5	-2.949***	-2.953***	-0.792***	0.151**	0.00714
	(0.0616)	(0.0617)	(0.154)	(0.0679)	(0.00613)
period6	-3.209***	-3.214***	-0.962***	0.195***	0.00852
	(0.0623)	(0.0623)	(0.179)	(0.0724)	(0.00628)
age			0.0757***	0.0419***	0.00466***
			(0.023)	(0.0141)	(0.00147)
age_sq			-0.000714***	-0.000389**	-4.41e-05**
			(0.000272)	(0.000168)	(1.72E-05)
educate2			-0.0216	-0.0183	-0.00511
			(0.0958)	(0.0607)	(0.00577)
educate3			0.0986	0.0587	0.00307
			(0.114)	(0.0713)	(0.00672)
educate4			0.0904	0.0695	0.00655
			(0.104)	(0.0673)	(0.00638)
log_turn (lagged)			0.259***	0.146***	0.0176***
			(0.0252)	(0.0152)	(0.00175)
own_xs			0.155	0.0969	0.00361
			(0.117)	(0.0722)	(0.00568)
own_male_inv			0.283***	0.161***	0.0144**
			(0.0938)	(0.0599)	(0.00623)
adv_entbl			0.11	0.0683	0.00915
			(0.117)	(0.0743)	(0.00742)
adv_acc			-0.123	-0.0747	-0.00637
			(0.0773)	(0.0486)	(0.00449)
adv_sol			0.194	0.121	0.00887
			(0.169)	(0.106)	(0.00943)
adv_coll			0.241	0.139	0.0077
			(0.186)	(0.116)	(0.0104)
adv_srs			-0.179	-0.0128	-0.00145
			(0.392)	(0.302)	(0.034)
adv_pybt			-0.359	-0.16	-0.0162
			(0.309)	(0.195)	(0.0265)
adv_fam			-0.023	-0.0194	-0.00153
			(0.0802)	(0.051)	(0.00488)
leg_frm2			-0.807***	-0.501***	-0.0422***
			(0.125)	(0.0729)	(0.00704)
leg_frm3			-0.286***	-0.155***	-0.00562
			(0.0953)	(0.0598)	(0.00549)

odlim_pc (lagged)			-0.231	-0.301	-0.00405
			(0.266)	(0.192)	(0.0158)
odxs_pc (lagged)			-2.783***	-1.997***	-0.374***
			(0.201)	(0.144)	(0.0239)
vol (lagged)			-1.624***	-1.146***	-0.149***
			(0.0793)	(0.0439)	(0.00585)
odlim_use (lagged)			0.168	0.0971	-0.000149
			(0.117)	(0.0842)	(0.00601)
odxs (lagged)			-0.189**	-0.128**	0.00443
			(0.0735)	(0.055)	(0.0053)
Industry Controls	No	No	Yes	Yes	Yes
Constant	3.195***	3.013***	1.297**	1.326***	0.775***
	(0.0632)	(0.0757)	(0.627)	(0.399)	(0.0403)
Observations	40,026	40,026	24,591	24,591	24,591
(Pseudo-)R2	0.1174	0.1188	n/a	0.1663	0.1523

Table 6: Fixed-effect OLS and Logit models for tests 2 and 3. OLS and Logit estimates obtained from clustering standard errors at the business level. Robust standard errors in parentheses. Stars denote significance levels: *** p<0.01, ** p<0.05, * p<0.1.

	OLS FE	Logit Clus SE	RE Logit	OLS FE
Dep. Var.	vol	odxs	odxs	odxs_pc
period2	-0.0230***	0.0924**	0.168**	0.00863***
	(0.00733)	(0.0436)	(0.0769)	(0.00145)
period3	-0.0438***	0.302***	0.534***	0.0219***
	(0.00789)	(0.0463)	(0.0757)	(0.00192)
period4	-0.0201**	0.416***	0.738***	0.0308***
	(0.0083)	(0.0452)	(0.0753)	(0.0023)
period5	-0.0176**	0.487***	0.867***	0.0450***
	(0.00858)	(0.0465)	(0.0754)	(0.00279)
period6	0.0244***	0.519***	0.929***	0.0576***
	(0.00886)	(0.0468)	(0.0754)	(0.00308)
log_turn	-0.168***	-0.0925***	-0.157***	-0.0280***
	(0.00622)	(0.0151)	(0.0215)	(0.00232)
Constant	2.324***	-0.264*	-0.610***	0.298***
	(0.0615)	(0.155)	(0.226)	(0.0227)
Obs.	19,542	19,542	19,542	19,542
(Pseudo-)R2	0.218	0.011	n/a	0.096

Chart A: Three year survival rates from 2004, for different data sources.

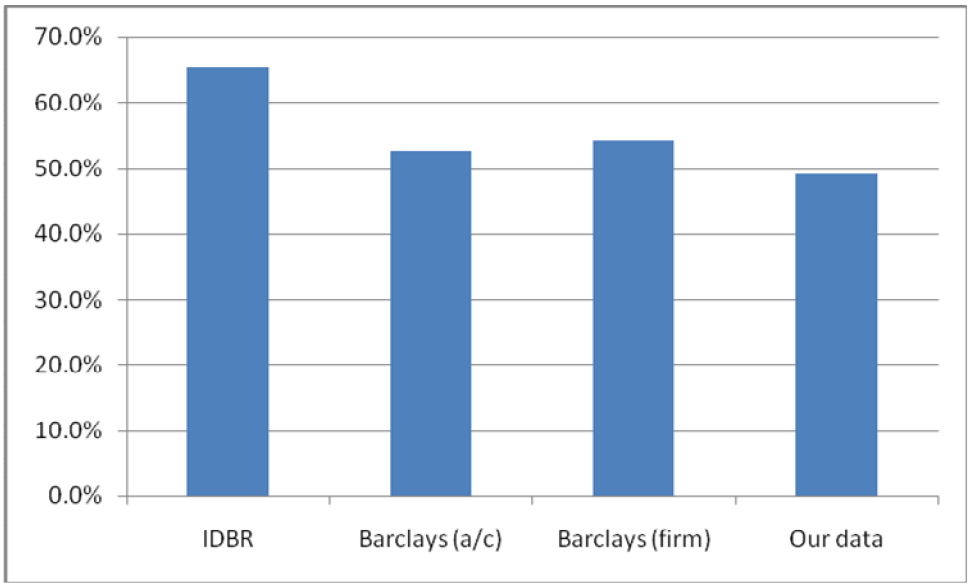

Chart B: Conditional closure rates, annual data.

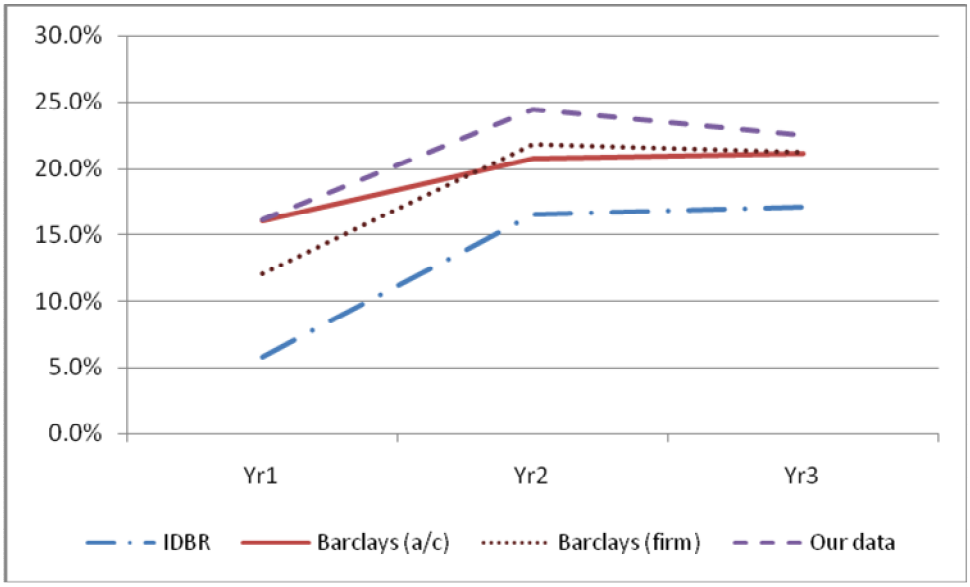

Chart C: Mean volatility for firms in each 6-month period

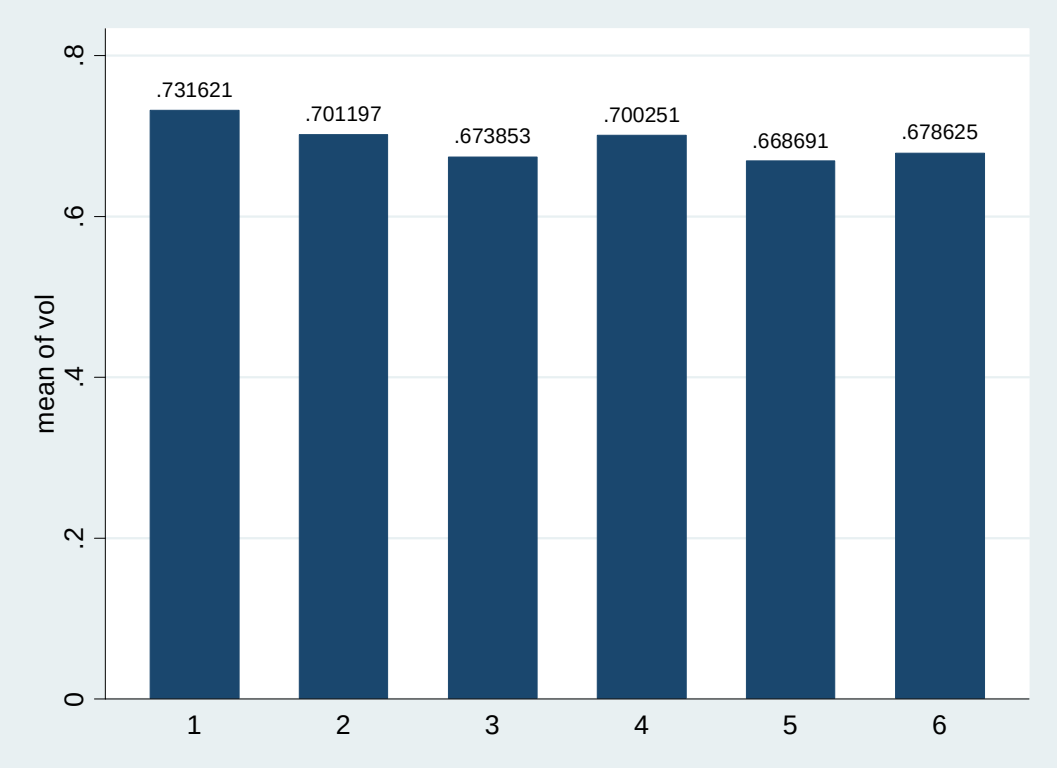

CHART D: Kaplan-Meier Survival Function by business experience

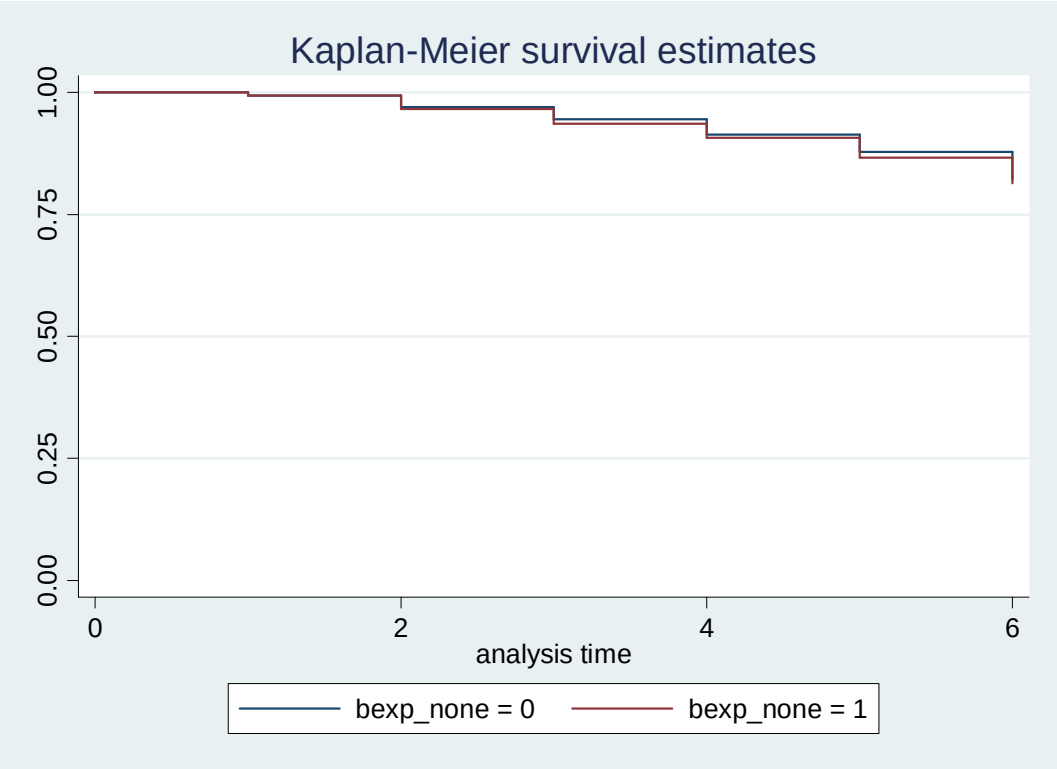

Chart E: Proportion of firms that used an unauthorized overdraft in each 6-month period

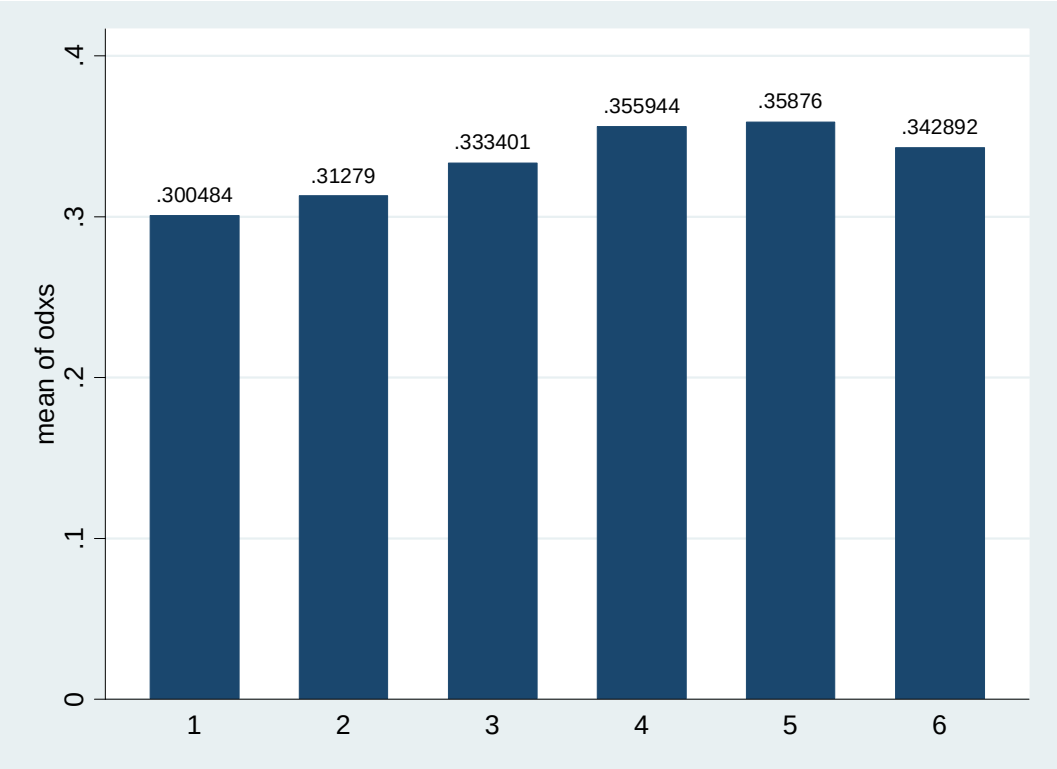

Chart F: Average Time spent in excess of the authorized overdraft limit in each 6-month period