Starting Over: Learning, Fresh Starts and the Reallocation of Serial Entrepreneurs

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This draft: 2nd November 2026
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Abstract

Firms run by serial entrepreneurs are larger and more productive, yet little is known about how much aggregate output is lost because starting over is costly. I develop a firm-dynamics model in which entrepreneurs learn about their own ability and their business-specific match quality, and must liquidate and refinance to start over. I estimate the model on administrative data covering UK companies linked to their beneficial owners, which lets me follow entrepreneurs across the businesses they run. Two facts discipline the mechanism: within entrepreneurs, the serial productivity premium predates the switch to a new business, so it reflects selection on ability, not learning by doing; and exit rates fall with firm age, as entrepreneurs learn their ability in their first years. Because entrepreneurs learn slowly how good a match their business is, the most able wait years longer to start over than they would if they could see it. Removing the cost of starting over raises aggregate output by 2 percent and makes serial entrepreneurship the norm, with the gain coming from more firms, not better ones. For bankruptcy policy, recovering more of a failed firm's capital does more for output than cutting the cost of a fresh start by a quarter.

Keywords: serial entrepreneurs; firm dynamics; learning; match quality; cost of starting over; reallocation.
JEL classification: D83, G33, L26, M13, O47.

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1 Introduction

Between 18 and 30 percent of entrepreneurs run more than one business over their careers (Plehn-Dujowich, 2010). Firms run by these serial entrepreneurs are larger and more productive, grow faster and are less likely to exit than firms run by first-time founders (Lafontaine and Shaw, 2016; Shaw and Sørensen, 2019; De Vera et al., 2026). In the UK data used in this paper, roughly one in five firms that can be linked to their owners is run by a serial entrepreneur, and their productivity is 28% higher than that of other firms of the same age and industry. Little is known however about why these differences are present, nor about the contribution to aggregate output of this mechanism, nor potentially policy gains if more entrepreneurs followed this path.

One strand of the literature is that an entrepreneur benefits from having run a prior business, and takes skills from the first business to subsequent ones - "learning by doing". Another, argues that entrepreneurial success in fact reflects an ex-ante ability that was present at the birth of the first business. In this instance, rather than learning by doing, entrepreneurs learn about their ability, and decide they would be better served operating another venture. For example, an entrepreneur opens a coffee shop in one location, and decides that they would be better served opening another one in a different location. Under the second view, the productivity premium reflects ex-ante factors rather than learning from the first business, and so, frictions that prevent switching or experimentation may have aggregate welfare consequences.

The workhorse firm dynamics models of Hopenhayn (1992) and Hopenhayn and Rogerson (1993) cannot distinguish these views, since each firm has a single productivity process and an entrepreneur cannot leave one business for another.

In this paper, I use administrative data that link UK companies to their owners to provide evidence on the source of the serial-entrepreneur premium. I use this evidence to build and calibrate a model of firm dynamics in which entrepreneurs can switch between businesses. With the model, I measure how much output and welfare are lost because entrepreneurs cannot observe their ability and their match, and because starting over is costly, and I compare a policy that lowers this cost with one that raises the liquidation value of capital.

The data combine the accounts of 414,618 UK limited companies from the Orbis Historical database with the Companies House register of Persons of Significant Control (PSC), which records the beneficial owners of UK companies from 2016 onwards. I link a person's records across companies by name and month and year of birth, so I can identify serial entrepreneurs from administrative ownership records, where earlier studies have relied

on surveys, imputation or payroll records (Plehn-Dujowich, 2010; Chen, 2013; Lafontaine and Shaw, 2016; De Vera et al., 2026). The register also lets me follow about 21,500 owners across the companies they control. Decomposing the permanent variance of log TFP among the businesses of owners of several firms, I find that the entrepreneur accounts for 56.6 percent and the business for the remainder.

The evidence is more consistent with selection on a permanent characteristic of the entrepreneur than with learning by doing. An entrepreneur's productivity is not higher after a switch to a new business than before it. In an event study around each serial entrepreneur's first switch, productivity is flat before the switch, falls while the new business starts up and stays lower while the business is young, and productivity well before the switch is about 10 percent higher than after it. At the same age, an owner's second business is not more productive than the first, and neither comparison suggests that running a business raises productivity by more than 3% over ten years. Moreover, owners who start again after a closure ran more productive businesses. In the last three years before a closure, their productivity is 39% higher than that of the closing businesses of other owners of the same age, industry and year, and the difference is present long before the closure. The model represents this permanent characteristic as ability.

I then build a firm dynamics model with monopolistic competition and free entry in which entrepreneurs learn about their ability and about their match with a business, and can close one business to start another. Firm productivity is the sum of a permanent component specific to the entrepreneur, which I call ability, and a component specific to the pairing of entrepreneur and business, which I call match quality. Entrepreneurs know part of their ability when they enter and learn the rest of it, and their match quality, from two noisy signals each year, as in Jovanovic (1982) but with two components instead of one. The two signals are the two parts of the realised productivity of the business. Labour is hired before output is realised, as in Arkolakis et al. (2018), so a year of poor output lowers both the profit of the year and the beliefs. Each year a firm chooses whether to continue, to switch to a new business or to exit.

Firms invest in capital financed with one-period defaultable debt, following Ottonello and Winberry (2020), and lenders share the firm's beliefs. A firm that switches redeploys part of its capital in the new business and sells the rest, recovering a share ρ of its value, which I call the liquidation value of capital. It also pays a cost of starting over that falls with its ability belief. A firm that exits or defaults sells all of its capital at ρ. Free entry determines aggregate demand, so the policy experiments account for the response of entry.

I calibrate the model by simulated method of moments to eleven moments, including the serial-entrepreneur share and premium, firm size, exit and survival, and the variance decomposition. The model matches the serial-entrepreneur share, the premium and five-year survival, but it attributes more of the variance of productivity to the entrepreneur than the data do, 80 percent against 56.6 percent. It also does not reproduce the fall in productivity after a switch, because in the model switchers are selected on poor realisations of the noisy match signal, which lowers their measured productivity before the switch.

In the calibrated model, entrepreneurs learn very little about their match. Match quality varies much less across businesses than ability across entrepreneurs, with standard deviations of 0.04 and 0.60, and the noise in the signal about it is large, so its posterior variance takes more than a century of annual signals to halve. Switches therefore respond to the ability belief and to noise rather than to match quality, and since the cost of starting over falls steeply with the ability belief, the owners who act on them are mainly those who believe they are able. At the estimate, switchers are selected on ability, as the second view holds, but they are not selected on poor matches. With full information, in general equilibrium, the most able quarter of entrepreneurs would first switch at a median age of 3 instead of 8, so learning delays their switches.

Knowing the match would raise welfare by 3.6 percent, because owners, who otherwise learn little about their match, could then switch out of a poor match early, which is worth most to able owners, who run the largest businesses. Full information, in contrast, leaves welfare almost unchanged once entry adjusts. Entrants who know their ability enter at a larger scale, which raises the labour used to produce capital goods and lowers welfare by 5.5 percent at fixed prices. However, full information also raises the value of entry, and the resulting fall in the demand shifter offsets almost all of the loss.

Lowering the cost of starting over by a quarter raises the switching rate by half and welfare by 0.11 to 0.18 percent, depending on whether the cost uses labour. Because a proportional cut lowers the cost most for the least able owners, the additional switchers are less able and the productivity premium of serial entrepreneurs falls from 28% to 15%. Removing the cost entirely raises output by 2.0 percent and welfare by 1.8 to 2.0 percent, about half the gain from knowing the match, mainly through a larger number of smaller firms.

Raising the liquidation value of capital from 0.40 to 0.50 raises welfare by 0.26 to 0.28 percent, more than cutting the cost of starting over by a quarter, and its gain comes from productivity, while the number of firms falls slightly. The higher liquidation value lowers

the loss on the capital that switchers do not redeploy. This loss is proportional to capital and able entrepreneurs run the largest businesses, so the switchers it adds are as able as the others.

2 Related Literature

Differences present at the time of firm birth account for a large share of the dispersion in firm size and growth (Pugsley et al., 2021; Belenzon et al., 2017; Smith et al., 2019; Choi et al., 2021; Ouimet and Zarutskie, 2014). In particular, Pugsley et al. (2021) estimate that ex-ante factors account for more than 90 percent of the dispersion in employment in the first year after entry and for about 40 percent after twenty years. Queiró (2022) shows that firms started by more educated entrepreneurs are larger at entry and grow faster.[1] I add to this work a model in which entrepreneurs cannot observe their match quality, and I measure how much this delays the reallocation of able entrepreneurs and what it costs in output. A firm that learns that its match is poor can start over, whereas in models with a single productivity component, such as Jovanovic (1982), it can only exit.[2]

A smaller literature studies serial entrepreneurs directly (Lafontaine and Shaw, 2016; Shaw and Sørensen, 2019). Serial entrepreneurs earn more than novice self-employed workers (Chen, 2013), and among founders backed by venture capital, success in one venture predicts success in the next (Gompers et al., 2010). The closest paper is De Vera et al. (2026), who use administrative data for Portugal to show that firms owned by serial entrepreneurs are larger, more productive and less likely to shut down. These differences are already present in their first businesses, which the authors interpret as selection. I show that productivity within entrepreneurs is not higher after a switch than before it, separate the entrepreneur and business components of productivity, and build a general equilibrium model of the decision to switch, with learning and defaultable debt. With the model in hand, I implement a series of policy counterfactuals to understand the margins through which policy designed to increase serial entrepreneurship could affect aggregate output and welfare. I evaluate bankruptcy reform as a baseline (where entrepreneurs who want to switch keep more of the capital from their previous business), and a full information baseline to understand how policies would compare to that benchmark

[1] Survey evidence also shows that founders differ in what they want from their business (Campbell and De Nardi, 2009; Hurst and Pugsley, 2011), and Sedláček and Sterk (2017) show that the composition of startup cohorts has lasting aggregate effects.

[2] Papageorgiou (2014) studies a related problem in the labour market, in which workers learn about their comparative advantage and move between occupations.

Work on business failure shows how the costs of failing and starting over affect which projects entrepreneurs start and abandon. Landier (2005) shows that when failed entrepreneurs face a high cost of capital, able entrepreneurs are reluctant to abandon poor projects, and Gromb and Scharfstein (2002) study how the market for failed entrepreneurs shapes whether new ventures are started as independent firms or inside established ones. Manso (2016) shows that the option to experiment raises the returns to entrepreneurship. More forgiving personal bankruptcy law is associated with more business ownership and self-employment (Fan and White, 2003; Armour and Cumming, 2008), and Bernstein et al. (2019) find that the assets of liquidated firms are used less in the long run than those of reorganised firms. I compare a lower cost of starting over with a higher liquidation value of capital in a quantitative general equilibrium model.

Khan and Thomas (2013) and Buera and Shin (2013) study the aggregate effects of financial frictions in economies with heterogeneous firms.[3] Restuccia and Rogerson (2008) and Hsieh and Klenow (2009) measure the output lost from misallocation across firms, Bartelsman et al. (2013) extend this across countries and Decker et al. (2017) relate it to the decline in business dynamism. I add to these literatures a measure of the output lost when entrepreneurs cannot observe their match quality, from a model in which a credit friction affects the decision to switch as well as investment.

Section 3 describes the data and the empirical evidence, Section 4 presents the model, Section 5 describes the calibration and the fit of the model, Section 6 reports the policy experiments and Section 7 concludes.

3 Data and Empirical Evidence

The data link the accounts of UK limited companies to their owners, so entrepreneurs can be followed across the businesses they run.

3.1 Data

The firm-level data come from Bureau van Dijk's Orbis Historical database for the United Kingdom and cover fiscal years 2005–2024.[4] I pool the Large, Medium and Small libraries, which gives broader coverage of small firms than the Large library commonly used in the literature (Kalemli-Özcan et al., 2024). From each library I take incorporation dates, legal

[3] Cooley and Quadrini (2001) and Clementi and Palazzo (2016) study how financing and entry frictions shape firm size and the number of firms.

[4] Appendix A describes the construction of the sample and the ownership linkage. The code used to construct all statistics is available on request.

status, employment, operating revenue, total assets and debt.[5] After keeping companies with a Companies House registration number and positive employment and revenue, the sample contains 414,618 companies and 1.51 million firm–year observations (Table 8 in Appendix A).[6] Firm age is the fiscal year minus the year of incorporation recorded at Companies House.

I measure productivity by log total factor productivity,

$$\log \mathrm{TFP}_{i,t} = \log R_{i,t} - \mu^{-1}\Big[(1-\alpha)\log n_{i,t} + \alpha \log k_{i,t}\Big], \tag{1}$$

where R is operating revenue, n is employment and k is total assets. I set the capital share to $\alpha = 0.30$ and $\mu = \sigma/(\sigma-1) = 4/3$, where $\sigma = 4$ is the elasticity of substitution between varieties, which are the values used in the calibration. With these values, measured TFP in the model of Section 4 is the productivity term X of its revenue function, up to the demand shifter and an error in the recorded accounts (Section 4.2.1). I also report log labour productivity, the log of revenue per employee. Employment growth is measured by the Davis–Haltiwanger–Schuh (DHS) rate (Haltiwanger et al., 2017), computed for consecutive years,

$$g^{\mathrm{DHS}}_{i,t} = 100 \cdot \frac{\mathrm{emp}_{i,t} - \mathrm{emp}_{i,t-1}}{0.5\,(\mathrm{emp}_{i,t} + \mathrm{emp}_{i,t-1})}, \tag{2}$$

which is bounded and so accommodates the large changes in employment that are common among small firms.

A company exits if Companies House records it as dissolved, inactive, closed, struck off or in liquidation, and I date the exit to the last year in which the company reports positive revenue or employment. For the exit and survival statistics I restrict the sample to firm–years with at least two employees, since companies with one employee are often shells whose dissolution differs from that of employer firms.

3.2 Identifying serial entrepreneurs

I identify owners from the Companies House register of Persons of Significant Control, which UK companies have been required to file since April 2016. The register lists individuals who hold more than 25 percent of a company's shares or voting rights, which

[5] Relative to the Business Population Estimates, Orbis over-represents larger and older firms, less so in the pooled libraries than in the Large library studied by Kalemli-Özcan et al. (2024). The serial-entrepreneur premia are differences between serial and other firms in the same panel, so selection that shifts both groups equally leaves them unchanged. Median employment and the exit statistics are levels, and they shift with the coverage of small employers.

[6] Note that De Vera et al. (2026) use linked employee-employer data and identify serial entrepreneurs from payroll data. I instead use ownership records.

corresponds to ownership of the business in the model. I match the register to the panel through company registration numbers and keep natural persons. Because the register has no person identifier that is common across companies, I identify individuals by surname, first name, and month and year of birth, all of which are mandatory fields. Two different people who share all four fields are treated as one person, but placebo permutations of the dates of birth and the Orbis director records suggest that such false links are rare.

A person who holds significant control in between two and twenty companies of the panel is treated as a multi-firm owner, where the upper limit excludes nominee shareholders and corporate-services providers (cf. Lafontaine and Shaw, 2016). Of the 279,236 matched persons, 7.7 percent, or 21,490 people, are multi-firm owners. Following Lafontaine and Shaw (2016), I classify the companies of all multi-firm owners as run by a serial entrepreneur. I also use the dates on which an owner's companies are incorporated and close to separate owners who hold their firms one after another from owners who hold several firms at the same time, as a robustness check (Appendix A.2). Firms that exited before 2016 cannot appear in the register, so I compute the serial-entrepreneur share among the 204,957 companies whose registration number appears in the register, which I call linkable.

3.3 Serial entrepreneurs, exit and debt

Firms run by serial entrepreneurs account for 19.25 percent of linkable companies, and I refer to the other linkable companies as regular firms. The TFP of serial-entrepreneur firms exceeds that of the other companies in the panel by 28%, in a regression with age dummies and fixed effects for 4-digit industry by year. Their labour productivity is 20% higher in the same regression.

Serial entrepreneurs also run larger businesses. I measure the size of a serial entrepreneur as mean employment over all firm–years of all the entrepreneur's companies, and the size of a regular firm as its mean employment, using linkable companies and firm–years with at least two employees. The median size is 38.9 employees for serial entrepreneurs and 4 for regular firms.[7] Among linkable companies, employment in serial-entrepreneur firms grows 0.39 percentage points a year faster than in regular firms after controlling for age, and the standard deviation of employment growth is 28.43 percentage points.[8] Table 11

[7]The median over serial entrepreneurs is computed over owners with at least two companies in the panel, which selects owners of larger companies and of company groups. Without the two-employee restriction, the median is 30.8 over these owners and 4 over all owners of two or more companies in the register.

[8]Without controls, employment in serial-entrepreneur firms grows 0.22 percentage points a year faster. Across all firm–years of the panel, the standard deviation of employment growth is 30.07 percentage

in Appendix A defines these statistics. Serial status does not vary within a firm, so these premia are comparisons across owners, and Section 3.5 compares the productivity of the same entrepreneur before and after a switch.

The exit statistics come from the hazard rates for the 169,890 companies incorporated in 2005–2022 that have at least two employees in some year. The hazard declines with age, from 0.100 at age one to 0.038 at age ten (Table 10 in Appendix A). The pooled hazard over ages one to ten is 0.063, and 66.0 percent of companies survive for five years. Moreover, serial-entrepreneur firms exit at 0.72 times the rate of regular firms of the same age.

Most firms borrow little, and insolvency is rare. Among firm–years of linkable companies with at least two employees, the ratio of debt to total assets has a mean of 0.229. Over all firm–years with at least two employees its median is 0.079, and 32.5 percent of these firm–years report no debt. Each year, 0.37 percent of companies with at least two employees enter liquidation, insolvency proceedings or bankruptcy, and 2.9 percent close for any reason.

3.4 Productivity across an owner's businesses

The ownership link allows me to compare the productivity of different businesses run by the same person. For entrepreneurs with exactly two firms that have no other multi-firm owner, the correlation of firm-average log labour productivity, is 0.55. I estimate the variance decomposition as a random-effects model in which each business is nested within the controlling entrepreneur and estimate by GMM. The sample consists of owners of several firms, and I keep companies that have no other multi-firm owner, so that each business is nested within one entrepreneur. Entrepreneurs account for a share $\sigma^2_{\text{owner}}/(\sigma^2_{\text{owner}} + \sigma^2_{\text{business}}) = 0.566$ of the permanent variance of log TFP (Table 1). The share is similar for log labour productivity and in each subsample of owners in the table, at between 0.570 and 0.599.

3.5 Experience or selection

If running a business raises an entrepreneur's productivity, productivity should rise when the entrepreneur switches to a new business. If instead the premium reflects selection, because more able entrepreneurs are more likely to close a poorly matched business and start another, productivity need not rise at the switch. To distinguish between these explanations, I estimate an event study around each serial entrepreneur's first switch.

points.

Sample	Owner share	95 percent CI	Noise SD	Entrepreneurs
All owners	0.570	[0.553, 0.590]	0.597	11,236
Sequential	0.599	[0.483, 0.731]	0.719	307
Simultaneous	0.584	[0.564, 0.602]	0.589	10,372
Owners of two firms	0.587	[0.567, 0.604]	0.575	9,098
All owners, log TFP	0.566	[0.545, 0.585]	0.555	10,956

Table 1: Share of the permanent variance of firm productivity accounted for by entrepreneurs. Nested method-of-moments estimates of $\sigma^2_{\text{owner}}/(\sigma^2_{\text{owner}} + \sigma^2_{\text{business}})$ among multi-firm owners, for log labour productivity and, in the last row, log TFP, with 95 percent confidence intervals from a bootstrap clustered by entrepreneur. Companies with more than one multi-firm owner are excluded, so that each business is nested within one entrepreneur, and the sample keeps owners with at least two remaining companies observed with the outcome. The noise SD is the standard deviation of the transitory component of measured productivity.

For each serial entrepreneur, I order the businesses by year of incorporation and date the switch to the incorporation of the second business. Orbis covers the first business before the switch, even though the ownership link is only available from 2016. Stacking the firm–years of both businesses in event time $r = \text{year} - \text{switch year}$, I estimate

$$y_{f,t} = \sum_{r \neq -1} \beta_r \, \mathbf{1}[\text{event time}_{f,t} = r] + a_e + \gamma_t + \xi_{f,t}, \tag{3}$$

where y is log TFP, a_e is an entrepreneur fixed effect and $r = -1$ is the reference year. The baseline specification has entrepreneur fixed effects only, $\gamma_t = 0$, and an alternative specification adds calendar-year fixed effects γ_t. The sample contains 5,132 entrepreneurs and 47,179 firm–years, event time is binned at ± 5, and standard errors are clustered by entrepreneur.

Figure 1 shows that productivity is flat before the switch, falls while the new business starts up and stays lower while the business is young. Before the switch the coefficients lie between -0.028 and 0.004, and only the coefficient at $r = -2$, -0.028, is statistically different from zero. TFP falls by 8% in the year of the switch and by 16% in the year after, while the new business starts up, and from $r = 2$ onwards the estimates are negative. After the switch, TFP rises by 2.3% a year as the new business ages.[9] Average TFP at $r \leq -3$ exceeds the average at $r \geq 1$ by 9.7%. Log employment falls after the switch (panel b), since the new business starts smaller than the business it follows.

For entrepreneurs who own their businesses one after another, as in the model, the dif-

[9]The new business is incorporated at $r = 0$, so its age equals event time, and the estimates after the switch combine any change in the entrepreneur's productivity with the productivity profile of young firms. Table 2 compares businesses at the same age. The entrepreneur fixed effect absorbs each entrepreneur's level, so the coefficients measure changes within entrepreneurs relative to $r = -1$, and the level of the premium is the coefficient in Section 3.3.

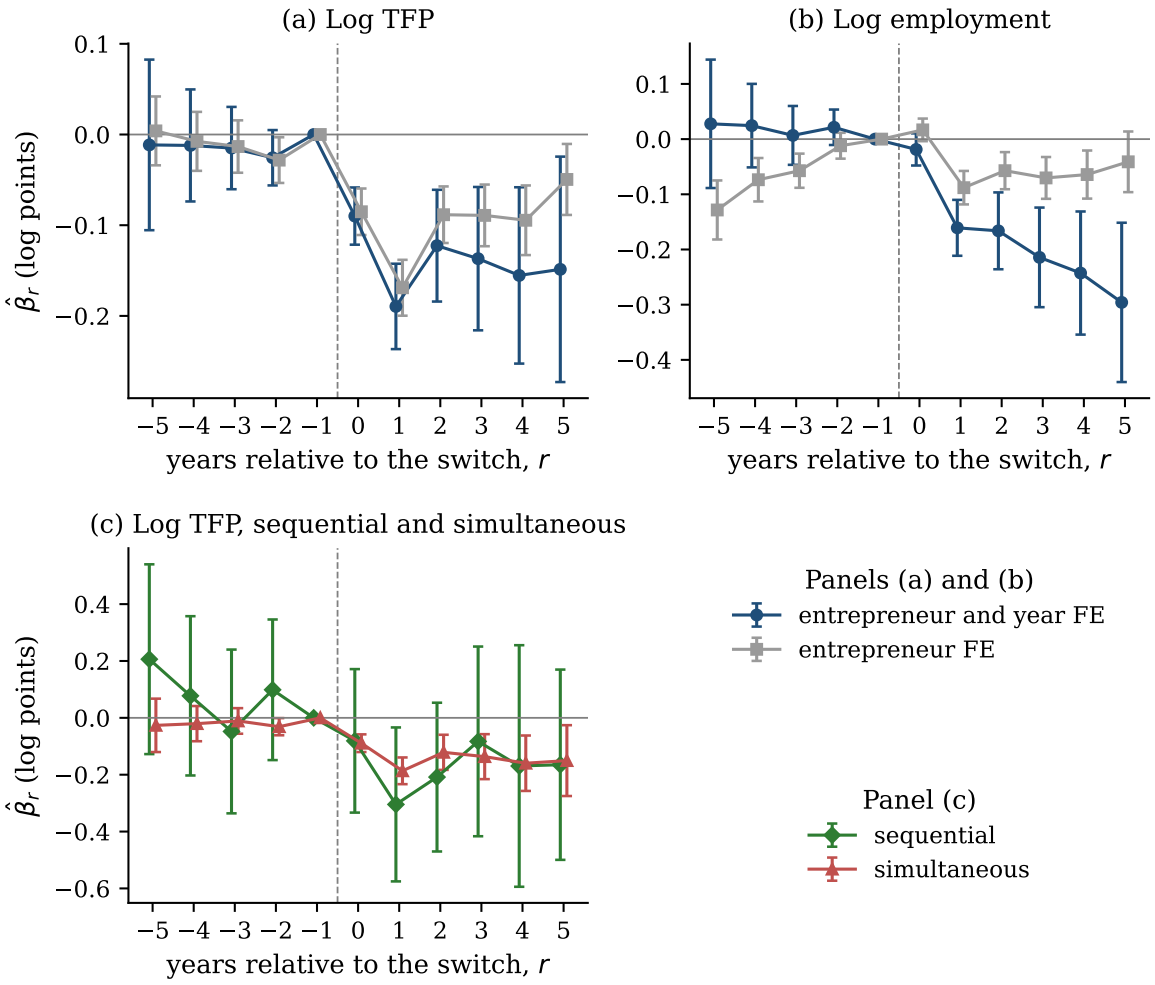


Figure 1: Log TFP and log employment around the first business switch. standard errors are clustered by entrepreneur. Panels (a) and (b) show log TFP and log employment with entrepreneur fixed effects only and with calendar-year fixed effects added. Panel (c) shows log TFP for entrepreneurs who own their firms one after another and for those who own them at the same time.

ference in TFP before and after the switch is 25%. For those who hold several firms at the same time it is 9%.[10]

The event study compares a new business in its first years with the old business at older ages. If running a business made an entrepreneur better at running the next one, a later business would also be more productive than an earlier one at the same age, and more so the longer the entrepreneur had run the earlier business. Table 2 compares an owner's businesses at the same age. At ages one to five, the TFP of an owner's second business is 8% lower than that of the first.[11] Among owners of three or more businesses, TFP changes by -0.4% with each later business. Each year of earlier ownership adds 0.27% to the TFP of a later business , or 3% over ten years. Moreover, the difference between the second and the first business does not rise with the number of years the owner ran the first business before starting the second.

If instead the premium reflects who starts again, the owners who start a new business after a closure should come from the more productive of the closing businesses. I take owners whose company closed between 2019 and 2022 and who held no other company started more than two years before the closure. Of these owners, 24.4 percent start or take over another company between two years before and three years after the closure. In the last three years before the closure, the TFP of the companies of those who start again is 47% higher, than that of the closing companies of other owners of the same age, 2-digit industry and year. Their employment is also 38% higher, and the owners who start again are 4.8 years younger.

Figure 2 shows that the difference is present long before the closure. Five or more years before it, the companies of owners who start again are as productive as companies of the same age, industry and year that do not close. In contrast, the TFP of the companies of owners who do not start again is 32% lower than that of these companies, and it falls by a further 4% a year.

[10] With calendar-year fixed effects common to all entrepreneurs added, the two differences are 31% and 14%. Panel (c) of Figure 1 shows the coefficients for the two groups from this specification.

[11] With 4-digit industry fixed effects it is 3% lower . Among owners of three or more businesses, the TFP of the third business is 11% lower than that of the first.

	Log TFP	Log labour productivity	Firm–years	Owners
A. Second against first business at the same age				
Second business	−0.085	−0.066	18,336	4,340
	(0.025)	(0.026)		
Second business, industry fixed effects	−0.028	−0.027	18,271	4,319
	(0.024)	(0.025)		
B. Order of the business and prior ownership				
Second business	−0.067	−0.025	40,828	4,343
	(0.038)	(0.040)		
Third business	−0.119	−0.068	40,828	4,343
	(0.040)	(0.043)		
Fourth or later business	0.018	0.007	40,828	4,343
	(0.048)	(0.051)		
Order of the business, linear	−0.004	−0.005	40,828	4,343
	(0.015)	(0.016)		
Years of prior ownership	0.0027	0.0024	40,828	4,343
	(0.0010)	(0.0011)		
C. Years the first business ran before the second				
Second business × years first ran	−0.008	−0.010	18,336	4,340
	(0.010)	(0.010)		

Table 2: Productivity across an owner's businesses. Panel A compares an owner's second business with the first at the same age (ages one to five), with owner and firm-age fixed effects. Panel B uses owners of three or more companies in the panel and firm–years at ages one to ten, with owner and firm-age fixed effects. Panel C adds to Panel A the interaction of the second business with the number of years between the incorporation of the first and of the second business.

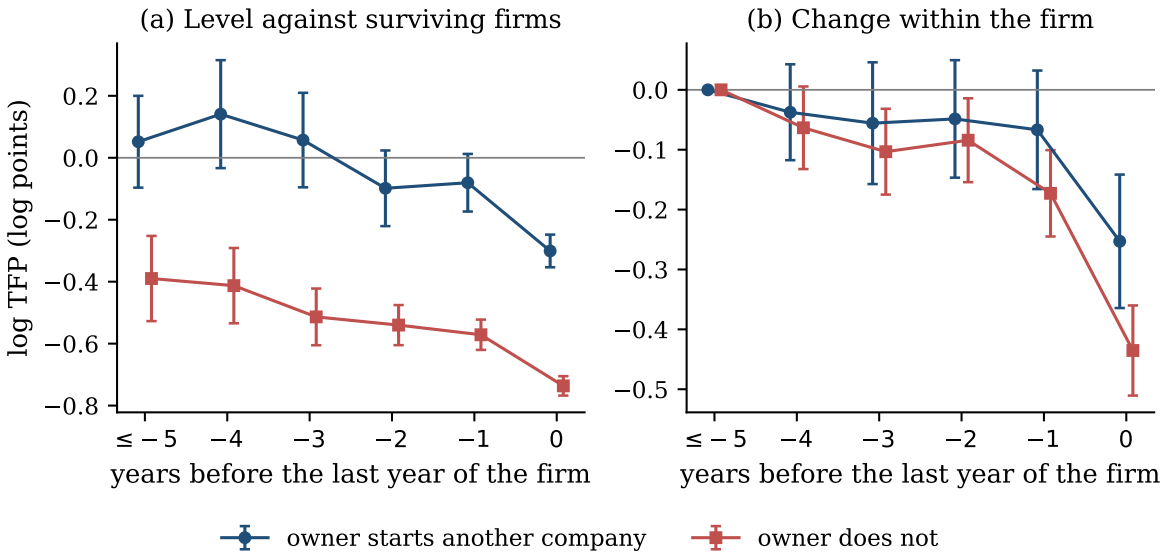


Figure 2: Log TFP of closing companies before closure, by whether the owner starts another company. Panel (a) shows the difference from companies that do not close, in the same cell of age, 2-digit industry and year; panel (b) shows the change within the company relative to five or more years before the last year. Companies closed in 2019–2022; 95 percent confidence intervals, with standard errors clustered by company. Appendix A.4 defines the samples.

4 Model

The model is a stationary general equilibrium economy with heterogeneous, monopolistically competitive firms and endogenous entry and exit, in the tradition of Hopenhayn (1992). I extend this framework so that firm productivity has a component specific to the entrepreneur and a component specific to the business, and firms learn about both from two noisy signals a year, which together make up the realised productivity of the business. Firms can also close their current business and start a new one, taking the entrepreneur's ability and the beliefs about it to the new business. Firms invest in capital financed with defaultable debt, following Ottonello and Winberry (2020). Time is discrete and a period is one year.

4.1 Households

A representative household has preferences

$$U = \sum_{t=0}^{\infty} \beta_H^t \ln Q_t, \tag{4}$$

where Q_t is the CES aggregate

$$Q_t = \left(\int Q_{i,t}^{\frac{\sigma-1}{\sigma}} \, di \right)^{\frac{\sigma}{\sigma-1}}, \tag{5}$$

$Q_{i,t}$ is consumption of variety i, and $\sigma > 1$ is the elasticity of substitution between varieties. The household supplies $\bar{N}$ units of labour inelastically at the wage w_t, owns all firms and receives their dividends net of the cost of entry, Π_t, so that its budget constraint is

$$P_t Q_t \;=\; w_t \bar{N} + \Pi_t. \tag{6}$$

Utility maximisation gives the standard CES demand for each variety. I take the wage as the numeraire. The household's discount factor is $\beta_H = 1/(1+r_f)$, where r_f is the interest rate on safe debt, and lenders price debt at this rate. The decisions of each firm are taken by its owner-manager, who discounts its dividends at the factor β, which I estimate in Section 5 to lie below β_H. I treat $\beta < \beta_H$ as a reduced form for owner-managers who hold an undiversified stake in their business, so firms are less patient than lenders.

4.2 Firms

There is a mass M of firms, each producing one variety. Firm i operates a business j with the constant-returns technology

$$y_{i,t} = Z_{i,t} \, k_{i,t}^{\alpha} \, n_{i,t}^{1-\alpha}, \tag{7}$$

where $n_{i,t}$ is labour, $k_{i,t}$ is capital, α is the capital share, and $Z_{i,t}$ is the physical productivity of the business, realised in year t. Given CES demand, revenue is

$$R_{i,t} \;=\; \Lambda^{1/\sigma} \, X_{i,t} \left(k_{i,t}^{\alpha} \, n_{i,t}^{1-\alpha} \right)^{1/\mu}, \qquad \mu \equiv \frac{\sigma}{\sigma - 1}, \qquad X_{i,t} \equiv Z_{i,t}^{1/\mu}, \tag{8}$$

where $X_{i,t}$ is realised productivity in revenue units (equation (11) below), which is the object the data section measures as TFP, and aggregate demand conditions enter through the demand shifter $\Lambda \equiv w^{1-\sigma} P^{\sigma} Y$ (Section 4.4.3).

4.2.1 Productivity and learning

Productivity has a component specific to the entrepreneur and a component specific to the business. Each year the owner observes a signal about the entrepreneur's ability and a signal about the quality of the match between the entrepreneur and the current business j,

$$\theta_{i,t} = \Theta_i + \varepsilon_{i,t}, \qquad \phi_{j,t} = \Phi_j + u_{j,t}, \tag{9}$$

with

$$\Theta_i = \Theta_i^K + \Theta_i^L, \qquad \Theta_i^K \sim N(\mu_\Theta, \sigma_K^2), \qquad \Theta_i^L \sim N(0, \sigma_L^2), \qquad \varepsilon_{i,t} \sim \text{i.i.d. } N(0, \sigma_\varepsilon^2),$$
$$\Phi_j \sim N(\mu_\Phi, \sigma_\Phi^2), \qquad u_{j,t} \sim \text{i.i.d. } N(0, \sigma_u^2). \tag{10}$$

Here Θ_i is the ability of the entrepreneur, which is permanent and stays with the entrepreneur across businesses. The entrepreneur knows the component Θ_i^K when the firm enters, for example from education and previous employment, and learns the component Θ_i^L from the signals. The total dispersion of ability is $(\sigma_K^2 + \sigma_L^2)^{1/2}$. The match quality Φ_j is constant while the business operates and is drawn again when the entrepreneur switches. The ability component is consistent with the evidence in De Vera et al. (2026) that the advantages of serial entrepreneurs are already present in their first businesses, while the match component follows Jovanovic (1982).

The two signals are the two parts of the realised productivity of the business, which in year t is

$$\begin{aligned} X_{i,t} &= \exp\Big(\theta_{i,t} + \phi_{j,t} - \tfrac{1}{2}\big(\sigma_\varepsilon^2 + \sigma_u^2\big)\Big) \\ &= \exp\Big(\Theta_i + \Phi_j + \varepsilon_{i,t} + u_{j,t} - \tfrac{1}{2}\big(\sigma_\varepsilon^2 + \sigma_u^2\big)\Big), \end{aligned} \tag{11}$$

where the term $-(\sigma_\varepsilon^2 + \sigma_u^2)/2$ normalises the level of the noise, so that $\mathbb{E}[X_{i,t} \mid \Theta_i, \Phi_j] = \exp(\Theta_i + \Phi_j)$ is the expected productivity of the pair of entrepreneur and business. Labour is chosen each year before output is realised, as in Arkolakis et al. (2018), and capital is chosen a year ahead, so both inputs are set on the firm's beliefs. The accounts of the business show the owner, and the lenders, each of the two parts of realised productivity, $\theta_{i,t}$ and $\phi_{j,t}$, so output carries no information beyond the two signals.

Firms know the population distributions but not their own Θ_i^L and Φ_j. Each year, once output is realised, they observe $\theta_{i,t}$ and $\phi_{j,t}$ and update their beliefs using Bayes' rule. With normal priors and normal noise, the beliefs at the start of year t, before the year's output, are independent and normal,

$$\tilde{\Theta}_{i,t} \sim N(A_{i,t}, B_x), \qquad \tilde{\Phi}_{j,t} \sim N(C_{j,t}, D_\tau), \tag{12}$$

where x is the number of ability signals the entrepreneur has observed and τ is the number of signals observed on the current business, its tenure. The posterior variances, which decline with the number of observations, are

$$B_x = \frac{\sigma_\varepsilon^2 \sigma_L^2}{\sigma_\varepsilon^2 + x\sigma_L^2}, \qquad D_\tau = \frac{\sigma_u^2 \sigma_\Phi^2}{\sigma_u^2 + \tau\sigma_\Phi^2}. \tag{13}$$

The posterior variance of match quality halves after $\tau = \sigma_u^2/\sigma_\Phi^2$ signals, so the match is learned slowly when the noise σ_u is large relative to the dispersion σ_Φ. The posterior means are weighted averages of the prior mean and the average signal $\bar{\theta}_{i,x} = (\theta_{i,1} + \cdots + \theta_{i,x})/x$,

$$A_{i,t} = \frac{x\sigma_L^2}{\sigma_\varepsilon^2 + x\sigma_L^2}\,\bar{\theta}_{i,x} + \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + x\sigma_L^2}\,\Theta_i^K, \tag{14}$$

where the prior mean of the ability belief is the known component Θ_i^K, and $C_{j,t}$ is defined analogously with prior mean μ_Φ. The posterior means follow martingales, with innovation variances equal to the reductions in posterior variance between successive observations, and they converge to Θ_i and Φ_j as the number of observations grows. When a firm switches, it keeps its belief about ability and the count x, while its belief about the new business starts at the prior, $C = \mu_\Phi$ with variance $D_0 = \sigma_\Phi^2$, and τ restarts at zero (Section 4.3.1). Learning about the match therefore starts again with the tenure of the new business, while learning about ability continues across businesses. For a firm that has not switched, x and τ coincide.

Since labour is chosen before the year's output is realised, the firm maximises expected revenue net of the wage bill. Given the beliefs, $\ln X_{i,t}$ is normal with mean $A_{i,t} + C_{j,t} - (\sigma_\varepsilon^2 + \sigma_u^2)/2$ and variance $B_x + D_\tau + \sigma_\varepsilon^2 + \sigma_u^2$, so expected productivity is

$$X(s_t) \;\equiv\; \mathbb{E}\Big[X_{i,t}\,\Big|\,s_t\Big] \;=\; \exp\!\Big(A_{i,t} + C_{j,t} + \tfrac{1}{2}\big(B_x + D_\tau\big)\Big), \tag{15}$$

where $s_t = (A_{i,t}, C_{j,t}, x, \tau)$ is the belief state, which gives the posterior variances through equation (13). Since revenue is convex in productivity, uncertainty about ability and the match raises expected productivity, so a new business hires more than an established business with the same posterior means. Revenue is linear in $X_{i,t}$, so the optimal choice of labour given (s_t, k_t) is

$$n^*(s_t, k_t) \;=\; \left(\frac{1-\alpha}{\mu}\,\Lambda^{1/\sigma}\,X(s_t)\,k_t^{\alpha/\mu}\,w^{-1}\right)^{\frac{1}{1-(1-\alpha)/\mu}}, \tag{16}$$

so that employment and the wage bill respond to the demand shifter and to the beliefs, but not to the signals of the year. Expected revenue is

$$R^e(s_t, k_t) \;=\; \Lambda^{1/\sigma} X(s_t)\left(k_t^\alpha\, n^*(s_t, k_t)^{1-\alpha}\right)^{1/\mu}, \tag{17}$$

the wage bill is a share $(1-\alpha)/\mu$ of it, and expected operating profit is

$$\begin{aligned}\pi^{e}(s_t,k_t) &= \frac{\mu-1+\alpha}{\mu}\,R^{e}(s_t,k_t)-c \\ &= \frac{\mu-1+\alpha}{\mu}\left(\frac{1-\alpha}{\mu\,w}\right)^{\frac{1-\alpha}{\mu-1+\alpha}}\left(\Lambda^{1/\sigma}X(s_t)\,k_t^{\alpha/\mu}\right)^{\frac{\mu}{\mu-1+\alpha}}-c,\end{aligned} \tag{18}$$

where c is a fixed operating cost in units of the wage.

Realised revenue differs from expected revenue by the ratio of realised to expected productivity, so realised profit is

$$\pi_{i,t} \;=\; R^{e}(s_t,k_t)\,\frac{X_{i,t}}{X(s_t)}-w\,n^{*}(s_t,k_t)-c \;=\; \pi^{e}(s_t,k_t)+R^{e}(s_t,k_t)\left(\frac{X_{i,t}}{X(s_t)}-1\right), \tag{19}$$

where

$$\frac{X_{i,t}}{X(s_t)} \;=\; \exp\!\Big(\theta_{i,t}+\phi_{j,t}-A_{i,t}-C_{j,t}-\tfrac{1}{2}\big(B_x+D_\tau+\sigma_\varepsilon^2+\sigma_u^2\big)\Big)$$

has a mean of one given s_t. A year of poor output lowers realised profit at a given wage bill, and the same signals lower the beliefs through equation (14). Because the operating cost must be paid every period, a firm whose beliefs about its ability or its business are poor may prefer to exit or to switch.

Measured TFP in the model is computed from recorded revenue, employment and capital as in the data, equation (1). The recorded accounts contain a measurement error $\eta_{i,t}$ that the owner does not see (Section 5.1), so the logarithm of measured TFP is $\ln X_{i,t} + \sigma^{-1}\ln\Lambda + \big(\sigma-(\sigma-1)(1-\alpha)/\mu\big)\eta_{i,t}$. Its permanent part is $\Theta_i+\Phi_j$, and its transitory part is $\varepsilon_{i,t}+u_{j,t}$ plus the measurement error.

4.2.2 Timing

At the start of each year the firm dies with probability δ_d, in which case its capital is sold at the liquidation value ρ and its debt repaid from the proceeds. A surviving firm then chooses, on its beliefs and before the year's output, whether to continue, to switch or to exit. A continuing firm chooses next-period capital and debt (k',b') subject to a non-negative dividend, $d\geq 0$, hires labour on its beliefs according to (16) and produces. A switching firm produces a last year with its current business, closes the business at the end of the year and repays its debt. It installs the capital of the new business without an adjustment cost, and the new business produces from the next year, as investment by a continuing firm does. In contrast, an exiting firm does not produce in the year. It liquidates its capital at ρ, repays its debt from the proceeds and keeps the surplus.

Once output is realised, the owner and the lenders observe the accounts and update the beliefs with the signals of the year by equations (13) and (14). An exit therefore forgoes the output of the year, and the signals of the year in which a firm switches arrive after its decision. I rule out a switch at the start of a firm's second year. A firm can therefore decide to switch at the start of the year in which it enters, closing its first business after one year, and at the start of every year from its third on.

4.2.3 Capital, debt and default

A continuing firm chooses next-period capital k' and one-period debt b'. Investment $\iota = k' - (1-\delta_k)k$ is subject to the convex adjustment cost $\Psi(\iota, k) = \frac{\psi}{2}(\iota/k)^2 k$, where δ_k is the depreciation rate. The dividend is

$$d \;=\; \pi^e(s,k) \;+\; (1-\delta_k)k \;-\; k' \;-\; \Psi(\iota,k) \;+\; q(s,k',b')\,b' \;-\; b, \tag{20}$$

where $\pi^e(s,k)$ is the expected operating profit of the year in equation (18) and s is the belief state at the start of the year. Firms cannot issue equity, so that $d \geq 0$. I assume that the owner absorbs the gap between realised and expected profit, $\pi_{i,t} - \pi^e(s_t, k_t)$ in equation (19), which has a mean of zero given the beliefs. The dividend, default and the price of debt therefore depend on the beliefs and not on the realised profit of the year, and a year of poor output tightens the constraint $d \geq 0$ and raises the risk of default only through the beliefs it lowers.

A firm may default at the start of a year, in which case it does not produce in that year. Its capital is then sold at the liquidation value of capital $\rho \in (0,1)$, the share of the value of capital that is recovered when it is sold. The lender receives the proceeds of the capital up to the face value of the debt, $\min\{b,\, \rho k\}$, and the owner keeps any surplus,

$$V^D(k,b) \;=\; \max\{\,0,\; \rho k - b\,\}. \tag{21}$$

Exit and default are the same action. A firm also defaults if it has no plan with a non-negative dividend and cannot finance a switch.

Lenders are risk neutral and observe the accounts of the firm, so they share its beliefs. They price debt using the probability that the firm exits or defaults at the start of the next year, once the signals of the year have moved its beliefs,

$$\begin{aligned} q(s,k',b') \;=\; \frac{1}{1+r_f}\Big[&(1-\delta_d)\Big(1 - \mathbb{E}_{\theta,\phi|s}\Big[p^D(s',k',b')\Big]\,\Big(1-\mathrm{rec}(k',b')\Big)\Big) \\ &+\; \delta_d\,\mathrm{rec}(k',b')\Big], \end{aligned} \tag{22}$$

where s' is the belief state at the start of the next year, updated with the year's signals, and $\text{rec}(k', b') = \min\{1,\ \rho k'/b'\}$ is the lender's recovery in a default. The probability $p^D(s', k', b')$ that the firm exits or defaults at (s', k', b') is implied by the choice probabilities in equation (30) below, and δ_d is the probability of exogenous death at the start of a year. The lender treats a death as a liquidation of the capital before the firm produces. Debt that the liquidation value of the capital covers, $b' \leq \rho k'$, is safe and priced at r_f, and beyond that firms pay a spread that depends on their beliefs. Since default risk falls with expected productivity, entrepreneurs who believe they are more able borrow more cheaply, while the uncertainty of the beliefs adds to the risk that a poor year lowers them to a point at which the firm exits.

The firm prices the death risk in the same way as the lender. If the firm dies at the start of the next year, before it produces, its capital is liquidated as in a default. The value of a plan (k', b') at the start of the next year, at the belief state s' of that year, is therefore

$$\bar{V}(s', k', b') \ \equiv\ (1 - \delta_d)\, V(s', k', b') \ +\ \delta_d \max\{0,\ \rho k' - b'\}, \tag{23}$$

where V is the value of a firm that survives the start of a year, defined in equation (27) below.

4.3 The firm's problem

At the start of each year the firm chooses, given its beliefs, capital and debt, between continuing with its current business, switching to a new business, and default or exit.

4.3.1 Switching

When a switching firm closes its current business at the end of the year, a fraction χ of the capital is redeployed into the new business, and the remainder is sold at the liquidation value ρ. The debt is repaid in full, which requires the expected profit of the year plus the liquidation value of the depreciated capital to cover it,

$$e \ =\ \pi^e(s, k) \ +\ \rho\,(1 - \delta_k)\, k \ -\ b \ \geq\ 0. \tag{24}$$

The budget of the new business is $e + \chi(1-\rho)k$, where $\chi(1-\rho)k$ is the liquidation loss the owner avoids on the redeployed capital. The liquidation value therefore enters a switch as a cost due to the capital that is not redeployed, and it enters exits and defaults through the whole capital stock.

The firm keeps its belief about ability and plans the new business at the prior belief about

its match quality,

$$s^{+} \;=\; \Big(A,\ \mu_{\Phi},\ x,\ 0\Big), \qquad s^{+\prime} \;=\; \Big(A',\ \mu_{\Phi},\ x+1,\ 0\Big), \tag{25}$$

where A and x are the mean of the ability belief and the number of ability signals in s. The ability signal of the closing business updates the ability belief to A', so the new business starts the next year at the belief state $s^{+\prime}$, while the match signal of the closing business carries no information about the new match. The new match is then learned from the signals of the new business, at the rate given by D_{τ} in equation (13).

In addition, the firm pays a cost of starting over that falls with its ability belief,

$$\lambda(s) = \kappa\Big[\,1 + \zeta\,(1 - \tilde{A})\,\Big], \tag{26}$$

Where $\tilde{A}$ is normalised to lie $\in [0, 1]$. I interpret $\lambda(s)$ as the time, administrative or legal costs of closing one business and starting another, and refer to it as the cost of starting over, or of a fresh start. It is paid in full in the period in which an owner closes one business and opens another. An owner with a good record keeps its lenders, suppliers and customers when it starts the new business, while an owner whose record is poor must rebuild these relationships and faces closer scrutiny when the new business borrows. The model imposes the financial cost of a switch through the liquidation and the price of the new debt.

A firm switches when the value of a new business at the prior match belief, net of the cost of starting over and the liquidation loss, exceeds the value of continuing with its current business. Since expected productivity in equation (15) scales with $\exp(A_{i,t})$ for any match, the gain from a new business rises with the ability belief, while the cost falls with it, so switchers are selected on ability. How far switching also selects on match quality depends on how much a firm learns about its match. When the noise σ_u is large relative to σ_{Φ}, the match belief moves little from its prior for many years, and as long as $\tau < \sigma_u^2/\sigma_{\Phi}^2$ the average match signal varies more with the noise than with match quality. A new business at the prior match belief then differs little in expected match quality from the current one, so switches are triggered mainly by the taste shocks of Section 4.3.2 and by the noise in the match signal. Since the cost of starting over falls with the ability belief, owners with higher ability beliefs are more likely to act on them. Section 5 shows that this is the case at the estimate, and Section 6.3 measures how much earlier able entrepreneurs would switch, and how output and welfare would change, if firms observed their ability and their match.

4.3.2 Value functions

The state of a firm at the start of a year is (s, k, b), where k is capital and b is the debt due in the year. The belief state $s = (A, C, x, \tau)$ contains the posterior means of ability and match quality and the two learning clocks, which give the posterior variances B_x and D_τ. Conditional on survival, the value of the firm is

$$V(s,k,b) \;=\; \mathcal{S}_\omega\Big\{\; V^C(s,k,b),\; V^S(s,k,b),\; V^D(k,b) \;\Big\}, \tag{27}$$

where V^D is the value of default or exit from equation (21) and $\mathcal{S}_\omega$ is the maximum defined below. The value of continuing is

$$V^C(s,k,b) \;=\; \max_{(k',b')\,:\,d\geq 0} \; d \;+\; \beta\,\mathbb{E}_{\theta,\phi|s}\Big[\bar{V}(s',k',b')\Big], \tag{28}$$

with d given by equation (20) and the continuation value by equation (23). The expectation is over the year's two signals, which given the beliefs are independent, with $\theta \mid s \sim N(A,\, B_x + \sigma_\varepsilon^2)$ and $\phi \mid s \sim N(C,\, D_\tau + \sigma_u^2)$, and which give the belief state of the next year, $s' = (A', C', x+1, \tau+1)$, by equations (13)–(14).

The value of switching is

$$\begin{aligned} V^S(s,k,b) \;= e \;+\; \chi(1-\rho)k \;+\; \max_{(k',b')} \Big[&-k' + q(s^+,k',b')\,b' \\ &+ \beta\,\mathbb{E}_{\theta|s}\Big[\bar{V}(s^{+\prime},k',b')\Big]\Big] \;-\; \lambda(s), \end{aligned} \tag{29}$$

where $e \geq 0$ is given by equation (24). The capital and debt of the new business are chosen at the time of the switch, at the belief state s^+ of equation (25), subject to the constraint that the budget plus the new debt covers the new capital, $-k' + q(s^+,k',b')\,b' \geq -e - \chi(1-\rho)k$. The expectation is over the ability signal of the closing business, which gives $s^{+\prime}$, and the price $q(s^+,k',b')$ is that of equation (22) with this expectation and with next year's beliefs $s^{+\prime}$, since the new business has not yet produced.

The cost of starting over $\lambda(s)$ is a function of the ability belief at the time of the switch. Recall that the model assumes owners and lenders both see the same signals, so there is no scope for disagreement on sentiment between owners and lenders.

The discrete choice is subject to i.i.d. extreme-value taste shocks with scale ω, so that

$$\mathcal{S}_\omega\{V_a\} \;=\; \omega \ln \sum_a e^{V_a/\omega}, \qquad \Pr(a \mid s,k,b) \;=\; \frac{e^{V_a/\omega}}{\sum_{a'} e^{V_{a'}/\omega}}. \tag{30}$$

The taste shocks generate closures and switches among firms in the same state, and they make the choice probabilities smooth in the parameters.

4.4 Equilibrium

In equilibrium, the free-entry condition sets the demand shifter, and the mass of entrants is scaled so that the labour market clears.

4.4.1 Entry

Each period a large number of potential entrants can pay an entry cost c_e to start a firm. After paying the entry cost, the entrant learns the known component of its ability, Θ_i^K, so that its beliefs at entry are

$$s_E(\Theta_i^K) \;=\; \Big(\Theta_i^K,\; \mu_\Phi,\; 0,\; 0\Big). \tag{31}$$

The ability belief has variance $B_0 = \sigma_L^2$ and the match belief has variance $D_0 = \sigma_\Phi^2$, so expected productivity at entry is $X(s_E) = \exp\Big(\Theta_i^K + \mu_\Phi + (\sigma_L^2 + \sigma_\Phi^2)/2\Big)$. The entrant buys the capital of the business at its frictionless optimum given these beliefs,

$$k_0(\Theta_i^K) \;=\; \arg\max_k \;\pi^e\Big(s_E(\Theta_i^K), k\Big) - \Big(1/\beta - 1 + \delta_k\Big)\, k, \tag{32}$$

at a price of one per unit, and starts with no debt. It faces the death risk δ_d before it first operates, in which case its capital is liquidated at ρ. The value of entry is the expectation over entrant types,

$$V^E \;=\; \mathbb{E}_{\Theta^K}\Big[\,(1-\delta_d)\,V\Big(s_E(\Theta^K),\, k_0(\Theta^K),\, 0\Big) \;+\; \delta_d\,\rho\,k_0(\Theta^K) \;-\; k_0(\Theta^K)\Big], \tag{33}$$

and free entry requires

$$V^E(\Lambda) \;=\; c_e. \tag{34}$$

Since the value of a firm is convex in the ability belief, entrants with a high known ability account for a large part of V^E, and they enter with more capital.

4.4.2 Stationary distribution

Let $\nu(s, k, b)$ denote the stationary measure of firms at the start of a year. I construct it age by age from a unit inflow of entrants distributed over $(s_E(\Theta^K), k_0(\Theta^K), 0)$ according to the distribution of Θ^K. At each age a fraction δ_d of firms dies, the remaining firms continue, switch or exit according to the choice probabilities (30), and the firms

that continue or switch produce, with the signals of the year moving their beliefs by equation (14). Continuing firms move to their chosen capital and debt at their updated beliefs, while switching firms start the next year at the belief state $s^{+\prime}$ of equation (25), with the prior match belief and the capital and debt chosen for the new business. In a stationary distribution entry equals exit,

$$M^E \;=\; M \cdot \Big(\delta_d + (1-\delta_d)\Pr\{\text{exit}\}\Big), \tag{35}$$

where $\Pr\{\text{exit}\}$ is the probability that a firm that survives the start of the year exits. The mass of entrants M^E, and with it the mass of firms M, is scaled so that the labour market clears (Section 4.4.3).

4.4.3 Aggregation

Revenue in equation (8), and with it employment and operating profit, depends on aggregate conditions through the demand shifter

$$\Lambda \;\equiv\; w^{1-\sigma} P^{\sigma} Y. \tag{36}$$

Output is the CES aggregate of the output of all firms,

$$Y \;=\; \Big(\int y_i^{\frac{\sigma-1}{\sigma}}\, di \Big)^{\frac{\sigma}{\sigma-1}}, \tag{37}$$

with y_i the realised output of the technology in equation (7). Inputs depend only on the state of the firm, and among the firms in a given state the noise in the signals and the errors in beliefs average out, so aggregate output depends on productivity through the expected productivity $X(s)$ of each firm. I also report the CES productivity index

$$\mathcal{X}^{\sigma-1} \;\equiv\; \mathbb{E}\Big[\exp\Big((\sigma-1)(A+C)\Big)\Big], \tag{38}$$

where the expectation is over active firms, and I refer to $\mathcal{X}$ as the reallocation index. It is the CES mean over active firms of the productivity implied by the posterior means, $\exp(A+C)$, with each firm weighted equally, so it rises when the posterior means of the firms in operation are higher. I compute it over the firm–years of a simulated panel (Section 6), and Section 6.4 splits the change in output into productivity, capital, the mass of firms and labour in production.

Every outlay of a firm is paid in units of the wage: the capital it buys net of the capital it sells at ρ, the adjustment cost, the operating cost c, the cost of starting over $\lambda(s)$ and

the entry cost c_e. I assume that capital goods and these services are produced one for one from labour, so that every outlay is labour. Per firm in the stationary distribution, the labour used in outlays is

$$o \;=\; \bar{\iota}^{\,\text{net}} \;+\; \bar{\Psi} \;+\; c \;+\; \bar{\lambda} \;+\; c_e \,\frac{M^E}{M}. \tag{39}$$

Here $\bar{\iota}^{\,\text{net}}$ is the capital bought net of the capital recovered at ρ at switches, exits, defaults and deaths, $\bar{\Psi}$ is the adjustment cost and $\bar{\lambda}$ is the cost of starting over, each averaged over firms. With $\bar{n}$ the mean employment of a firm in production, the labour market clears when

$$\bar{N} \;=\; M\left(\bar{n} + o\right), \tag{40}$$

so that labour in production is $N = M\bar{n} = \bar{N} - Mo$. Final output is used only for consumption, $Q = Y$, and the household's budget constraint (6) holds with Π equal to the dividends of all firms net of the cost of entry. I measure welfare by the consumption-equivalent change between stationary equilibria, which with log utility and inelastic labour is $Q_1/Q_0 - 1 = Y_1/Y_0 - 1$, whatever the household's discount factor β_H, since consumption is constant within each stationary equilibrium. An outlay therefore lowers welfare through the labour it takes from production.

A stationary equilibrium consists of value and policy functions, a demand shifter Λ^*, a mass of entrants and a stationary distribution ν^* such that firms' policies solve their problem given Λ^*, free entry (34) holds, the distribution is stationary given the policies and entry, and the labour market clears, equation (40).

5 Calibration

5.1 Parameters set outside the model

I set the elasticity of substitution to $\sigma = 4$ and the interest rate on safe debt to $r_f = 0.04$, which is within the range of effective lending rates to UK small businesses (Bank of England, 2023; BVA BDRC, 2022). The capital share is $\alpha = 0.30$ and capital depreciates at $\delta_k = 0.10$ a year. The liquidation value of capital is set to $\rho = 0.40$. The closest evidence for the UK is on what creditors recover in administrations after the Enterprise Act, about 0.30 of their claims (UK Insolvency Service, 2023), and Section 6.2 reports the effects of lowering ρ to 0.30. Entrants start with no debt, and the mean of the known ability component is normalised to $\mu_\Theta = 0$. I normalise the demand shifter to $\Lambda^* = 1$ and set the entry cost to the resulting value of entry, $c_e = V^E(1)$, which is held fixed in the policy experiments.

The recorded accounts also contain a measurement error $\eta_t \sim N(0, \sigma_\eta^2)$, drawn independently across firms and years, which the owner does not see. Recorded employment is employment times $\exp((\sigma - 1)\,\eta_t)$, and recorded revenue is revenue times $\exp(\sigma\,\eta_t)$. The error is realised after decisions are made and does not enter the firm's problem or the owner's signals.

5.2 Parameters set by matching moments

The remaining fourteen parameters are chosen to minimise the distance between moments in the data, $\widehat{m}$, and the same moments in a simulated panel of firms, $m(\vartheta)$,

$$\widehat{\vartheta} \;=\; \arg\min_{\vartheta} \sum_{h} W_h \left(\frac{m_h(\vartheta) - \widehat{m}_h}{|\widehat{m}_h|} \right)^2 , \tag{41}$$

where dividing by the absolute value of the data moment keeps the dispersion of employment growth, which is large in levels, from dominating the other moments.

The targeted moments are listed in Table 4. They cover the serial-entrepreneur share and premium, firm size and the dispersion of employment growth, three exit moments, the variance decomposition and the transitory dispersion of productivity, and leverage and insolvency. The exit moments come from the life table in Table 10, the variance share and the transitory standard deviation from the variance decomposition of Section 3.4 on log TFP, and the premium from column (2) of Table 9. The serial-entrepreneur share, the size medians, the dispersion of employment growth and mean leverage are computed on linkable companies, whose owners are observed in the register, and Appendix A.5 gives the model counterparts of the share and the premium. Measured TFP in the model is computed from recorded revenue, employment and capital as in the data, so it contains the noise in realised productivity as well as the measurement error.

I do not target median employment of serial-entrepreneur firms, which selects owners of larger companies and of company groups (Section 3.3), the employment growth premia, the dispersion of log employment among serial-entrepreneur firms at age five or the timing of switches by ability.

Ability is dispersed mainly in the component that the entrepreneur knows at entry, $\sigma_K = 0.49$, with a further $\sigma_L = 0.34$ learned from the signals (Table 3). The total dispersion of ability is therefore 0.60, and the entrepreneur knows about two thirds of its variance at entry. The noise in the ability signal, $\sigma_\varepsilon = 0.17$, is small relative to σ_L, so the posterior standard deviation of ability in equation (13) falls from 0.34 at entry to 0.07 after five observations.

Table 3: Calibrated parameters

Parameter	Description	Value
Ability and match quality		
σ_K	Dispersion of ability known at entry	0.492
σ_L	Dispersion of ability learned from signals	0.339
σ_ε	Noise in ability signal	0.168
σ_Φ	Dispersion of match quality	0.042
σ_u	Noise in match-quality signal	0.486
μ_Φ	Mean match quality	0.811
Operation, exit and finance		
c	Operating cost	2.191
δ_d	Probability of exogenous death	0.0057
ψ	Capital adjustment cost	3.546
β	Discount factor	0.937
ω	Scale of taste shocks	5.332
Starting over		
κ	Base cost of starting over	5.151
ζ	Ability slope of the cost of starting over	12.15
χ	Fraction of capital redeployed at a switch	0.80

In contrast, owners learn very little about their match. Match quality is much less dispersed than ability, with $\sigma_\Phi = 0.042$ around a mean of $\mu_\Phi = 0.81$, and the noise in the match signal, $\sigma_u = 0.49$, is 11.6 times this dispersion. The posterior variance of match quality therefore halves after $\sigma_u^2/\sigma_\Phi^2 \approx 135$ observations, more than a century of annual signals, and across owners the standard deviation of match beliefs is 0.008 after five years, against 0.042 for match quality itself.[12]

The operating cost is $c = 2.19$ in units of the annual wage, about £66,000 a year at £30,000 per unit, close to the median gross annual earnings of full-time employees in the UK over the sample period (Office for National Statistics, 2025). The discount factor is $\beta = 0.937$, below the discount factor of the household and the lenders, $\beta_H = 1/(1+r_f) = 0.962$, so firms, whose decisions are taken by undiversified owner-managers, discount the future more than lenders and borrow more against their capital. The adjustment cost parameter is $\psi = 3.55$, the exogenous death probability is $\delta_d = 0.006$, and the scale of the taste shocks is $\omega = 5.33$, or about £160,000.[13]

The base cost of starting over is $\kappa = 5.15$, about £155,000 or 2.35 times the annual

[12]The posterior standard deviation of match quality falls from 0.042 to 0.041 over the first five observations, and the standard deviation of match beliefs across owners is 0.015 after twenty years. The noise of the two signals together, $(\sigma_\varepsilon^2 + \sigma_u^2)^{1/2} = 0.51$, is the transitory variation of realised productivity in equation (11).

[13]The scale of the taste shocks is 2.4 times the operating cost and 0.16 of the value of entry at the mean entrant type.

operating cost. The average switcher pays $\lambda = 20.6$ units, about £617,000 and 4.0 times κ.

5.3 Model fit

Moment	Data	Model
Targeted		
Serial-entrepreneur share	0.1925	0.189
Log TFP premium of serial entrepreneurs	0.245	0.248
Median employment, regular firms	4	6.96
SD of employment growth (pp)	28.43	24.55
Exit hazard at age one	0.0998	0.079
Pooled exit hazard, ages 1–10	0.0629	0.063
Five-year survival	0.660	0.664
Entrepreneur share of productivity variance	0.566	0.799
Transitory SD of log TFP	0.555	0.522
Mean leverage	0.229	0.253
Insolvency rate (percent a year)	0.37	0.38
Not targeted		
Event-study contrast, log TFP	0.093	−0.085
	(0.016)	
Median employment, serial-entrepreneur firms	38.9	33.2
Switch timing by ability (years per SD)	−0.13	−1.64
	(0.07)	
Employment growth premium, age-controlled (pp)	0.39	0.95
Employment growth difference, unconditional (pp)	0.22	0.81
SD of log employment, serial firms at age five	1.88	1.23

Table 4: Moments in the data and in the calibrated model.

The model matches the serial-entrepreneur share and the log TFP premium closely, at 0.189 and 0.248 against 0.1925 and 0.245 in the data (Table 4). The pooled exit hazard and five-year survival are also close to the data, but the hazard at age one is lower, 0.079 against 0.100. In the model the hazard falls to 0.028 at age ten, against 0.038 in the data, but it dips to 0.067 at age two and peaks at 0.112 at age three. The dip and the peak arise because no switch is decided at the start of the second year (Section 4.2.2) and a switch ends a business in the life table.

Mean leverage, the insolvency rate and the transitory standard deviation of log TFP are close to the data. The model has less dispersion in employment growth and larger regular firms than the data, so that the median serial-entrepreneur firm, which is not targeted, is 4.8 times the size of the median regular firm in the model and 9.7 times in the data.

At the estimate, switchers are selected on ability, so serial entrepreneurs are more able

than other owners. Since match beliefs stay close to their prior, a new business differs little in expected match quality from the current one, so switches are triggered mainly by the taste shocks once the owner's ability belief has become sufficiently positive. The cost of starting over, which falls with the ability belief, determines which owners act on them. The cost falls by 8.1 units of the wage for each standard deviation of the ability belief among owners, which is 1.5 times the scale of the taste shocks. All else equal, each standard deviation of the belief therefore multiplies the odds of switching rather than continuing by about 4.6. In the simulated panel the mean ability of switchers is 0.73, against 0.53 over all firm–years, and this advantage is present before the switch, since switchers keep their ability in the new business. The businesses they close have a mean match quality of 0.803, against 0.815 over all firm–years.

The event study of Section 3.5, run on the simulated panel with the same estimator and sample restrictions, gives a contrast of -0.085, against 0.093 in the data. The permanent part of productivity, ability and match quality, contributes only -0.008 to this difference, and the transitory part of measured productivity -0.078. The transitory part is negative because switchers are selected on poor realisations of the noisy match signal. An owner decides to switch at the start of the last year of the closing business, so the last match signal before the decision comes from $r = -2$, and over all switches the noise in this signal is on average negative. Since the match belief averages all the match signals of the business, the selection on the noise also lowers measured productivity in the years $r \leq -3$. When the match is known, so that the belief does not respond to this noise, the equivalent value is -0.020 (Table 6). In the data, by contrast, the second business of an owner is less productive than the first at the same age (Section 3.5), which suggests that switches in the data do not move owners from poorly matched businesses to better ones.

Switch timing by ability, the years of tenure at the first switch per standard deviation of the owner's ability among closure-dated switchers, is -1.64 in the model and -0.13 in the data.[14] The slope is steep in the model because part of switching responds to news about ability, which arrives within the first few years (Section 6.3). As an owner's ability belief rises, the cost of starting over falls, so more able owners act on the taste shocks earlier.

The model attributes more of the variance of productivity to the entrepreneur than the data do. Its counterparts of the owner and business variances of Section 3.4 are the variance of total ability, $\sigma_K^2 + \sigma_L^2$, and of match quality, σ_Φ^2, whose ratio $(\sigma_K^2 + \sigma_L^2)/(\sigma_K^2 +$

[14] In the data the ability proxy is the owner's leave-one-out mean log TFP across businesses, over 1,071 owners whose first business closed before the second was incorporated. The model statistic is computed on the simulated panel with the same definition.

$\sigma_L^2 + \sigma_\Phi^2$) is 0.995. The variance decomposition, applied to the simulated panel with the same adjustments and sample selection as in the data, gives an entrepreneur share of 0.799, against 0.566 in the data. Finally, the model overstates the employment growth premium of serial entrepreneurs, at 0.95 percentage points a year after controlling for age, against 0.39 in the data.

5.4 The stationary equilibrium

At the calibrated parameters, the entry cost is $c_e = 269.5$ in units of the wage. This is the value of entry averaged over entrant types, while the value of entry at the mean type is 33.9, since entrants with a high known ability account for a large part of V^E (Section 4.4). The average entrant buys 72.2 units of capital, and 2.7 percent of entrants start at the upper end of the capital grid, 1,000 units.[15] Mean employment is 105.8 and mean capital is 144 units, against a median of about seven employees among regular firms in the simulated panel, because the entrants with a high known ability form a long right tail of large firms.

6 Counterfactuals

I run three sets of experiments at the estimate. The first lowers the cost of starting over, as lower administrative and legal costs of restarting or less stigma attached to business failure would. I cut the base switching cost κ by 25% and by 50%, and finally remove all together. The second experiment raises the liquidation value from 40% to 50%, reflecting faster or cheaper insolvency procedures. The final experiment gives firms full information about their ability and match quality. This is undoubtedly a difficult policy counterfactual to implement in practice but I do so to understand how information uncertainty contributes to the aggregate dynamics, as well as bound the effects from the other two experiments.

In implement each experiment holding the entry cost constant at its calibrated value, and solve for the demand shifter Λ^* that ensures free entry holds.

Labour demand gives the same expected revenue per worker, $\mu w/(1-\alpha)$, in every firm, so total revenue PY is proportional to labour in production, $N = \bar{N} - Mo$ in equation (40). Since the demand shifter is $\Lambda = P^\sigma Y$, the price index satisfies $P^{\sigma-1} \propto \Lambda/N$, so output moves with labour in production and with the value of the demand shifter that satisfies

[15] The elasticity of the value of entry with respect to the demand shifter is 0.95.

free entry,

$$\Delta \ln Y \;=\; \mu\, \Delta \ln N \;-\; \frac{\Delta \ln \Lambda^*}{\sigma - 1}. \tag{42}$$

A reform that raises the value of entry therefore lowers Λ^* and raises output, less μ times any fall in labour in production. I also report the reallocation index $\mathcal{X}$ of equation (38), the CES mean over active firms of the productivity implied by their beliefs, computed on the simulated panel. The text gives changes in percent, and the tables give them as 100 times the log difference from the baseline.

I measure welfare by the consumption-equivalent change between steady states, $Q_1/Q_0 - 1$ (Section 4.4.3). Every outlay of the firms is labour, so consumption equals output, and the welfare change is the percentage change in output. I report welfare under two treatments of the cost of starting over.

6.1 Lowering the cost of starting over

Table 5: The cost of starting over and the liquidation value of capital in the free-entry general equilibrium.

		Base cost of starting over κ			Liquidation value ρ	
	Baseline	$\times 0.75$	$\times 0.5$	0	0.50	0.30
Aggregates						
Demand shifter Λ^*	1.000	0.995	0.988	0.916	0.994	1.005
Output Y		+0.11	+0.13	+2.01	+0.26	−0.22
Reallocation index $\mathcal{X}$		−0.20	−0.64	−3.21	+0.10	−0.16
Aggregate capital K		−0.32	−1.72	−2.83	+0.16	−0.35
Labour in production (baseline = 1)	1	0.9995	0.9980	0.9931	1.0005	0.9997
Mass of firms (baseline = 1)	1	1.0070	1.0386	1.2088	0.9963	1.0018
Welfare, resource cost (percent)		+0.11	+0.13	+2.03	+0.26	−0.22
Welfare, private cost (percent)		+0.18	+0.41	+1.76	+0.28	−0.23
Rates per 100 firms a year						
Switching	1.25	1.95	4.11	33.67	1.34	1.18
Entry	1.50	1.49	1.48	1.37	1.51	1.49
Exit and default, excluding death	0.93	0.92	0.91	0.80	0.94	0.92
Insolvent exit or default, $b > \rho k$, excluding death	0.148	0.161	0.170	0.205	0.162	0.178
Serial entrepreneurs						
Serial-entrepreneur share	0.189	0.272	0.458	0.939	0.199	0.181
Log TFP premium	0.248	0.147	−0.014	−0.054	0.246	0.243
Firm size and productivity						
Mean employment per firm	105.8	105.0	101.6	86.9	106.2	105.5
Median employment, firm–years	23.4	23.0	22.2	16.7	23.4	23.3
Employment-weighted mean employment	507.5	506.4	491.4	459.4	506.5	508.1
Mean log productivity, per firm		−0.05	−0.55	−4.50	+0.38	−0.16
Mean log productivity, employment-weighted		+0.08	−0.28	−0.33	+0.09	−0.06

Lowering the cost of starting over by a quarter raises the switching rate by half, from 1.25 to 1.95 per 100 firms a year, and the serial-entrepreneur share from 0.189 to 0.272 (Table 5). Welfare rises by 0.11 percent with a resource cost and by 0.18 percent with a

private cost. The gain comes from the number of firms, which rises by 0.7 percent and more than offsets a small fall in the reallocation index (Section 6.4).

The premium of serial entrepreneurs falls from 0.248 to 0.147, because the cost of starting over rises steeply as the ability belief falls. With $\zeta = 12.1$ in equation (26), a proportional cut in κ removes the most cost for the least able owners, so the additional switchers are less able than those who switch at the baseline. In the stationary distribution, the mean ability belief of switchers exceeds that of all firms by 0.075, against 0.163 at the baseline, and the mean cost per switch falls from 20.6 to 16.8 units of the wage.

Removing the cost of starting over altogether raises the switching rate to 34 per 100 firms a year, since a switch then costs only the loss on the capital that is not redeployed, and serial entrepreneurs then run 94 percent of firms. Removing the cost raises the value of entry, so the demand shifter falls to 0.916 and firms are smaller, with mean employment of 86.9 against 105.8. With a fixed labour force, the labour market then clears with 21 percent more firms (equation (40)). Output rises by 2.0 percent, and welfare by 2.0 percent with a resource cost and 1.8 percent with a private cost. Welfare rises by more with a resource cost, since the labour used in the cost of starting over at the baseline returns to production.

The additional switchers are less able. In the simulated panel, the gap in true ability between the owners who have switched by age 3 and those who have not falls from 0.21 to -0.23, and the premium turns negative, at -0.054, measured against the 6 percent of firms that remain regular. The gain in output therefore comes from the number of firms. The reallocation index falls by 3.2 percent, and the loss is concentrated in small firms.

6.2 Raising the liquidation value of capital

The liquidation value of capital works through exits and defaults as well as through switches. It sets the value of the capital that a switcher does not redeploy, of the whole capital stock of firms that exit, default or die, and so of the collateral that lenders price in equation (22). Raising ρ from 0.40 to 0.50 raises output and welfare by 0.26 percent with a resource cost, and welfare by 0.28 percent with a private cost, more than cutting the cost of starting over by a quarter under either treatment.

Switching rises from 1.25 to 1.34 per 100 firms a year, while the premium is almost unchanged, at 0.246 against 0.248. In contrast to a lower κ, a higher liquidation value lowers the cost of a switch in proportion to capital, $(1 - \rho)(1 - \delta_k - \chi)k$, and the able owners run the largest businesses, so the additional switchers are as able as the others. The mean ability belief of switchers exceeds that of all firms by 0.169, against 0.163 at

the baseline. The gain in output comes from productivity, while the number of firms falls slightly (Table 7). A higher ρ also raises the value of exit and default, $\rho k - b$, and insolvent exit and default, by firms with $b > \rho k$, rise from 0.148 to 0.162 per 100 firms a year. Lowering ρ to 0.30 has the opposite effects.

6.3 The role of learning

At the estimate the match belief stays close to its prior (Section 5.2), and switchers are selected on ability rather than on poor matches (Section 5.3). To measure how learning about ability and the match shapes switching, output and welfare, I solve the model in three information regimes, holding every parameter at the estimate (Table 6). With full information, entrants know their ability Θ_i and the quality of their match Φ_j, and an owner who switches learns the quality of the new match when the business starts. With ability known, or with the match known, the other component is learned as in the calibrated model. In each regime realised productivity still contains the noise of the two signals, and the posterior variance of a known component in equation (15) is zero. No policy in the model delivers this information, so the regimes measure the role of learning in the model rather than the effect of a policy.

Table 6: Learning against full information.

		General equilibrium			Fixed prices		
	Learning	Full information	Ability known	Match known	Full information	Ability known	Match known
Selection							
Median age at first switch, top quartile	8	3	14	3	1	14	3
Share of top quartile switched by age 3	0.167	0.379	0.077	0.382	0.407	0.050	0.410
Share of top quartile switched by age 10	0.425	0.528	0.241	0.640	0.549	0.232	0.658
Share of top quartile that ever switches	0.718	0.644	0.594	0.759	0.651	0.590	0.762
Ability gap, switched minus not, at age 3	0.206	0.534	0.481	0.428	0.540	0.435	0.424
Serial-entrepreneur share	0.189	0.166	0.137	0.229	0.161	0.130	0.223
Log TFP premium	0.248	0.267	0.253	0.275	0.256	0.266	0.277
Event-study	−0.085	−0.043	−0.139	−0.020	−0.035	−0.156	−0.014
Aggregates							
Demand shifter Λ	1	0.808	0.889	0.907	1	1	1
Switching rate per 100 firms	1.25	0.90	0.68	1.89	0.87	0.66	1.78
Reallocation index $\mathcal{X}$		+5.65	+0.74	+4.69	+3.23	−0.04	+3.55
Output Y		−0.07	−3.42	+3.57	−5.69	−6.74	+1.00
Aggregate capital K		+27.30	+27.71	−1.08	+26.03	+28.17	−1.93
Labour in production (baseline = 1)	1	0.9476	0.9465	1.0023	0.9582	0.9507	1.0075
Mass of firms (baseline = 1)	1	1.038	1.076	0.946	0.957	1.013	0.912
Welfare, resource cost (percent)		−0.07	−3.36	+3.64	−5.53	−6.51	+1.00
Welfare, private cost (percent)		−0.14	−3.46	+3.71	−5.62	−6.62	+1.06
Mean employment per firm	105.8	96.5	93.0	112.1	105.9	99.2	116.9
Employment-weighted mean employment	507.5	402.3	389.6	529.0	444.1	416.1	550.0

With full information, able owners switch earlier, so learning delays the switches of the most able. In general equilibrium, the most able quarter of owners, ranked by true ability,

first switch at a median age of 3 instead of 8, and 0.38 of them have switched by age 3, against 0.17 under learning. Fewer of them ever switch, 0.64 against 0.72, which suggests that under learning able owners also leave good matches, since they cannot tell them from poor ones. Switching is also more closely tied to ability, as the gap in true ability between the owners who have switched by age 3 and those who have not rises from 0.21 to 0.53.

However, full information leaves output and welfare almost unchanged in general equilibrium, since the fall in labour in production is offset by a fall in the demand shifter. Entrants who know their total ability enter at a larger scale, since the frictionless capital of equation (32) is convex in productivity. The mean entrant buys 90.1 units of capital, against 72.2 at the baseline, so more of the labour force produces capital goods and less works in production. At fixed prices, where output moves only with labour in production, this lowers welfare by 5.5 percent. However, an entrant who knows its ability and its match exits or switches immediately if its ability or match is poor and grows if they are good, so at $\Lambda = 1$ the value of entry exceeds the entry cost by 22 percent. Free entry therefore lowers the demand shifter by 19 percent, to 0.81, which offsets almost all of the loss. Output and welfare fall by 0.07 percent with a resource cost and welfare by 0.14 percent with a private cost, while aggregate capital rises by 31 percent and the reallocation index by 5.8 percent.[16]

In general equilibrium, knowing only the match raises welfare by 3.6 percent with a resource cost and 3.7 percent with a private cost, while knowing only ability lowers it by 3.4 and 3.5 percent. At fixed prices the two raise the value of entry by similar amounts, 10 percent with the match known and 12 percent with ability known, so the difference between them lies in labour in production. With ability known, labour in production falls by 5.4 percent, as with full information, while with the match known it rises by 0.2 percent. A known match is worth 3.6 percent because owners would otherwise learn little about their match, so it lets those in poor matches switch early, which is worth most to able owners, who run the largest businesses. Since revenue has returns to scale of $1/\mu = 3/4$ in capital and labour, the operating profit of a business at its frictionless scale rises with the fourth power of its productivity. A match one standard deviation better, 0.042 higher in logs, therefore raises it by about 18 percent.

[16]By equation (42), the fall in the demand shifter adds 7.1 to 100 times the log change in output, and the fall in labour in production, 5.2 percent, takes away 7.2. Per firm of the baseline, the outlays take 5.5 more units of labour, of which 4.7 produce capital goods and 0.8 pay adjustment costs. At fixed prices the share of the labour force in the firms' outlays rises from 18.5 to 21.9 percent. The index values firms at the productivity implied by their posterior means. Valuing them instead at their expected true productivity given their beliefs, $X(s)$ in equation (15), which adds half the posterior variances, gives gains of 2.9 percent at fixed prices and 5.4 percent in general equilibrium, against 3.3 and 5.8 percent.

With only the match known, owners switch more and earlier. The switching rate rises from 1.25 to 1.89 per 100 firms a year, and 0.38 of the most able quarter have switched by age 3, against 0.17 under learning. Output rises by 3.6 percent and the reallocation index by 4.8 percent. At fixed prices, knowing only the match raises welfare by 1.0 percent, since the share of labour in the firms' outlays falls to 17.9 percent.

With only ability known, owners switch less and later. The switching rate falls from 1.25 to 0.68 per 100 firms a year, and the most able quarter first switch at a median age of 14. This suggests that under learning part of the switching responds to news about ability, since the value of a new business rises and the cost of starting over falls with the ability belief. With ability known, the least able owners exit in their first year, since the exit hazard of the least able quarter, pooled over ages 1 to 3 and excluding deaths, is 1.00, against a pooled hazard of 0.72 under learning.

At the estimate, removing κ raises welfare by 1.8 to 2.0 percent, about half as much as knowing the match in general equilibrium, 3.6 to 3.7 percent, while full information leaves welfare almost unchanged. Not observing the match therefore lowers welfare by more than the cost of starting over does, while not observing ability at entry raises welfare once entry adjusts.

6.4 Decomposition of output

I split the change in output into productivity, capital deepening, the number of firms and labour in production (Table 7),

$$\Delta \ln Y \;=\; \underbrace{\Delta \ln \mathcal{X}_B + \Delta \ln \mathrm{AE} + \Delta \ln \mathrm{IM}}_{\text{productivity}} \;+\; \alpha\, \Delta \ln K \;+\; \frac{\Delta \ln M}{\sigma - 1} \;+\; (1-\alpha)\, \Delta \ln N. \quad (43)$$

Here $\mathcal{X}_B = \left(\int X^{\sigma}\, d\nu \right)^{1/(\sigma-1)}$ is aggregate productivity at the efficient allocation of inputs across firms, K is aggregate capital, M is the mass of firms and N is labour in production. Allocative efficiency, AE, measures the productivity of the actual allocation of inputs relative to the efficient one, and the input mix, IM, reflects how capital and labour are combined within firms.[17] The terms add up to equation (42) in every experiment.

Cutting the cost of starting over raises output through the number of firms, while raising ρ to 0.50 raises it through productivity. When κ is removed, the larger number of firms more than offsets lower productivity, less capital and less labour in production. Labour in production falls because the share of labour in the firms' outlays rises from 18.52 to 19.08

[17] With $l = k^{\alpha} n^{1-\alpha}$, ν normalised to integrate to one and bars denoting means over firms, $\mathrm{AE} = \Omega^{\mu} / \mathcal{X}_B$ with $\Omega = \int X\, (l/\bar{l})^{1/\mu}\, d\nu$, and $\mathrm{IM} = \bar{l} / (\bar{k}^{\alpha} \bar{n}^{1-\alpha})$.

Table 7: Decomposition of output in the free-entry general equilibrium, with the cost of starting over as a resource cost. The terms are contributions to 100 times the log change in output, follow equation (43) and are computed on the stationary distribution. Terms may not add up to the total because of rounding. The share of labour in outlays is $o/(\bar{n}+o)$ in equation (40), which is 18.52 percent at the baseline.

	Base cost of starting over κ			Liquidation value ρ	
	$\times 0.75$	$\times 0.5$	0	0.50	0.30
Efficient index $\mathcal{X}_B$	-0.08	-0.48	-3.16	$+0.28$	-0.09
Allocative efficiency AE	$+0.05$	-0.02	$+0.07$	$+0.01$	-0.03
Input mix IM	$+0.04$	$+0.02$	$+0.12$	$+0.01$	-0.02
Productivity	$+0.01$	-0.48	-2.98	$+0.30$	-0.15
Capital deepening $\alpha\Delta \ln K$	-0.09	-0.52	-0.85	$+0.05$	-0.11
Variety $\Delta \ln M/(\sigma-1)$	$+0.23$	$+1.26$	$+6.32$	-0.12	$+0.06$
Labour in production $(1-\alpha)\Delta \ln N$	-0.04	-0.14	-0.49	$+0.04$	-0.02
Total	$+0.11$	$+0.13$	$+2.01$	$+0.26$	-0.22
Share of labour in outlays (percent)	18.56	18.68	19.08	18.48	18.54
Welfare, resource cost (percent)	$+0.11$	$+0.13$	$+2.03$	$+0.26$	-0.22
Welfare, private cost (percent)	$+0.18$	$+0.41$	$+1.76$	$+0.28$	-0.23

percent, since the larger number of firms pays more in operating and entry costs than is saved on the cost of starting over and on adjustment costs. The gain from removing κ comes through the variety term $\Delta \ln M/(\sigma-1)$, so it scales with $1/(\sigma-1)$ and would be about half as large at $\sigma = 6$, holding the other terms fixed.

7 Conclusion

Ownership records for UK companies show that the productivity premium of serial entrepreneurs reflects a permanent characteristic of the entrepreneur. The entrepreneur accounts for 56.6 percent of the permanent variance of log TFP among the businesses of owners of several firms, and productivity is not higher after a switch than before it. Moreover, owners who start again after a closure ran more productive businesses than owners who do not. The model represents this characteristic as ability.

In the calibrated model, switchers are selected on ability. Match quality varies little across businesses, with a standard deviation of 0.04 against 0.60 for ability, and entrepreneurs learn it slowly, so who switches depends on the ability belief, through the cost of starting over. Learning delays the switches of the most able, and knowing the match would raise welfare by 3.6 percent, since owners in a poor match could then switch early. I find that the full information benchmark actually has a negligible effect on aggregate welfare. Entrants who know their ability in the full information counterfactual enter closer to their optimal scale and consequently use more labour to produce capital.

It is important to note that the calibrated model attributes substantially more of the variance of productivity to the entrepreneur than the data. Obvious next steps are to discipline the model to the ex-ante and ex-post productivity life cycles of Pugsley et al. (2021) and examine the welfare gains or losses of policies in that setting.

A Data Appendix

A.1 Sample construction

The panel described in Section 3.1 is built from the Orbis Historical extracts in the following steps, and Table 8 reports the number of firms and firm–years at each step.

1. The company table (legal information, incorporation dates and current status) is merged with the financial table (employment, operating revenue, total assets and debt) on the Bureau van Dijk firm identifier.
2. duplicate firm–year observations are removed
3. Firm–years with non-positive employment or operating revenue are dropped.
4. I keep firms whose identifier contains a Companies House registration number, that is, identifiers made up of the country code and either eight digits or one of the two-letter prefixes of the register followed by six digits. The other identifiers belong to Market Location records of unincorporated businesses, which have a single observation, no incorporation date and no balance sheet, and to charities and to bodies registered in the Channel Islands, the Isle of Man or abroad. None of these can appear in the register of Persons of Significant Control. Each registration number belongs to exactly one firm of the panel.
5. Firm age is the fiscal year minus the year of incorporation recorded at Companies House.[18]
6. Employment growth is computed from equation (2) for consecutive years only.
7. A firm is coded as closed if its status is dissolved, inactive, in liquidation, closed or struck off. The exit of a closed firm is dated to the last fiscal year in which it reports positive revenue or employment in the Orbis financial records. For many firms these records extend beyond the last year in which the firm meets the requirements of the panel. Status is recorded at the firm level, so gaps in a firm's reporting are not coded as exit.

[18]Incorporation dates come from the legal-information table. Where the incorporation date is missing, the first year in which the firm appears in the panel is used instead.

8. Debt is long-term debt plus short-term loans, with a missing component set to zero, and leverage is debt divided by total assets.

The restriction to firm–years with at least two employees, used for the exit, survival, median-employment and leverage moments, is applied when those moments are computed.

Table 8: Construction of the sample. The panel keeps one observation per firm and fiscal year in 2005–2024 with positive employment and revenue. Linkable companies are those whose registration number appears in the PSC register with an owner of at least 25 percent. A serial entrepreneur holds significant control in between two and twenty companies of the panel.

	Firms	Firm–years
Orbis panel	1,176,076	2,295,497
less: Market Location records of unincorporated businesses	750,725	750,725
less: other identifiers without a Companies House number	10,733	34,798
Companies with a Companies House number	414,618	1,509,974
of which linkable to the PSC register	204,957	556,577
of which run by a serial entrepreneur	39,448	158,816
Persons in the register matched to a panel company		279,236
of which serial entrepreneurs		21,490
Estimation samples		
Productivity premium, column (2) of Table 9	394,917	1,458,851
Productivity premium, column (4) of Table 9	178,294	471,090
Employment growth premia (linkable companies)		330,453
Life table (Table 10)	169,890	
Variance decomposition (11,236 entrepreneurs)	26,643	103,816
Event study, all firm–years (5,146 entrepreneurs)		47,454
of which with log TFP (5,132 entrepreneurs)		47,179

A.2 Linkage to the PSC register

The ownership linkage of Section 3.2 proceeds as follows.

1. The Companies House number of each company is its Orbis identifier without the country code.

2. PSC records are restricted to those that report ownership of more than 25 percent of shares or voting rights, that is, the register's bands of 25 to 50, 50 to 75 and 75 to 100 percent. Corporate and trust owners are dropped and only natural persons are kept.

3. The register has no person identifier that is common across companies, so I construct one from surname, first name, and month and year of birth, after converting to lower

case and removing spaces. Month and year of birth are mandatory fields, which reduces false matches compared with a key based on names alone

4. The PSC records are merged with the panel on the Companies House number. A company is classified as linkable if its registration number appears in the filtered register, whether or not it is linked to a multi-firm owner.

5. A person is a multi-firm owner if the person holds significant control in between 2 and 20 companies of the panel, counted by registration number.

6. For each matched person, the companies in the register in which the person holds more than 25 percent, including companies outside the panel, are ordered by date of incorporation. A company is closed if its status is dissolved, inactive, in liquidation or struck off, and the closure is dated to the last year for which the company files accounts. Two consecutive companies are held sequentially if the earlier one closes no later than two years after the later one is incorporated, and at the same time if the earlier one has not closed by then.

7. In the baseline, all companies of multi-firm owners are classified as run by a serial entrepreneur, following Lafontaine and Shaw (2016). A sequential-only classification, which requires that all of an owner's consecutive companies are held sequentially and that at least one closes between one year before and two years after the incorporation of the next, is used as a robustness check.

Filing with the register became mandatory in April 2016, so coverage starts at that date for firms that were already trading and at incorporation for firms formed later. The serial-entrepreneur share is therefore computed among linkable firms, in both the numerator and the denominator.

A.3 Productivity premia and exit

Table 9 reports the productivity premium of serial entrepreneurs under four specifications. Column (2) is the specification used in the text and in the calibration. It compares serial-entrepreneur firms with all other companies of the panel, with age dummies and fixed effects for 4-digit industry by year, and gives a premium of 0.245. Column (3) compares serial-entrepreneur firms only with other companies whose owners are observed in the register and gives 0.511. Companies that cannot be linked to the register are mostly owned by other companies and are more productive, so leaving them out of the comparison raises the premium. Column (4) also excludes holding and property companies, whose revenue and assets do not measure the output and capital of an operating business, and

gives 0.538. Table 10 reports the life table from which the exit and survival moments are taken.

Table 9: Productivity premium of serial entrepreneurs. Coefficient on an indicator for firms run by a serial entrepreneur in regressions of log TFP and of log labour productivity, measured as log revenue per employee. Log TFP is $\log\left(\text{revenue}/(\text{emp}^{1-\alpha}k^{\alpha})^{1/\mu}\right)$ with k total assets, $\alpha = 0.30$ and $\mu = 4/3$. Industry is the 4-digit NACE code. Holding and property companies are NACE codes 6420, 6430, 6810, 6820 and 7010. Standard errors, clustered by firm, are in parentheses.

	(1)	(2)	(3)	(4)
Log TFP	0.436	0.245	0.511	0.538
	(0.009)	(0.008)	(0.009)	(0.010)
Log labour productivity	0.394	0.184	0.478	0.493
	(0.009)	(0.009)	(0.010)	(0.010)
Age controls	Linear	Dummies	Dummies	Dummies
Industry × year effects	No	Yes	Yes	Yes
Companies	All	All	Linkable	Linkable
Holding and property companies	Included	Included	Included	Excluded
Firm–years (log TFP)	1,491,425	1,458,851	535,260	471,090
Serial-entrepreneur firms	38,977	38,123	38,123	30,319

A.4 Comparisons across an owner's businesses

The comparisons in Section 3.5 use the following samples and definitions.

1. Productivity is winsorised at the 1st and 99th percentiles of the panel. For Table 2, it is adjusted for 4-digit industry and calendar-year effects, estimated together with firm-age effects on all firm–years of multi-firm owners without firm fixed effects. Age effects are then absorbed by firm-age fixed effects in each regression.

2. An owner's first two businesses are the two earliest-incorporated companies, incorporated in different years. Panel A of Table 2 uses owners with at least one firm–year of each business at ages one to five. The order of a business is one plus the number of the owner's companies incorporated in an earlier year, top-coded at four. Years of prior ownership add up, over the owner's earlier companies, the years from incorporation to closure or to the incorporation of the business in question, whichever comes first.

3. The comparison of owners who start again with other owners uses companies that closed between 2019 and 2022, so that the register, which starts in 2016, covers at least three years before each closure. For this comparison, a closure is dated to the last year in which the company appears in the panel, the last year in which

Table 10: Exit hazard by firm age. Life table for companies incorporated in 2005–2022 that have at least two employees in some year. A company enters the risk set in the first year in which it has at least two employees, age is the fiscal year minus the year of incorporation, and the exit of a closed company is dated to the last year in which it reports positive revenue or employment.

Age	At risk	Exits	$h(a)$	$S(a)$
1	45,320	4,522	0.0998	0.900
2	60,501	5,321	0.0879	0.821
3	66,305	5,256	0.0793	0.756
4	68,793	4,712	0.0685	0.704
5	68,176	4,262	0.0625	0.660
6	66,193	3,794	0.0573	0.622
7	63,466	3,330	0.0525	0.590
8	60,340	2,714	0.0450	0.563
9	56,688	2,305	0.0407	0.540
10	51,627	1,965	0.0381	0.520

$h_1 = 0.0998$; $\bar{h}_{1\text{–}10} = 0.0629$; $S_5 = 0.660$; companies 169,890

its revenue and employment are both observed, so that its labour productivity is measured up to the closure. Its TFP is measured in those years in which its total assets are also positive. For companies whose financial records continue after they leave the panel, this date is earlier than the one used for the exit statistics (Appendix A.1). The owners are those who still held significant control in the year before the closure or later, and who held no other company in which their control started more than two years before the closure. An owner starts again if the owner's significant control of another company, new or existing, starts between two years before and three years after the closure. Notifications made when the register opened, in 2016 and 2017, for companies incorporated by 2015 are treated as control that started before 2016.

4. Productivity differences between owners who start again and other owners compare closing companies in the same cell of age, 2-digit industry and calendar year, in the last three years before closure. In Figure 2, the closing companies are compared with companies in the register that do not close and are not linked to a multi-firm owner, in the same cell of age, 2-digit industry and year. Panel (b) adds a firm fixed effect and measures productivity relative to five or more years before closure.

A.5 Moment definitions

Table 11 defines the data moments. In the model, the serial-entrepreneur share is the share of businesses whose owner runs two or more businesses within a nine-year window,

the span of the ownership register. The premium compares the businesses of owners who ever switch in the panel with those of owners who do not, controlling for the age of the business.

Table 11: Definitions of the data moments. "All companies" is the panel of Section 3.1. "Linkable" is the set of companies whose registration number appears in the PSC register, and "Linkable, two or more employees" restricts it to firm–years with at least two employees. "Life table" is the sample of Table 10. "Two or more employees" is the sample of firm–years with at least two employees, and "Ever two or more employees" is the set of companies with at least two employees in some year.

Moment	Definition	Sample
Serial-entrepreneur share	$\dfrac{\#\{i : \mathrm{SE}_i = 1\}}{\#\{i : \mathrm{linkable}_i = 1\}}$	Linkable
Log TFP premium of serial entrepreneurs	$\hat{\beta}_{\mathrm{SE}}$ in $\log \mathrm{TFP}_{i,t} = \beta_{\mathrm{SE}} \mathbf{1}_{\mathrm{SE},i} + a_{\mathrm{age}(i,t)} + \gamma_{\mathrm{ind}(i),t} + \xi_{i,t}$, column (2) of Table 9	All companies
Median employment, regular firms	$\mathrm{med}_i\, \overline{\mathrm{emp}}_i \,\big|\, \mathrm{SE}_i = 0$, where $\overline{\mathrm{emp}}_i$ is the company's mean employment	Linkable, two or more employees
Median employment, serial-entrepreneur firms	$\mathrm{med}_p\, \overline{\mathrm{emp}}_p$ over serial entrepreneurs p, where $\overline{\mathrm{emp}}_p$ is mean employment over all firm–years of all of p's companies	Linkable, two or more employees
SD of employment growth (pp)	$\sqrt{\mathrm{Var}_{i,t}\, g^{\mathrm{DHS}}_{i,t}}$	Linkable
Exit hazard at age one	Life-table hazard at age one, with delayed entry into the risk set	Life table
Pooled exit hazard, ages 1–10	$\bar{h} = \sum_a \mathrm{exits}_a \big/ \sum_a \mathrm{at\ risk}_a$ from the same life table	Life table
Five-year survival	$\prod_{a \le 5}(1 - h(a))$ from the same life table	Life table
Mean leverage	Mean of debt/total assets, winsorised at the 1st and 99th percentiles	Linkable, two or more employees
Share without debt	Share of firm–years with zero debt	Two or more employees
Insolvency rate	Companies entering liquidation, insolvency proceedings or bankruptcy per firm–year, 2014–2023	Ever two or more employees
Event-study contrast, log TFP	Mean of $\hat{\beta}_r$ at $r \le -3$ minus mean at $r \ge 1$ in equation (3), log TFP, entrepreneur fixed effects	Event study
Entrepreneur share of productivity variance	$\sigma^2_{\mathrm{owner}} / (\sigma^2_{\mathrm{owner}} + \sigma^2_{\mathrm{business}})$ on log TFP, Table 1	Multi-firm owners
Employment growth premium, age-controlled (pp)	$\hat{\beta}_{\mathrm{SE}}$ in $g^{\mathrm{DHS}}_{i,t} = \beta_0 + \beta_{\mathrm{SE}} \mathbf{1}_{\mathrm{SE},i} + \beta_a\, \mathrm{age}_{i,t} + \xi_{i,t}$	Linkable
Employment growth difference, unconditional (pp)	$\overline{g^{\mathrm{DHS}}}\big\vert_{\mathrm{SE}=1} - \overline{g^{\mathrm{DHS}}}\big\vert_{\mathrm{SE}=0}$	Linkable
SD of log employment, serial firms at age five	$\mathrm{SD}_i\ \log \mathrm{emp}_{i,t} \big|\, \mathrm{SE}_i = 1,\ \mathrm{age}_{i,t} = 5$	Linkable, two or more employees
Switch timing by ability (years per SD)	Slope of the age of the first business when the second is incorporated on the owner's standardised mean log TFP in the later businesses	Closure-dated switchers

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