Online Appendix for "Serial Entrepreneurship in China"

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A Tables and Figures

Table A-1: Number of Firms in the Inspection Data, 2008-2012.

Year	Number of Firms
2008	1711562
2009	2002896
2010	2476916
2011	3064303
2012	3414300
Total	12669977

Notes: Authors' calculations from the Inspection Data, State Administration for Industry and Commerce (2012).

Table A-2: Reporting Ratio of Inspection Data, Different Type of Entrepreneur.

Year	Non-SE	1st-SE	2nd-SE
2008	43.78%	46.15%	43.61%
2009	45.73%	48.01%	45.25%
2010	49.63%	51.66%	47.82%
2011	53.65%	55.98%	50.30%
2012	53.58%	55.74%	49.57%

Notes: Authors' calculations from the Inspection Data and Registry Data, State Administration for Industry and Commerce (2012, 2015).

Table A-3: Share of Registered Capital, by Ownership Type, 1995-2015.

Year	Total (Trillion)	Unregistered(%)	Individual(%)		Enterprise(%)		Share of baseline sample:
			Single	Multiple	Single	Multiple	(2)+(3)
		(1)	(2)	(3)	(4)	(5)	
1995	13.50	50.45	2.95	7.99	23.73	14.88	10.94
1996	14.87	50.17	3.13	9.50	21.74	15.46	12.63
1997	16.31	48.51	3.34	10.96	21.19	15.99	14.30
1998	19.03	43.33	3.35	18.55	19.18	15.59	21.90
1999	21.34	42.73	3.43	18.89	18.94	16.00	22.32
2000	24.63	39.45	3.36	18.82	18.60	19.77	22.18
2001	26.41	38.76	3.82	17.78	19.05	20.60	21.60
2002	28.75	37.85	4.63	19.16	16.50	21.86	23.78
2003	34.14	34.98	4.64	22.12	17.78	20.48	26.76
2004	35.98	35.09	5.21	22.55	18.01	19.13	27.76
2005	39.32	34.12	5.45	23.95	17.46	19.03	29.40
2006	43.26	33.30	5.76	24.67	16.94	19.34	30.43
2007	48.77	34.45	5.56	23.56	16.69	19.73	29.12
2008	52.59	33.77	5.81	23.40	16.72	20.30	29.21
2009	58.73	31.95	5.99	24.68	16.80	20.59	30.66
2010	67.79	29.55	6.14	26.49	16.62	21.20	32.62
2011	78.07	27.33	6.16	28.27	16.34	21.91	34.43
2012	87.60	25.72	6.21	29.15	16.35	22.57	35.36
2013	99.82	23.84	6.46	30.40	15.88	23.42	36.86
2014	125.69	20.67	7.77	33.57	14.89	23.10	41.34
2015	161.53	18.39	9.26	35.06	13.94	23.35	44.32

Notes: Authors' calculations from the Registry Data, State Administration for Industry and Commerce (2015).

Table A-4: Entry and Exit of Firms, by Serial Entrepreneur Status, Registry Data, 1995-2015.

Year	Non-SE					1st-SE					2nd-SE				
	Survival	New	Exit	Entry rate (%)	Exit rate (%)	Survival	New	Exit	Entry rate (%)	Exit rate (%)	Survival	New	Exit	Entry rate (%)	Exit rate (%)
1995	255281	79230	1449	44.64	0.82	101392	32720	378	47.39	0.55	13649	4298	47	45.73	0.50
1996	342187	90733	3827	35.54	1.50	138605	38289	1076	37.76	1.06	19507	6064	206	44.43	1.51
1997	445856	111720	8051	32.65	2.35	183287	46966	2284	33.88	1.65	28164	9047	390	46.38	2.00
1998	591741	160711	14826	36.05	3.33	245842	67187	4632	36.66	2.53	42501	15239	902	54.11	3.20
1999	744789	180349	27301	30.48	4.61	310848	74474	9468	30.29	3.85	61995	21272	1778	50.05	4.18
2000	941225	234011	37575	31.42	5.05	391935	93894	12807	30.21	4.12	90756	31885	3124	51.43	5.04
2001	1177521	291674	55378	30.99	5.88	485266	111939	18608	28.56	4.75	130942	46014	5828	50.70	6.42
2002	1466502	360214	71233	30.59	6.05	587600	128996	26662	26.58	5.49	187014	64731	8659	49.43	6.61
2003	1826715	453275	93062	30.91	6.35	706033	154942	36509	26.37	6.21	268039	93320	12295	49.90	6.57
2004	2248106	538832	117441	29.50	6.43	835496	173297	43834	24.55	6.21	365302	114803	17540	42.83	6.54
2005	2661806	558619	144919	24.85	6.45	949500	167150	53146	20.01	6.36	475850	135104	24556	36.98	6.72
2006	3082195	599348	178959	22.52	6.72	1047088	159037	61449	16.75	6.47	591328	148364	32886	31.18	6.91
2007	3404725	599751	277221	19.46	8.99	1109610	150698	88176	14.39	8.42	691569	151033	50792	25.54	8.59
2008	3775775	647212	276162	19.01	8.11	1177517	152671	84764	13.76	7.64	795829	159424	55164	23.05	7.98
2009	4343514	838904	271165	22.22	7.18	1277974	181356	80899	15.40	6.87	948327	210248	57750	26.42	7.26
2010	5073756	1009311	279069	23.24	6.42	1387115	188143	79002	14.72	6.18	1155879	268499	60947	28.31	6.43
2011	5932872	1175431	316315	23.17	6.23	1487933	184922	84104	13.33	6.06	1393257	308286	70908	26.67	6.13
2012	6747935	1198632	383569	20.20	6.47	1554932	160251	93252	10.77	6.27	1620835	316159	88581	22.69	6.36
2013	8093650	1707083	361368	25.30	5.36	1645899	175307	84340	11.27	5.42	1946573	418230	92492	25.80	5.71
2014	10233045	2433003	293608	30.06	3.63	1756998	173709	62610	10.55	3.80	2536705	664817	74685	34.15	3.84
2015	12605107	2703599	331537	26.42	3.24	1783434	85933	59497	4.89	3.39	3210127	761557	88135	30.02	3.47

Notes: Authors' calculations from the Registry Data, State Administration for Industry and Commerce (2015). Survival measures the number of firms in a given year while New and Exit denote the number of new and exiting firms in a given year, respectively.

Table A-5: Debt-Equity Ratio, Capital, and Relative TFP, Conditional on Equity, Inspection Data, 2008-2012.

	Log Assets	Debt-Equity Ratio
	(1)	(2)
Log TFP	0.04***	0.18***
2nd quarter of equity	1.27***	-2.00***
3rd quarter of equity	1.87***	-2.10***
4th quarter of equity	3.39***	-2.63***
TFP × 2nd quarter of equity	0.00***	-0.08***
TFP × 3rd quarter of equity	0.00***	-0.09***
TFP × 4th quarter of equity	0.01***	-0.13***
Age	0.07***	0.14***
Age square	-0.00***	-0.00***
Observations	12,669,977	12,669,926
Adjusted R-squared	0.52	0.00

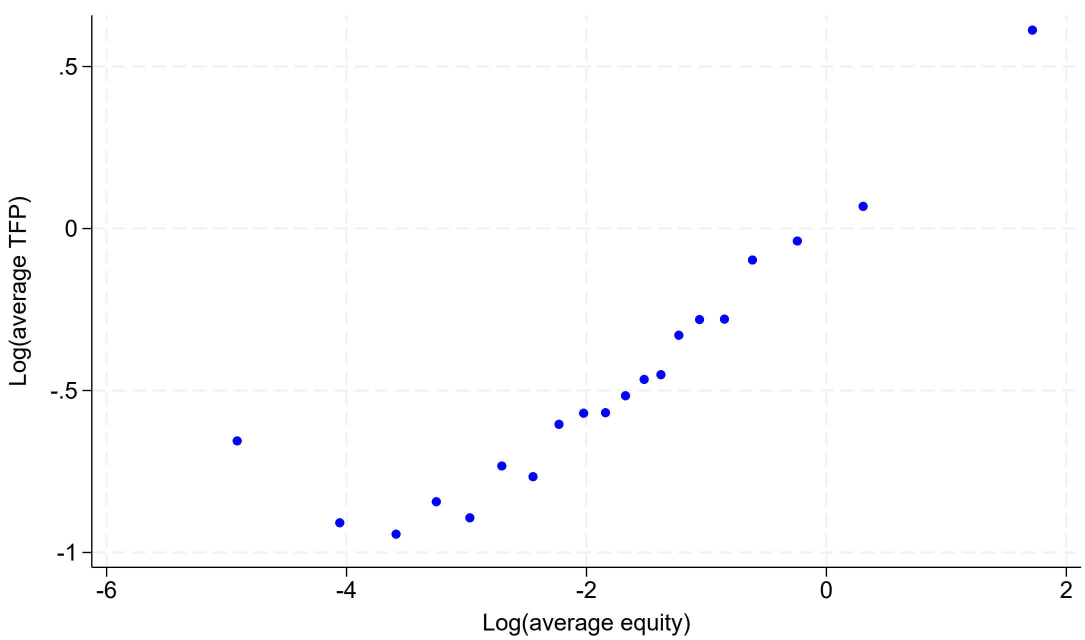
Notes: Authors' calculations from the Inspection Data, State Administration for Industry and Commerce (2012). The table reports the relationship between assets and the debt-equity ratio and TFP. The results are computed for different quarters in the equity distribution. All variables, except age, are computed relative to their averages of all firms in the same province-industry-year cell. *** – statistically significant at the 1% level.

Table A-6: Performance of Serial Entrepreneurs: Robustness Test for Age Effects

	Log TFP			
	benchmark	age quartic	age dummy	firms established 2009 or earlier
	(1)	(2)	(3)	(4)
1st-SE	0.11***	0.11***	0.11***	0.13***
2nd-SE	0.21***	0.17***	0.17***	0.23***
Age	0.42***	1.00***	–	0.28***
Age square	-0.01***	-0.09***	–	-0.01***
Age cubic	–	0.00***	–	–
Age quartic	–	-0.00***	–	–
Age fixed effects	No	No	Yes	No
Observations	12,669,977	12,669,977	12,669,976	10,054,120
Adjusted R-squared	0.03	0.04	0.04	0.01

Notes: Authors' calculations from the Inspection Data and Registry Data, State Administration for Industry and Commerce (2012, 2015). The table compares the performance of 1st-SE and 2nd-SE firms, relative to non-SE firms. All variables, except age, are computed relative to their averages of all firms in the same province-industry-year cell. Column (1) is same to the Table 6. Column (2) adds age cubic and quartic as additional controls. Column (3) adds age fixed effects. Column (4) includes firms that are established in 2009 or earlier. *** – statistically significant at the 1% level.

Figure A-1: Equity and TFP, Newly Established Non-Serial and 1st-SE Firms.



Notes: The figure reports a bin scatter plot of the log average TFP and log average equity for non-serial and 1st-SE firms that are less than four years old in the Inspection Data. Based on their equity, firms are divided into 20 ventiles, and the figure reports the averages for each ventile. Data source: Inspection Data, State Administration for Industry and Commerce (2012).

B Theoretical Results

B.1 Proof of Proposition 1

Consider first an unconstrained entrepreneur. Assuming that $k < \lambda e$, the entrepreneur's problem is

$$\begin{aligned}\Pi(e,z;1) &= \max_{k,n}\{y - wn - Rk\} + eR \\ &= \max_{k,n}\left\{z^{1-\eta}\left(k^{1-\alpha}n^{\alpha}\right)^{\eta} - wn - R(k-e)\right\}.\end{aligned}$$

The first-order conditions are given by

$$\alpha\eta y = wn, \tag{B-1}$$

$$(1-\alpha)\eta y = Rk, \tag{B-2}$$

Plugging this back into the production function yields an expression for output in terms of z and equity. The optimal allocations follow directly from eq. (B-1)-(B-2) and are given by equation (B-3),

$$\begin{aligned}y^*(e,z,1) &= z\cdot\left(\frac{(1-\alpha)\eta}{R}\right)^{\frac{(1-\alpha)\eta}{1-\eta}}\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}} \\ k^*(e,z,1) &= z\cdot\left(\frac{(1-\alpha)\eta}{R}\right)^{\frac{1-\alpha\eta}{1-\eta}}\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}} \equiv zk^* \\ n^*(e,z,1) &= z\cdot\left(\frac{(1-\alpha)\eta}{R}\right)^{\frac{(1-\alpha)\eta}{1-\eta}}\left(\frac{\alpha\eta}{w}\right)^{\frac{1-\eta(1-\alpha)}{1-\eta}}\end{aligned} \tag{B-3}$$

and where profits are

$$\Pi(e,z,1) = z\cdot(1-\eta)\cdot\left(\frac{(1-\alpha)\eta}{R}\right)^{\frac{(1-\alpha)\eta}{1-\eta}}\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}} + Re$$

Consider now the unconstrained entrepreneur's decision whether or not to enter. The entrepreneur will enter if profits exceed the opportunity cost, which is depositing the equity in the bank. Given the prices and state variables, the condition $\Pi(z,e,1) - \nu \geq Re$ implies a cutoff z^* such that all potential entrepreneurs with $z \geq z^*$ will choose to operate firms, where z^* is given by

$$z^* \equiv \frac{v}{1-\eta}\left(\frac{(1-\alpha)\eta}{R}\right)^{-\frac{(1-\alpha)\eta}{1-\eta}}\left(\frac{\alpha\eta}{w}\right)^{-\frac{\alpha\eta}{1-\eta}} = \frac{\eta}{1-\eta}\frac{1-\alpha}{R}\frac{\nu}{k^*}$$

This threshold is independent of equity since equity is irrelevant for the unconstrained entrepreneur. Moreover, the threshold is increasing in the wage rate (since higher wages lower profits) and increasing in R (since higher returns on deposits increase the alternative value of equity). The unconstrained entrepreneur will install a capital stock given by $k^*(e,z,1) = zk^*$ (see equation (B-3)). It follows that the potential entrepreneur will be an unconstrained entrepreneur and operate the firm if and only if two conditions are simultaneously satisfied: (1) $z \geq z^*$ and (2) $\lambda e \geq z \cdot k^*$. Namely, both TFP and equity must be sufficiently large. Moreover, it follows that the lower bound for equity for an unconstrained entrepreneur is $\underline{e} \equiv z^*k^*/\lambda = \nu(1-\alpha)\eta/[(1-\eta)\lambda R]$.

Next, consider a constrained entrepreneur who is constrained in terms of borrowing, i.e., $k = \lambda e$ and $b = (\lambda - 1)\, e$. This entrepreneur solves the problem

$$\Pi(e, z; 0) = \max_{n} \left\{ z^{1-\eta} \left((\lambda e)^{1-\alpha} n^{\alpha} \right)^{\eta} - wn - R(\lambda - 1)\, e \right\}.$$

The first-order condition for employment n, equation (B-1), applies, while equation (B-2) becomes an inequality, $R\lambda e < (1-\alpha)\,\eta y$. For constrained entrepreneurs the optimal allocations are given by equation (B-4),

$$\begin{aligned}
y_c^* &= z^{\frac{1-\eta}{1-\alpha\eta}} (\lambda e)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} \left(\frac{\alpha\eta}{w} \right)^{\frac{\alpha\eta}{1-\alpha\eta}} \\
k_c^* &= \lambda e \\
n_c^* &= z^{\frac{1-\eta}{1-\alpha\eta}} (\lambda e)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} \left(\frac{\alpha\eta}{w} \right)^{\frac{1}{1-\alpha\eta}} \\
\Pi(e, z; 0) &= (1-\alpha\eta)\, z^{\frac{1-\eta}{1-\alpha\eta}} (\lambda e)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} \left(\frac{\alpha\eta}{w} \right)^{\frac{\alpha\eta}{1-\alpha\eta}} - R(\lambda - 1)\, e,
\end{aligned} \tag{B-4}$$

where the subscript c denotes "constrained."

The analysis of the unconstrained and constrained cases implies that the potential entrepreneur will be constrained if and only if

$$\lambda e < z k^*.$$

Note that the return to equity for constrained entrepreneurs exceeds R.

Consider now the entry decision for the constrained entrepreneurs. The entrepreneur will enter if operating the firm is better than depositing the equity, i.e., if $\Pi(e, z, 0) - \nu \geq Re$. This condition implies a threshold function $z^*(e)$ given by

$$z^*(e) \geq \left(\frac{\nu + R\lambda e}{1-\alpha\eta} \right)^{\frac{1-\alpha\eta}{1-\eta}} (\lambda e)^{-\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{w}{\alpha\eta} \right)^{\frac{\alpha\eta}{1-\eta}}.$$

Equity and better financial markets (larger λ) affects the threshold for constrained entrepreneurs in two opposing ways. On the one hand, a larger equity and/or a larger λ increase the value of the firm. This tends to reduce the threshold. On the other hand, a larger equity and/or a larger λ increase the opportunity cost of deposits, which tends to decrease the threshold. The former effect dominates and the comparative statics of the threshold with respect to e is given by

$$\frac{\partial \ln(z^*(e))}{\partial \ln e} = \frac{1-\alpha\eta}{1-\eta} \frac{R\lambda e}{\nu + R\lambda e} - \frac{(1-\alpha)\,\eta}{1-\eta} \leq 0,$$

where the inequality is strict for $e < e^* = \frac{\nu}{1-\eta} \frac{(1-\alpha)\eta}{R}$ and holds with equality for $e = e^*$.

B.2 Proof of Proposition 2

The proof that SE firms have higher TFP than non-SE firms (part 1 of Proposition 2) relies on the following lemma for conditional expectations.

Lemma 1. *If $\rho \geq 0$ then*

$$E\{z | z \geq a \ \text{ and } \ G(z) + \epsilon \geq b\} \geq E\{z | z \geq a\},$$

where G is a monotone increasing function, z and ε are stochastic variables, and a and b are constants.

When setting $G(z) = \rho z$ and $a = b = z^*$ and interpreting z and $\rho z + \epsilon$ as the TFP draw in the first and second period, respectively, Lemma 1 implies the key result of Part 1 that 1st-SE firms will on average have higher TFP than non-serial firms provided that $\rho > 0$. A similar argument establishes also that 2nd-SE firms are on average more productive than non-serial firms when $\rho > 0$. To see this, note that Lemma 1 also implies that $E[z_2|z_2 \geq b, z_2 \geq a - \epsilon/\rho] \geq E[z_2|z_2 \geq b]$, where $\tilde{\varepsilon} \equiv -\varepsilon/\rho$ is a stochastic variable and $z_1 = z_2/\rho - \varepsilon/\rho = z_2/\rho + \tilde{\varepsilon}$.

- **Proof of Lemma 1.** Proving Lemma 1 amounts to proving that if $g(z)$ is monotone increasing in z then

$$E[z|z \geq a, G(z) + \epsilon \geq b] \geq E[z|z \geq a],$$

where Z is a stochastic variable and a and b are constants.

The main idea is to show that (1) adding the condition $G(z) + \epsilon \geq b$ is equivalent to multiplying an increasing function $h(z)$ to the pdf conditional on $z \geq a$, denoted as $f(z)$ and (2) generally, if we multiply pdf $f(z)$ by an increasing function $h(z)$ to get a new pdf $g(z)$, then $g(z)$ first order dominates $f(z)$ and leads to higher expected z.

First, denote the unconditional pdf and cdf of z as $i(z)$ and $I(z)$, and the pdf and cdf of ϵ as $j(z)$ and $J(z)$. The pdf conditional on $z \geq a$ can then be expressed as

$$f(z) = \frac{i(z)}{1 - I(a)}, z \geq a.$$

Then the pdf of z conditional on $z \geq a$ and $G(z) + \epsilon \geq b$ is

$$g(z) = f(z) \frac{\int_{b-G(z)}^{\infty} j(\epsilon) d\epsilon}{\int_a^{\infty} f(x) \int_{b-G(x)}^{\infty} j(\epsilon) d\epsilon dx} = f(z) \frac{1 - J(b - G(z))}{\int_a^{\infty} f(x)(1 - J(b - G(x))) dx}$$
$$\doteq f(z) \frac{h(z)}{\int_a^{\infty} f(x) h(x) dx},$$

where $h(z) = 1 - J(b - G(z))$ is an increasing function of z because $G(z)$ is increasing in z.

Next, we illustrate the impacts of multiplying $h(z)$ to a pdf $f(z)$. Define

$$g(z) = \frac{f(z) h(z)}{\int f(x) h(x) d(x)} \doteq \frac{f(z) h(z)}{H},$$

where H is a constant to turn $\int g(z) dz = 1$ and make g also a pdf.

Third, we show that g first order dominate (FOD) f, i.e., for any z, we have $G(z) < F(z)$. If z is small, such that $h(z) \leq H$, then

$$G(z) = \int^z \frac{f(x) h(x)}{H} dx < \int^z \frac{f(x) h(z)}{H} dx = F(z).$$

If z is large, such that $h(z) > H$, then

$$1 - G(z) = \int_z \frac{f(x) h(x)}{H} dx > \int_z \frac{f(x) h(z)}{H} dx = 1 - F(z).$$

FOD implies higher expected value. To see this, note that for any z and $F(z)$, we can find a corresponding $y > z$ such that $G(y) = F(z)$, because $G(z) < F(z)$ and G is increasing. Then

$$E[z|F] = \int z dF(z) = \int z dG(y) < \int y dG(y) = \int z dG(z) = E[z|G].$$

QED

B.3 Optimal allocations under financial frictions

Proof of Proposition 3. The maintained assumption is that the entrepreneur entered and operated firm 1 in period 1. If $z_2 > z_1$, it will be strictly more profitable to operate firm 2 than firm 1. The entrepreneur will therefore enter and operate firm 2 regardless whether or not firm 1 is operated. It follows that $Z(z_1, e) \leq z_1$. Proposition 1 implies that firm 2 would not be operated if $z_2 < z^*$. From now on we focus on the case when $z^* \leq z_2 \leq z_1$.

Suppose first that $\lambda e \geq (z_2 + z_1) k^*$. Proposition 1 implies that it is better to operate each firm with capital $z_2 k^*$ and $z_1 k^*$, respectively, than depositing the equity earning rate R. Since equity is sufficient to fund both firms, this allocation is also feasible. This lower bound on z_2 is independent of e and z_1.

Suppose now that $\lambda e < (z_2 + z_1) k^*$. Proposition 1 then implies that if the entrepreneur is operating both firms then she will be constrained: $b = (\lambda - 1) e$. The optimal employment would be to allocate capital and labor so as to equate the marginal product of labor in each firm to the wage rate. This implies that for each firm j,

$$n_j = (z_j)^{\frac{1-\eta}{1-\alpha\eta}} (k_j)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} \left(\frac{\alpha\eta}{w}\right)^{\frac{1}{1-\alpha\eta}}.$$

Moreover, the entrepreneur's equity would be distributed across the firms so as to equalize the marginal product of capital across firms. This implies

$$(1-\alpha)\eta (z_2)^{1-\eta} \frac{\left(k_2^{1-\alpha} n_2^{\alpha}\right)^{\eta}}{k_2} = (1-\alpha)\eta (z_1)^{1-\eta} \frac{\left(k_1^{1-\alpha} n_1^{\alpha}\right)^{\eta}}{k_1}$$

which in turn implies $k_2 = \frac{z_2}{z_1} k_1$. Since we hypothesize $k_1 + k_2 = \lambda e$, it follows that $\lambda e = \left(\frac{z_2}{z_1} + 1\right) k_1$, implying

$$k_2 = \frac{z_2}{z_2 + z_1} \lambda e \qquad \text{and} \qquad k_1 = \frac{z_1}{z_2 + z_1} \lambda e.$$

Maintaining that $\lambda e \leq (z_2 + z_1) k^*$, we now consider two cases.

Suppose first that equity is sufficiently large that the entrepreneur is unconstrained when operating one firm, i.e., $\lambda e \geq z_1 k^*$ so $\lambda e \in [z_1 k^*, (z_2 + z_1) k^*)$. The entrepreneur would then operate two firms if and only if

$$\Pi\left(\frac{z_2}{z_2 + z_1} \lambda e, z_2; 0\right) + \Pi\left(\frac{z_1}{z_2 + z_1} \lambda e, z_1; 0\right) - 2\nu \geq \Pi(z_1; 1) + Re - \nu, \qquad \text{(B-5)}$$

where the function $\Pi(k, z; 0)$ denotes profits net of the operating cost ν from a constrained entrepreneur with equity e operating a firm with capital $k = \lambda e$ and TFP z,

$$\Pi(\lambda e, z, 0) = (1 - \alpha\eta) z^{\frac{1-\eta}{1-\alpha\eta}} (\lambda e)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} - R(\lambda - 1) e.$$

Moreover, the function $\Pi(z; 1)$ denotes profits net of the operating cost ν from an unconstrained entrepreneur operating a firm with TFP z,

$$\Pi(z;1) \equiv z \cdot (1-\eta) \cdot \left(\frac{(1-\alpha)\eta}{R}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}}.$$

Simple algebra establishes that the condition (B-5) is equivalent to the following lower bound on z_2,

$$\begin{aligned} z_2 &\geq Z(z_1,e) \equiv \left(z_1 \cdot \frac{1-\eta}{1-\alpha\eta}\left(\frac{(1-\alpha)\eta}{R}\right)^{\frac{(1-\alpha)\eta}{1-\eta}}\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}} + \frac{R\lambda e+\nu}{1-\alpha\eta}\right)^{\frac{1-\alpha\eta}{1-\eta}} (\lambda e)^{-\frac{(1-\alpha)\eta}{1-\eta}}\left(\frac{\alpha\eta}{w}\right)^{-\frac{\alpha\eta}{1-\eta}} - z_1 \quad \text{(B-6)} \\ &= \left(1+\frac{1-\eta}{1-\alpha\eta}\left(\frac{zk^*}{\lambda e}-1\right)+\frac{(1-\alpha)\eta}{1-\alpha\eta}\frac{1}{\lambda e}\frac{v}{R}\right)^{\frac{1-\alpha\eta}{1-\eta}} \frac{\lambda e}{k^*} - z \end{aligned}$$

Simple algebra establishes that

$$\frac{\partial Z(z,e)}{\partial z} = \left(1+\frac{1-\eta}{1-\alpha\eta}\left(\frac{zk^*}{\lambda e}-1\right)+\frac{1-\eta}{1-\alpha\eta}\frac{z^*k^*}{\lambda e}\right)^{\frac{1-\alpha\eta}{1-\eta}-1} - 1 > 0,$$

which is positive given the maintained assumption that $\lambda e \leq z_1 k^*$. This implies that the lower bound $Z(z_1,e)$ is increasing in z_1 whenever $\lambda e \in [z_1 k^*, (z_2+z_1)k^*)$.

In terms of equity, simple algebra establishes that

$$k^* = \left(\frac{(1-\alpha)\eta}{R}\right)^{\frac{1-\alpha\eta}{1-\eta}} \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}}$$

$$\begin{aligned} \frac{\partial Z}{\partial e} &= -\left(z_1 k^* - \lambda e + \frac{(1-\alpha)\eta}{1-\eta}\frac{\nu}{R}\right) \\ &\quad \cdot \frac{R\lambda}{1-\alpha\eta}\left(\frac{1-\eta}{1-\alpha\eta}\frac{Rk^*}{(1-\alpha)\eta}z_1 + \frac{R\lambda e+\nu}{1-\alpha\eta}\right)^{\frac{1-\alpha\eta}{1-\eta}-1} (\lambda e)^{-\frac{1-\alpha\eta}{1-\eta}} \left(\frac{\alpha\eta}{w}\right)^{-\frac{\alpha\eta}{1-\eta}} \\ &< 0, \end{aligned}$$

where the inequality follows from the maintained assumption that $z_1 k^* \geq \lambda e$. This implies that the lower bound $Z(z_1,e)$ is falling in e whenever $\lambda e \in [z_1 k^*, (z_2+z_1)k^*)$.

Finally, consider the case when equity is sufficiently small that the entrepreneur would be constrained even when operating one firm, i.e., $\lambda e < z_1 k^*$. In this case, the entrepreneur would operate two firms if

$$\Pi\left(\frac{z_2}{z_2+z_1}\lambda e, z_1; 0\right) + \Pi\left(\frac{z_1}{z_2+z_1}e, z_1; 0\right) - 2\nu \geq \Pi(e, z_1; 0) - \nu. \quad \text{(B-7)}$$

Standard algebra establishes that the condition (B-7) is equivalent to the lower bound $z_2 \geq Z(z_1,e)$, where

$$Z(z_1,e) \equiv \left((z_1)^{\frac{1-\eta}{1-\alpha\eta}} + \left(\frac{w}{\alpha\eta}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} \frac{\nu}{1-\alpha\eta}(\lambda e)^{-\frac{(1-\alpha)\eta}{1-\alpha\eta}}\right)^{\frac{1-\alpha\eta}{1-\eta}} - z_1. \quad \text{(B-8)}$$

It is immediate that $Z(z_1,e)$ is monotone increasing in z_1 and monotone falling in e in this range. This completes the proof of Proposition 3.

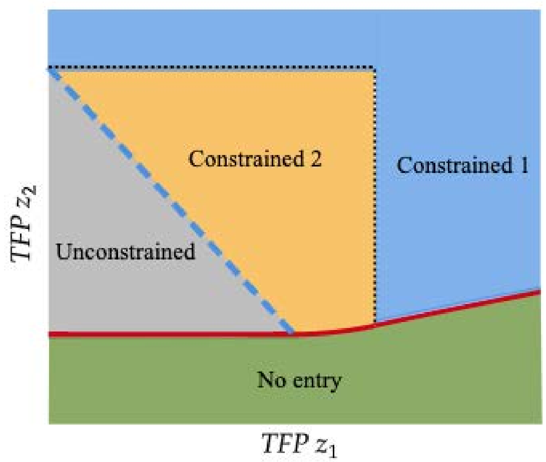
QED

Figure B-1 illustrates the decision to enter for a second firm. The graph shows the threshold $Z(z_1, e)$ for the TFP of the 2nd firm as a function of the TFP of the first firm z_1. If the TFP draws z_1 and z_2 are low relative to the entrepreneur's equity, she will be unconstrained in the sense that she has sufficient equity to fund both firms at the optimal size (area labeled "Unconstrained").[1] The threshold is therefore constant at $Z = z^*$.

For intermediate levels of z_1 and z_2 the entrepreneur will be constrained when operating two firms but unconstrained when operating one firm (area labeled "Constrained 2"). In this case the opportunity cost of equity is larger and this cost is increasing in z_1. Therefore, the threshold $Z(z_1, e)$ is monotone increasing in z_1. The dotted black line marks the combinations of z_1 and z_2 for which equity would be exactly sufficient to fund the most productive firm at the optimal size, $\lambda e = z_j k^*$.

For higher levels of z_1 and z_2 the entrepreneur will be constrained even when operating just one firm (area labeled "Constrained 1"). This further increases the opportunity cost of equity and the threshold keeps growing in z_1.

Figure B-1: Entry Decision for 2nd Firm.



Notes: The figure shows the entry threshold for the 2nd firm of entrepreneurs as a function of the TFP of the entrepreneur's first firm, z_1.

The opportunity cost of equity is lower when equity is more abundant. Entrepreneurs with more equity are therefore more likely to start the second firm. It follows that $Z(z_1, e)$ is monotone decreasing in e.

Note that $Z(z, e)$ is always below the 45-degree line in z. Since it was optimal to operate the first firm (with TFP z_1) in the first period, it must also be better to operate this firm in the second period than not operating any firms.[2] The fact that the birth date of each firm is irrelevant implies that the entrepreneur will always choose to operate the most productive firm in the second period. It follows that $z_2 > z_1$ is a sufficient condition for the second firms to be operated and for the entrepreneur to become a SE. This is why the threshold function satisfies $Z(z_1, e) \leq z_1$.

[1]The blue dashed line marks the combinations of z_1 and z_2 for which equity is exactly sufficient to fund both firms at the optimal size, $\lambda e = (z_1 + z_2)k^*$.

[2]The reason is that the wages and interest rates are assumed to be constant over time. Moreover, the entrepreneur's equity e must be at least as large as what the entrepreneur had available in the beginning of the first period – otherwise it would not have been optimal to operate the firm in the first period.

B.4 Proof of Proposition 4

From Proposition 3 the condition for choosing to operate firm 2 in period 2 is

$$\rho z_1 + \varepsilon - Z(z_1, e_2) \geq 0, \tag{B-9}$$

where Z is monotone increasing in z_1. By taking the partial differential of the functions $\underline{Z}$ and $\bar{Z}$ with respect to z_1 it is straightforward to show that $\underline{Z}$ is convex in z_1 while $\bar{Z}$ is concave in z_1,

$$\begin{aligned}
\frac{\partial^2 \bar{Z}}{\partial z^2} &= -X\left(1+\left(\frac{w}{\alpha\eta}\right)^{\frac{\alpha\eta}{1-\alpha\eta}}\frac{\nu}{1-\alpha\eta}(\lambda e)^{-\frac{(1-\alpha)\eta}{1-\alpha\eta}}(z)^{-\frac{1-\eta}{1-\alpha\eta}}\right)^{\frac{(1-\alpha)\eta}{1-\eta}-1}(\lambda e)^{-\frac{(1-\alpha)\eta}{1-\alpha\eta}}(z)^{-\frac{1-\eta}{1-\alpha\eta}-1} < 0 \\
\frac{\partial^2 \underline{Z}}{\partial z^2} &= \frac{(1-\alpha)\eta}{1-\alpha\eta}\frac{k^*}{\lambda e}\left(\frac{1-\eta}{1-\alpha\eta}\frac{zk^*}{\lambda e}+\frac{R\lambda e+\nu}{1-\alpha\eta}\frac{1-\alpha}{R}\frac{\eta}{\lambda e}\right)^{\frac{(1-\alpha)\eta}{1-\eta}-1} > 0.
\end{aligned}$$

where $X = \nu(1-\alpha)\eta/(1-\alpha\eta)^2[w/(\alpha\eta)]^{\alpha\eta/(1-\alpha\eta)} > 0$ is a constant. Since $Z(z,e)$ is convex in z for $z < \lambda e/k^*$ and concave in z for $z \geq \lambda e/k^*$, the largest value of $\partial Z(z,e)/\partial z$ occurs for $z = \lambda e/k^*$. It follows that $\partial Z(z,e)/\partial z$ is bounded from above by the following expression,

$$\frac{\partial Z(z,e)}{\partial z}\Big|_{z=\lambda e/k^*} = \left(1+\frac{1-\eta}{1-\alpha\eta}\frac{z^*}{z}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} - 1 < \left(1+\frac{1-\eta}{1-\alpha\eta}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} - 1,$$

where the last inequality follows from the maintained assumption that $z_1 = \lambda e/k^* \geq z^*$. Recall now that equity $e_2 = \Pi(z_1, e_1)$ is given by the accumulated equity after operating the 1st-SE firm for one period. Since profits are monotone increasing in TFP, Assumption 1 guarantees that e_2 is monotone increasing in z_1. Equity e_2 therefore mitigates the degree to which Z is increasing in z_1. Therefore, the inequality (B-10) provides an upper bound for the derivative $dZ(z_1, \Pi(z_1, e_1))/dz_1$. It follows that if ρ is sufficiently large, the expression $\rho z_1 + \varepsilon - Z(z_1, e_2)$ is monotone increasing in z_1. Lemma 1 therefore applies and implies that

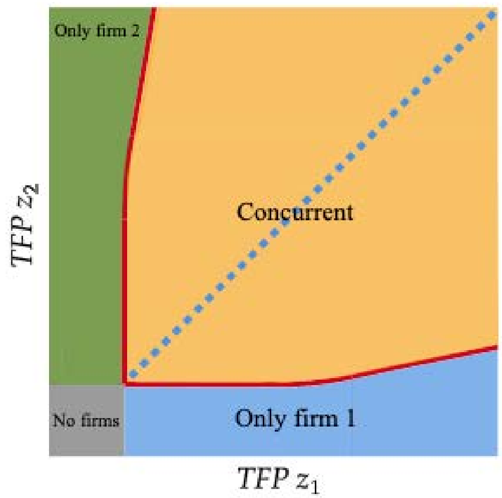
$$E\{z_1 | z_1 \geq z^{**} \text{ and } \rho * z_1 + \varepsilon - Z(z_1, \Pi(z_1, e_1)) \geq 0\} \geq E\{z_1 | z_1 \geq z^{**}\},$$

which establishes that the expected TFP of 1st-SE firms will exceed the expected TFP of non-serial entrepreneurs. Finally, following the proof of Proposition 2, a sufficiently large ρ guarantees that the expected TFP of the 2nd-SE firm will exceed the expected TFP of the 1st-SE firm.

B.5 Concurrent versus Non-concurrent SE Firms

The TFP difference $z_1 - z_2$ matters because the opportunity cost of operating the least productive firm is increasing in TFP of the most productive firm. Intuitively, if the TFP difference $|z_2 - z_1|$ is sufficiently large, it is optimal to allocate the entire endowment of the scarce factor to the most productive firm. Figure B-2 illustrates this aspect of Proposition 6. In a range close to the 45-degree line – when z_1 is close to z_2 – it is optimal to operate the firms concurrently. However, when the difference $|z_2 - z_1|$ is large (one firm being much more productive), the opportunity cost of equity becomes so large that it is optimal to allocate all funds to one firm and not operate the least productive one. In other words, the larger the difference in TFP, the lower the chance that the entrepreneur will operate both firms concurrently. In the same vein, when equity is more abundant, the opportunity cost of equity is lower. This explains why more equity increases the chance that the entrepreneur will operate both firms concurrently.

Figure B-2: Entry Decision for 2nd Firm.



Notes: The figure illustrates the choice of whether to operate two firms concurrently or to operate just the most productive firm in the second period. These choices are determined by the combinations of z_1 and z_2 in the regions marked as "Concurrent", "1st firm only", or versus "2nd firm only".

B.6 Proof of Proposition 8

Consider two sectors with identical realizations of the idiosyncratic draws $z_{s'} = z_{\tilde{s}}$. Since the sector-specific return to capital has the same mean and variance in all sectors and $E\{u(W)\}$ is strictly falling in the covariance term, sector s' will be strictly preferred to sector $\tilde{s}$ if and only if $Cov(\delta_{s'}, \delta_s) < Cov(\delta_{\tilde{s}}, \delta_s)$. Since the distribution of δ is the same for all sectors, it follows immediately that when $Cov(\delta_{s'}, \delta_s) < Cov(\delta_{\tilde{s}}, \delta_s)$ then sector $\tilde{s}$ will be chosen only if it has the largest TFP, $z_{\tilde{s}} > z_{s'}$. This implies that 2nd-SE firms in sectors with a larger covariance with the sector of the 1st-SE firm will on average have a larger TFP. It follows that sector s' will be chosen more often than sector $\tilde{s}$.

C Favored and Non-Favored Entrepreneurs with Sector Learning

Consider an extension of our learning model where favored entrepreneurs (i.e., individuals who possess non-skill advantages) coexist with non-favored entrepreneurs. For ease of exposition, assume that the advantage of the favored entrepreneurs takes the form that they do not face strict collateral constraints (i.e., very large λ). Since favored entrepreneurs can borrow more, they have a lower TFP threshold z^* than the non-favored entrepreneurs: $z^*_{nf}(e) \geq z^*_f(e)$.

A key implication of this setting is that favored individuals will be more preponderant among the sector switchers than among the stayers. To understand this result, note that there are no differences between the favored and the non-favored in their second-period decision rule on switching sectors because all entrepreneurs have the same switching threshold $\bar{z}$. Consider the case when $\bar{z} > z^*_f(e)$, which is necessary to observe some entrepreneurs switch sector in equilibrium. Otherwise, all entrants would have TFP above the switching threshold and would choose to remain in their initial sector. In this case, favored entrepreneurs would be more over-represented among the switchers than among the stayers. Since favored entrepreneurs have a lower TFP threshold for entry than the non-favored ones (i.e., $z^*_f(e) \leq z^*_{nf}(e)$), the favored should be proportionally represented among entrepreneurs who choose to enter for sufficiently high realizations of z and over-represented for low realizations of z. This holds true for any level of equity e. It follows that the preponderance of favored entrepreneurs should be larger for TFP levels below the switching threshold $\bar{z}$ than for TFP levels above this threshold.

This result allows us to use sector switching as a proxy for favored individuals.

An implication of this result is that the presence of favored individuals will be a force for lower TFP and larger capital stock among switchers. In particular, switchers will have more capital than stayers, relative to their TFP. If the advantage is sufficiently large, the switchers could end up having larger average capital than the stayers, even if their average TFP is lower.

We summarize these insights in the following corollary.

Corollary 1. *Favored entrepreneurs are over-represented among entrepreneurs who switch and locate the 1st-SE and 2nd-SE in different sectors. Switchers therefore have more capital relative to their TFP than stayers. If the favored entrepreneurs enjoy sufficiently large advantages in terms of borrowing, switchers could have larger average capital stocks than stayers.*

In this section we have focused on easier access to borrowing (i.e., a larger λ) as the source of favoritism. The effects of favoritism would be quantitatively stronger a lower cost of borrowing (i.e., a lower interest rate).

D Industry-Specific Labor Income Shares

Following much of the literature on firm-level productivity measurements in China (including for example Brandt, Van Biesebroeck and Zhang (2012), Hsieh and Klenow (2009), and Bai, Hsieh and Qian (2006)), our preferred approach when estimating firm-level TFP is to use sector-specific labor-income shares from the U.S. The values for sector-specific labor-income shares for the U.S. are reported in column 1 of Table D-1 (source: BEA).

Unfortunately, it is not possible to estimate sector-specific labor-income shares using the Inspection Data, which our analysis is based on. The reason is that these data do not include information on labor and wages. We estimate the labor-income share from Chinese data in two ways for each sector j – as a pure labor-income share $\phi_{1,j}$ and as an elasticity $\phi_{2,j}$.

We measure the share parameter $\phi_{1,j}$ as the ratio of aggregate labor income to aggregate value added in industry j. We rely on data from the Chinese 2007 Input-Output table, National Bureau of Statistics (2007), to measure the labor compensation and value added for each sector. The Chinese 2007 Input-Output table also includes each industries' use of labor, capital depreciation, surplus, and paid-in tax. We aggregate data at the 3-digit industry level up to a 1-digit industry level, and use this to calculate the labor share ratio of 1-digit industries. When aggregating up to the 1-digit level, the weight for each 3-digit industry is the number of firms from the 2008 census data, National Bureau of Statistics (2009).

We measure the parameters $\phi_{2,j}$ as the elasticity of value added to a change in labor input in industry j. Formally, we estimate $\phi_{2,j}$ running the following OLS regression using data from the 2008 Chinese Enterprise Census Data, National Bureau of Statistics (2009),

$$\ln y_{i,j} = (0.85 - \alpha_j)\ln(k_{i,j}) + \alpha_j \ln(n_{i,j}) + \varepsilon_{i,j} \tag{D-1}$$

where $y_{i,j}$ is value added for firm i in industry j, $k_{i,j}$ is capital, and $n_{i,j}$ is the labor input. The decreasing returns to scale parameter of 0.85 is taken from Restuccia and Rogerson (2008).

Table D-1 reports the results. We have two main findings. First, the measured labor share estimates are positively correlated with the corresponding shares for U.S. industries, with a correlation of about 0.3. We conclude that the U.S. labor shares are informative about labor elasticities in Chinese data.

Second, we observe that for the largest industries (i.e., Wholesale and Retail, Manufacturing, and Leasing and Business Services), the estimated labor shares using Chinese data are low compared to their U.S. counterparts (see columns 2 and 3 of Table D-1). Manufacturing is a point in case, where the estimates for China are around 0.33. This compares to 0.514 for the U.S. It seems unreasonable to us that China should have a substantially lower aggregate labor share in manufacturing than the U.S. This could be due to the fact that firm-level data probably do not include all labor compensation because contributions through pension plans, insurance, etc. might be ignored (this issue is relevant also when estimating labor shares in U.S. data). Furthermore, Chinese data are likely to mis-measure labor compensation because some firms report costs of hired temporary workers as "intermediary inputs" rather than as part of the labor cost. Finally, the measured production parameters might be biased because of sector-specific distortions, including subsidies or taxes (see for example Hsieh and Klenow (2009) and Brandt, Kambourov and Storesletten (forthcoming)).

Therefore, we find it reasonable to rely on U.S. labor-income shares when estimating firm-level TFP. The reason is that these measurement issues are arguably much smaller in the U.S.

Table D-1: Labor Share Estimation

1-digit industry	ϕ_j^{US}	$\phi_{1,j}$	$\phi_{2,j}$
	(1)	(2)	(3)
Mining	0.264	0.352	0.254
Manufacturing	0.514	0.324	0.338
Utilities	0.269	0.254	0.377
Construction	0.641	0.510	0.454
Wholesale and Retail	0.533	0.242	0.233
Transportation	0.623	0.271	0.420
Catering	0.580	0.276	0.613
IT	0.399	0.230	0.328
Finance	0.238	0.260	0.551
Real Estate	0.238	0.109	0.316
Leasing and Business Service	0.714	0.552	0.488
R&D	0.387	0.537	0.387
Public Facilities	0.387	0.384	0.453
Resident Service	0.387	0.679	0.379
Education	0.387	0.663	0.380
Health	0.580	0.509	0.398
Culture	0.580	0.820	0.451
Social Organization	0.413	0.887	0.314
International Organization	0.413	–	0.451
$CORR(\phi_j, \phi_j^{US})$	–	0.266	0.306

Notes: ϕ_j^{US} is from the BEA; $\phi_{1,j}$ is from the Chinese Input-Output Table 2007, National Bureau of Statistics (2007); and $\phi_{2,j}$ is estimated based on the Chinese Enterprise Census Data 2008, National Bureau of Statistics (2009).

References

BAI, C.-E., C.-T. HSIEH AND Y. QIAN, "The Return to Capital in China," *Brookings Papers on Economic Activity* 2 (2006), 61–88.

BRANDT, L., G. KAMBOUROV AND K. STORESLETTEN, "Barriers to Entry and Regional Economic Growth in China," *Review of Economic Studies* (forthcoming).

BRANDT, L., J. VAN BIESEBROECK AND Y. ZHANG, "Creative Accounting or Creative Destruction? Firm-Level Productivity Growth in Chinese Manufacturing," *Journal of Development Economics* 97 (2012), 339–351.

HSIEH, C.-T. AND P. J. KLENOW, "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics* 124 (2009), 1403–1448.

NATIONAL BUREAU OF STATISTICS, *2007 National Input-Output Table for 135 Industries* (Distributed by the National Bureau of Statistics (accessed September 2016), 2007).

———, *China Statistical Yearbook* (Distributed by the National Bureau of Statistics (accessed September 2016), 2009).

RESTUCCIA, D. AND R. ROGERSON, "Policy Distortions and Aggregate Productivity with Heterogeneous Establishments," *Review of Economic Dynamics* 11 (2008), 707–720.

STATE ADMINISTRATION FOR INDUSTRY AND COMMERCE, *2008-2012 Business Inspection Database* (Distributed by the Center for Enterprise Research at Peking University, Beijing (accessed September 2016), 2012).

———, *1995-2015 Business Registry of China Database.* (Distributed by the Center for Enterprise Research at Peking University, Beijing (accessed September 2016), 2015).