Serial Entrepreneurship in China*

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Abstract

This paper studies entrepreneurship and the creation of new firms in China through the lens of serial entrepreneurs, i.e. entrepreneurs who establish more than one firm, and their differences with non-serial entrepreneurs. Drawing on data on the universe of all firms in China, we document key facts about serial entrepreneurship in China since the early 1990s and develop a theoretical framework to rationalize the role of endowments, ability, and capital market frictions in their behavior. We also examine the key determinants of the sectoral choice for serial entrepreneurs' second firms. Quantitatively, serial entrepreneurs are more productive, raise more capital, and operate larger firms than non-serial entrepreneurs. Moreover, serial entrepreneurs with greater liquidity and firms similar in their productivity are more likely to operate these firms concurrently rather than sequentially. We also find that less productive serial entrepreneurs are more likely to switch sectors when establishing new firms, with the choice of sector influenced by considerations of risk diversification, upstream and downstream linkages, and sectoral complementarities.

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1 Introduction

The creation of new productive firms is an important engine of growth, especially in emerging economies. China's high growth has been accompanied by high rates of entry of new firms that on average have been significantly more productive than existing firms (Brandt, Van Biesebroeck and Zhang (2012)). While most entrepreneurs start only a single firm during their lifetime, some entrepreneurs start and operate a series of firms. A small number of studies for other countries document that in upwards of a quarter of all firms may be those of such *serial entrepreneurs* (SEs).

This paper studies entrepreneurship and the creation of new firms in China through the lens of serial entrepreneurs and their differences with entrepreneurs who only start a single firm (*non-serial entrepreneurs*). These differences are informative about the underlying frictions and dynamics of entrepreneurship. In principle, serial entrepreneurs could be highly able individuals good at identifying new business opportunities; alternatively, their advantage may lie in access to scarce factors or connections, which helps them access finance and overcome barriers that might exist. If the former, we expect them to be better than average; if the latter, we expect the opposite. We also explore sectoral choices of SEs which are revealing of other frictions these entrepreneurs face.

Studying serial entrepreneurs is often constrained by data availability. One needs data capturing entrepreneurial activity of individuals over their lifetime, as well as data on the outcomes of these firms. In this paper, we leverage two unique data sources for Chinese firms: the Business Registry of China and the Inspection Database. These data allow us to document salient facts about entrepreneurship and serial entrepreneurship over the period between 1995-2015. The Business Registry of China contains information on all firms that have ever operated in China and includes unique identifiers for the main owner(s) of each firm at the time of establishment, which allow us to identify serial entrepreneurs. These data also allow us to observe sectoral choices of serial entrepreneurs, most notably, the sector and location of the second firm given the choices with respect to the first. The Inspection Data, which runs from 2008 to 2012, provide annual information on firms' assets, liabilities, total sales, profits, and taxes paid. We link these data sources and use the data to calculate relative TFP, debt, equity, and capital for each firm.

To guide our empirical measurements, we develop a simple two-period model of firm creation, in the spirit of Hopenhayn (1992). Each period, potential entrepreneurs receive the option to start a new firm with a stochastic productivity. Operating a firm requires capital, and entrepreneurs can use their own equity or rent capital from banks. The model has one key friction that captures frictions in capital markets – the interest rate for borrowing is higher than the return on bank deposits.

The theory has a number of implications. We first study the allocation of capital and debt across firms with different productivity. According to the model, both installed capital and debt should be larger for more productive firms because it is optimal to install more capital in firms with higher TFP. High-TFP firms are therefore more likely to be debt financed. The data for Chinese firms conform tightly with these predictions.

We then study implications for how SE should differ from non-serial entrepreneurs. The theory predicts that the first firm started by an SE should be more productive than other firms in the same industry. However, the predictions for TFP of the subsequent firms started by the SE depend crucially on the economic forces and frictions prevalent in the economy. The productivity of these firms is shaped by a fundamental trade-off between persistence of productivity (i.e., across different productivity draws for an individual entrepreneur) and the entrepreneurs' access to scarce factors. On the one hand, if productivity is highly persistent across different firms which an individual might start, then SE will become positively selected on productivity, and one should observe that the firms of the SE are more productive than other firms. On the other hand, if the main advantage

of SE is their ability to get access to scarce factors such as capital, then SE will become negatively selected on productivity, and one should observe that the firms of the SE are less productive than other firms

In line with the productivity-persistence force, we find that the 1st-SE firm is significantly more productive than other firms in their industry. Moreover, the 2nd-SE firm is even more productive. Relative to their peers, the 1st- and 2nd-SE firms are 11% and 18% more productive, respectively. The evidence in China points toward entrepreneurs becoming SEs for efficiency reasons – productivity is highly persistent across firms started by the same entrepreneur and better entrepreneurs start more firms.

We also study the extent to which SEs operate multiple firms concurrently or sequentially, i.e., that old firms are closed when new firms are established. Our theory predicts that entrepreneurs who have larger endowments and/or have a more productive first firm are more likely to operate firms concurrently. Moreover, SEs with firms that have relatively similar TFP are also more likely to run them concurrently. Conversely, SEs with a larger gap in TFP between firms − one firm being substantially more productive than the other − are more likely to run these firms sequentially due to a larger opportunity cost of capital. These predictions are borne out in the data. This evidence points to financial frictions as an important feature of entrepreneurship in China, consistent with the view that access to finance has been difficult for private entrepreneurs in China (Hsieh and Klenow (2009); Song, Storesletten and Zilibotti (2011); Lardy (2019)).

To study migration across sectors, we extend the model to incorporate a choice of industry for subsequent firms, given the initial industry of the first firm. We consider several motives for sectoral choice, including (1) learning about own comparative advantage for a particular sector; and (2) diversification of sector-specific risk. The key assumption is that the persistence of TFP draws across firms is larger for firms operating in the same industry than for firms in more distant industries. This captures a form of learning in the spirit of the Jovanovic (1979) learning model: if one is relatively successful (unsuccessful) at operating a firm in a particular sector s, then a future firm started in sector s by the same entrepreneur can also be expected to be relatively successful (unsuccessful). The model predicts that firms started in the same sector by the same entrepreneur should be more productive than firms started in different sectors. To study diversification, we assume that each sector has an industry-specific return to capital. These returns are imperfectly correlated across sectors, which creates a hedging motive for sector choice.

The theoretical predictions for sectoral migration are born out in the data. While the vast majority of serial entrepreneurs start firms in different industries (60% of SE locate their 2nd-SE firm in a different 3-digit industry), the firms that operate in the same industry are substantially more productive than other firms. If the 2nd-SE firm is in a different 1-digit industry, then the TFPs for both 1st- and the 2nd-SE firms are around 67% lower than the case when the 1st- and the 2nd-SE firms are in the same industry. Entrepreneurs's sectoral choices suggest a motive for diversification: sectors with a lower covariance (of return to capital) with the sector of the first firm are chosen more frequently. Moreover, the firms in the sectors with low covariance (with the first sector) have lower TFP on average. Finally, conditional on switching sectors, entrepreneurs are more likely to choose sectors with strong input-output linkages and sectors that share the same downstream and/or upstream links.

Our paper contributes to the small but growing literature that recognizes that entrepreneurship is a "serial" activity, i.e. entrepreneurs establish multiple firms over their lifetimes. A number of studies document that serial entrepreneurship is common in the US and other countries.[1] These

[1]See, for example, Holmes and Schmitz (1990, 1995), Chari, Golosov and Tsyvinsky (2005), and Lafontaine and Shaw (2016) for the US; Westhead and Wright (1998) for the UK; Wagner (2003) for Germany; Hyytinen and

and other studies discuss the relative importance of entrepreneurial learning by doing, ability, and luck in understanding serial entrepreneurship.[2] Finally, Feliz, Karmakar and Sedlacek (2021) provides stylized facts on serial entrepreneurs in Portugal, including that they have larger and more productive firms.

We contribute to the literature on serial entrepreneurship in several ways. First, using the universe of all firms in one country (China) we conduct a comprehensive empirical analysis on serial entrepreneurship and map out the rich empirical facts and patterns related to the firms started by serial entrepreneurs. Second, we develop a theoretical framework that is consistent with the documented facts and use it to highlight the key features needed to understand the emergence of serial entrepreneurs and the performance of the firms they operate. Finally, we highlight the fact that the observed behavior of serial entrepreneurs reflects, and thus sheds light on, the existing underlying frictions in the economy that determine the behavior of all entrepreneurs.

Our paper also contributes to the broader literature on entrepreneurship (e.g., Quadrini (2000) and Cagetti and De Nardi (2006)) and the effect of distortions and misallocations on economic development and growth (see e.g., Restuccia and Rogerson (2008) and Hsieh and Klenow (2009)). In this context, a country's financial system is seen as critical to the nexus between entrepreneurship and growth (King and Levine (1993a,b)). Especially important is the role of liquidity, intermediation, and financial constraints (Evans and Jovanovic (1989)), which may prevent individuals from starting new firms and may lead to a misallocation of resources among currently operating firms (e.g., Erosa (2001), Buera, Kaboski and Shin (2011), Midrigan and Xu (2014), and Moll (2014)). These papers, however, do not analyze serial entrepreneurship.

The rest of the paper is organized as follows. Section 2 describes the datasets used in the paper and provides an introductory discussion of entrepreneurship and serial entrepreneurship in China. Section 3 lay out a stylized model of entrepreneurship and serial entrepreneurship. Section 4 confronts the theoretical predictions with our Chinese data on serial entrepreneurship. Section 5 extends the theoretical and empirical analysis to study the sectoral migration choices of serial entrepreneurs, i.e., the industry where a serial entrepreneur locates the second firm. Section 6 concludes.

2 Datasets and a First Look at Serial Entrepreneurs

2.1 Business Registry of China

Our primary data source for analyzing the behaviour of serial entrepreneurs is the Business Registry of China Database which is maintained by the State Administration of Industry and Commerce (SAIC). From now on we will refer to it as the *Registry Data*.

The Registry Data captures all firms established in China since 1949. It contains information on the year of establishment, exit date (if applicable), primary 4-digit industry, location, background of its legal representative, registered capital, and investors in the firm and their share.[3] The firm investors are classified into three groups − individuals, enterprises, or the government. For each investor, we know their total paid-in capital and date of investment into the firm. Unique investor

Ilmakunnas (2007) for Finland; Amaral, Baptista and Lima (2011) and Rocha, Carneiro and Amorim Varum (2015) for Portugal; Shaw and Sorenson (2019) for Denmark; Carbonara, Tran and Santarelli (2020) for Vietnam.

[2]See, for example, Plehn-Dujowich (2010), Gompers, Kovner, Lerner and Sharfstein (2010), Zhang (2011), Chen (2013), Parker (2013, 2014), Rocha et al. (2015).

[3]Registered capital is total capital contributed by all investors in the firm. A small percentage of unincorporated firms such as TVEs do not have registered capital. We retain these firms but drop those incorporated firms with no registered capital information. We also drop firms with missing or invalid information on location and industry.

identifiers (IDs) allow us to trace out each entrepreneur's investment history.

We use a snapshot of the data at the end of 2015, supplemented with information collected by SAIC on changes in the registered capital of firms, and report all empirical facts for the post-1995 time period.[4,5]

The structure of the dataset. The Registry Data, and thus the information available to us, has the following structure.

- *Operating firms in 2015.* For all existing firms, as of the end of 2015, the Registry Data provides information on the current ownership of the registered capital in the firm. For each investor in the firm we know the value and their share of registered capital and the year it was acquired.
- *Firms that went out of business before 2015.* For firms that went out of business in year T, prior to 2015, the Registry Data provides information on the ownership of the registered capital in the firm in year T. For each investor in the firm we know the value and share of their registered capital in year T and the year it was acquired.

As we discuss later in section 2.3, this organization of the dataset allows us to have a very precise view of the ownership structure of the Chinese firms in our baseline sample.

2.2 Inspection Database

The Registry Data provides comprehensive ownership information on all firms ever established in China since 1949. To analyze firm performance, we draw on complementary data collected by SAIC for regulatory purposes that provides annual information on firm's assets, liabilities, total sales, total profit, net profit, and total taxes. We will refer to these data as the *Inspection Data*. Responsibility for collection was delegated to local SAIC offices, which originally was done manually. In 2007, information began to be collected digitally, which contributed to a significant increase in its coverage.[6] The inspection system was abolished in 2014 as part of the reform of the business registry system, and replaced by an annual self-reporting system. For quality reasons, we restrict our use to 2008-2012. The Appendix provides more detail on the number of firms with information we use.

2.3 Business Registry of China: Ownership Information

Table 1 provides information on the ownership types of firms in China between 1995 and 2015. In order to classify firms into various ownership categories we identify the largest shareholder in

[4]There are snapshots of the Business Registry for later years, but these data are less accurate. A combination of reform of the Business Registry system in 2014 and evaluation of local government officials based on new firm entry likely contributed to a growing number of shell (fake) companies. Simultaneously, stricter rules regarding firm liquidation that increased these costs likely reduced firm exit. In Table 4 below, the slightly higher (lower) rate of entry (exit) in 2014 and 2015 for non-serial and serial firms may be related to these issues. As explained more fully below, most of our analysis uses data through 2012.

[5]SAIC records in a separate database all changes in firm location, registered capital, and ownership in the form of unstructured texts. We successfully extract and use the data on changes in registered capital of firms over time, which shows that approximately 10% of firms updated their initial registered capital. The ownership information is harder to extract because of the more complicated format of the data reported.

[6]Between 2007 and 2008, the number of prefectures that were not reporting declined from 159 to 98, and by 2012 fell to 81, which were concentrated in 7 provinces.

a firm: either an individual, an enterprise, or the government. For a declining fraction of firms − primarily township and village enterprises − shareholder information is not reported. We classify those as *Unreported* in Table 1.

Table 1: Firms in China, by Ownership Type, Registry Data, 1995-2015.

Year	Based on largest shareholder							Unreported
	Total	Unregistered	Individual			Enterprise		
			Single	Multiple	No citizenship ID	Single	Multiple	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1995	1,430,103	696,360	167,405	282,714	23,409	185,971	74,244	1,308,997
1996	1,643,682	744,208	190,893	388,025	30,089	196,750	93,717	1,316,905
1997	1,871,490	782,314	218,856	515,180	36,410	205,797	112,933	1,258,499
1998	2,140,039	796,678	258,381	695,444	44,544	211,512	133,480	1,116,969
1999	2,391,549	792,066	298,586	884,976	50,206	215,840	149,875	976,950
2000	2,695,474	777,957	349,285	1,126,996	58,210	215,650	167,376	814,285
2001	3,035,907	749,190	413,114	1,411,723	69,150	210,493	182,237	662,684
2002	3,471,415	732,381	502,352	1,750,830	81,662	206,339	197,851	551,899
2003	4,009,790	706,995	603,567	2,184,454	95,541	201,932	217,301	462,327
2004	4,618,975	678,845	728,560	2,667,475	112,286	197,961	233,848	387,707
2005	5,227,288	652,670	848,383	3,149,658	127,626	198,133	250,818	328,340
2006	5,823,894	627,669	1,025,673	3,557,152	142,378	205,643	265,379	285,420
2007	6,250,449	595,254	1,173,769	3,840,937	151,779	213,192	275,518	240,008
2008	6,694,951	566,598	1,323,365	4,142,290	158,127	221,270	283,301	214,270
2009	7,392,919	553,404	1,515,931	4,619,457	172,394	233,686	298,047	196,156
2010	8,344,938	545,334	1,763,082	5,267,974	193,274	252,365	322,909	180,745
2011	9,449,050	548,094	2,056,461	6,002,784	216,729	273,391	351,591	165,736
2012	10,433,087	546,815	2,341,327	6,636,122	237,491	293,355	377,977	149,325
2013	11,993,517	578,233	2,875,091	7,528,168	278,799	320,477	412,749	142,201
2014	14,664,539	619,902	3,847,231	8,899,364	454,639	369,777	473,626	138,690
2015	17,823,017	757,257	5,143,272	10,353,350	585,905	431,477	551,756	133,561

Notes: Authors' calculations from the Registry Data. Ownership type is identified based on the largest shareholder in a firm: either an individual, an enterprise, or the government.

Firms for which the largest investor is not registered are classified as *Unregistered*. In most of these cases, the largest investor is a government entity such as the State-owned Assets Supervision and Administration Commission(SASAC), or an unincorporated enterprise, i.e. an enterprise that had not been formally incorporated as part of China's Corporate Law in 2004, which include collectively- and state-owned enterprises.

Firms for which an individual is the largest investor are classified as *Individual*. We further disaggregate the *Individual* firms into three groups: (i) Single, if there is only one investor, (ii) Multiple, if there are multiple investors, and (iii) firms for which there is no information on the ID of the largest individual shareholder. Firms for which an enterprise is the largest investor are classified as an *Enterprise*. These are also divided into two groups based on whether the enterprise is the only investor in the firm or not.

As Table 1 illustrates, China has experienced a significant rise in the number of firms operating in the economy − from around 3 million (columns (1) plus (8)) in 1995 to 18.1 million in 2015. Most of this increase is driven by a dramatic increase in firms with individual investors: either single or multiple. Even though these *Individual* firms are smaller than the *Enterprise* and the *Unregistered*

firms, based on their average registered capital as reported in Table 2, the rapid increase in their numbers makes them the main engine of growth in China over this period.

Table 2: Average Registered Capital, in Millions of Yuans, by Ownership Type, Registry Data, 1995-2015.

Year	Total	Unregistered	Individual		Enterprise	
			Single	Multiple	Single	Multiple
1995	7.28	8.40	1.74	2.69	9.45	22.35
1996	7.00	8.41	1.70	2.60	9.59	20.60
1997	6.76	8.45	1.71	2.52	10.02	19.29
1998	6.48	8.68	1.70	2.39	10.50	18.53
1999	6.52	9.51	1.70	2.30	12.13	18.23
2000	6.47	10.24	1.69	2.24	14.34	18.46
2001	6.37	11.07	1.70	2.22	16.47	19.38
2002	6.20	11.96	1.62	2.17	18.82	20.20
2003	6.29	13.43	1.65	2.18	25.26	21.13
2004	6.14	14.84	1.67	2.18	27.68	23.33
2005	6.03	16.53	1.68	2.21	29.31	24.52
2006	6.00	18.39	1.68	2.27	30.37	25.95
2007	6.52	23.36	1.74	2.42	32.54	29.21
2008	6.74	26.41	1.79	2.53	34.35	31.98
2009	6.91	28.99	1.84	2.70	36.59	35.30
2010	7.13	31.78	1.93	2.93	39.10	39.02
2011	7.32	34.20	1.96	3.18	41.23	43.01
2012	7.53	36.96	2.01	3.34	43.63	46.69
2013	7.62	39.58	1.95	3.51	44.78	50.63
2014	7.83	40.66	2.24	4.09	45.65	54.20
2015	7.71	35.94	2.44	4.40	43.63	55.29

Notes: Authors' calculations from the Registry Data.

Universe of firms in the analysis. The analysis in this paper is focused on firms for which the largest shareholder is an individual: either single or multiple, as classified in columns (3) and (4) in Table 1. The share of these firms, excluding the *Unreported* firms in column (8), increases from 31% of all firms in 1995 to 87% in 2015. By 2015, as reported in Appendix Table A-3 which also excludes the *Unreported* firms, these firms held 42.3% of all the registered capital in the economy, up from 10.1% in 1995.

Since we have a "snapshot" of the Registry data at the end of 2015, the organization of the dataset implies that we cannot reconstruct the entire ownership history of each firm since its establishment. If we had access to earlier "snapshots" of the dataset, then that would be feasible. However, this is not a serious drawback for the analysis of our baseline sample of *Individual* firms, either single or multiple. For more than 80% of all *Individual* firms, either operating or out of business in 2015, the individual that currently owns the firm or owned it when it went out of business is also the individual that established it. We are able to infer this from the data since in those cases the year in which the firm was established is identical to the year in which the individual acquired the registered capital in the firm.

Entrepreneur. Based on the universe of firms in our analysis, an entrepreneur will be defined as an individual investor with the largest share in a firm at the time of the firm's establishment or acquired later.

2.4 Serial Entrepreneurs in the Business Registry of China

We now provide our definition of a serial entrepreneur, describe how we identify firms that belong to serial entrepreneurs, and discuss several preliminary findings regarding serial entrepreneur firms.

Serial entrepreneur. We define a serial entrepreneur as an investor that is or has been defined as the "Entrepreneur" for more than one firm. In other words, a serial entrepreneur is an individual that is the largest shareholder, not necessarily concurrently, in at least two firms.

Identifying a serial entrepreneur (SE) firm. We look at the period up through 2015 in order to identify an individual as a serial entrepreneur. Any entrepreneur that established two or more firms by 2015 is classified as serial. Then, using each firm's establishment date, we classify each serial entrepreneurs' firms as first (1st-SE), second (2nd-SE), and so forth. All other firms are classified as firms belonging to individuals that are not serial entrepreneurs, or Non-SE firms. In the following analysis, we use *1st-SE* to represent the first firm of SE and *2nd-SE* to denote second and following firms of SE.

SE firms over time. Table 3 highlights the changing role of SE firms over time in our data. By construction, we likely underestimate the number and role of SE firms in later years as the window for new entrepreneurs to start 2nd firms narrows. As shown in column (2), the fraction of SE firms increased from 30.6% in 1995 to 33.9% in 2005 before falling to 28.2% in 2015. We observe similar behavior with respect to registered capital of SE firms which increased from 42.6% in 1995 to a high of 50.0% in 2011 before falling to 46.9% in 2015. Over the entire period, the average registered capital in SE firms is about two times larger than in Non-SE firms and has increased over time.

The changing role over time of SE firms, in terms of their number, can be a product of differences in either entry or exit patterns, which we report separately by type of firm in Table 4.[7] Entry rates for 1st-SE firms lag those for Non-SE firms for most years, but this is more than offset by the higher entry rate for 2nd SE firms. Exit rates for SE and Non-SE firms are fairly similar for both groups and rise up through 2007 before falling afterwards. In summary, the growing role of SE firms over time documented in Table 3 is due to the higher entry rates of 2nd SEs and larger registered capital of SEs.

Finally, we document that in the majority of cases new SE firms are started while the previously established SE firm is still operating. Column (1) in Table 5 lists firms, for each entrepreneur, based on the date of establishment. Column (2) in Table 5, reports only the newly established firms for which the previously established firm is still operating: e.g., 2nd-SE firm while the 1st-SE firm is still operating, or 3rd-SE firm while the 2nd-SE firm or 1st-SE is still operating. Clearly, most of the new firms are run concurrently with the previously established firms: in total, 86.2% of the serial entrepreneurs establish their second firm and following firms concurrently with their previous firm.

[7] Because of a reform in the registry system, entry (exit) rates in 2014 and 2015 are not comparable with estimates for earlier years, and likely over (under) estimate true rates.

Table 3: Serial Entrepreneur Firms, Registry Data, 1995-2015.

Year	Number of firms		Total registered capital (in trill.)		Mean registered capital (in mill.)	
	Number	SE (%)	Capital	SE (%)	SE	Non-SE
	(1)	(2)	(3)	(4)	(5)	(6)
1995	353,319	30.61	0.82	42.58	3.22	1.91
1996	476,077	31.08	1.07	44.25	3.19	1.81
1997	625,160	31.58	1.38	43.98	3.07	1.80
1998	839,072	32.11	1.77	44.71	2.94	1.72
1999	1,065,698	32.65	2.19	45.11	2.84	1.67
2000	1,360,283	33.14	2.74	46.39	2.82	1.61
2001	1,714,500	33.54	3.42	46.54	2.77	1.61
2002	2,144,883	33.71	4.18	46.92	2.72	1.56
2003	2,681,983	33.90	5.27	47.35	2.75	1.57
2004	3,299,761	33.91	6.51	47.66	2.77	1.56
2005	3,906,842	33.93	7.83	47.68	2.82	1.59
2006	4,499,496	33.73	9.21	47.69	2.90	1.62
2007	4,938,521	33.64	10.70	48.06	3.09	1.70
2008	5,395,817	33.51	12.19	48.44	3.27	1.75
2009	6,072,664	33.29	14.55	49.03	3.53	1.83
2010	6,971,506	32.90	18.09	49.48	3.90	1.95
2011	8,003,341	32.27	22.29	49.99	4.31	2.06
2012	8,922,821	31.67	25.98	49.71	4.57	2.14
2013	10,347,113	30.58	31.05	49.32	4.84	2.19
2014	12,684,705	29.46	43.84	48.31	5.67	2.53
2015	15,351,831	28.21	60.22	46.94	6.53	2.90

Notes: Authors' calculations from the Registry Data. SE stands for Serial Entrepreneur firms. Capital is calculated based on the registered capital in a firm.

3 A Model of Entrepreneurship

We now lay out a model of entrepreneurship. Before studying the decision to become a serial entrepreneur, Section 3.1 analyzes the decision to start a firm, i.e. to become an entrepreneur in a static setting. In Section 3.2 we interpret this as the first period of a dynamic model, where we study serial entrepreneurship. Capital market frictions play a prominent role in China ((Hsieh and Klenow (2009); Song et al. (2011)), and in such an environment, both endowments (equity) and entrepreneurial ability matter for the decision to start a firm. The static model will allow us to derive theoretical predictions about the relationship between total factor productivity (TFP), assets, debt and equity.

3.1 First Period: TFP, Capital, and Debt in a Static Model

Consider an economy populated by a fixed set of (potential) entrepreneurs who may choose to operate firms. Firms produce a homogenous good with decreasing returns to scale. The production function is Cobb-Douglas,

$$y_i = z_i^{1-\eta} \left(k_i^{1-\alpha} n_i^{\alpha}\right)^{\eta} , \tag{1}$$

where y_i is the firm's value added, k_i is the firm's capital stock, n_i is the firm's employment, z_i is the firm's total factor productivity, $\eta \in (0,1)$, and $\alpha \in (0,1)$. There is a fixed cost ν for operating the firm.

Table 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	245,184	75,026	1,368	43.74	0.80	94,771	30,082	361	46.24	0.55	13,364	4,083	45	43.78	0.48
1996	328,122	86,795	3,857	35.40	1.57	129,162	35,493	1,102	37.45	1.16	18,793	5,656	227	42.32	1.70
1997	427,721	107,528	7,929	32.77	2.42	170,545	43,664	2,281	33.81	1.77	26,894	8,538	437	45.43	2.33
1998	569,607	155,760	13,874	36.42	3.24	229,270	62,946	4,221	36.91	2.48	40,195	14,167	866	52.68	3.22
1999	717,729	175,139	27,017	30.75	4.74	290,023	69,929	9,176	30.50	4.00	57,946	19,737	1,986	49.10	4.94
2000	909,536	227,523	35,716	31.70	4.98	366,075	87,945	11,893	30.32	4.10	84,672	29,718	2,992	51.29	5.16
2001	1,139,399	283,334	53,471	31.15	5.88	453,020	104,514	17,569	28.55	4.80	122,081	42,932	5,523	50.70	6.52
2002	1,421,780	350,911	68,530	30.80	6.01	548,311	120,301	25,010	26.56	5.52	174,792	60,755	8,044	49.77	6.59
2003	1,772,821	442,237	91,196	31.10	6.41	657,844	144,159	34,626	26.29	6.32	251,318	88,057	11,531	50.38	6.60
2004	2,180,848	525,563	117,536	29.65	6.63	776,224	160,930	42,550	24.46	6.47	342,689	108,407	17,036	43.14	6.78
2005	2,581,179	544,575	144,244	24.97	6.61	879,714	154,377	50,887	19.89	6.56	445,949	126,796	23,536	37.00	6.87
2006	2,981,665	580,523	180,037	22.49	6.97	965,436	145,174	59,452	16.50	6.76	552,395	138,356	31,910	31.03	7.16
2007	3,277,086	564,395	268,974	18.93	9.02	1,017,901	134,546	82,081	13.94	8.50	643,534	139,312	48,173	25.22	8.72
2008	3,587,587	577,054	266,553	17.61	8.13	1,071,828	132,180	78,253	12.99	7.69	736,402	144,553	51,685	22.46	8.03
2009	4,051,297	728,279	264,569	20.30	7.37	1,150,743	153,948	75,033	14.36	7.00	870,624	188,445	54,223	25.59	7.36
2010	4,677,688	898,131	271,740	22.17	6.71	1,239,215	161,397	72,925	14.03	6.34	1,054,603	241,401	57,422	27.73	6.60
2011	5,420,688	1,053,245	310,245	22.52	6.63	1,319,033	158,017	78,199	12.75	6.31	1,263,620	276,005	66,988	26.17	6.35
2012	6,097,177	1,051,010	374,521	19.39	6.91	1,366,441	133,261	85,853	10.10	6.51	1,459,203	278,569	82,986	22.05	6.57
2013	7,182,716	1,437,989	352,450	23.58	5.78	1,431,581	142,323	77,183	10.42	5.65	1,732,816	359,868	86,255	24.66	5.91
2014	8,947,389	2,046,414	281,741	28.49	3.92	1,515,725	141,247	57,103	9.87	3.99	2,221,591	557,685	68,910	32.18	3.98
2015	11,021,518	2,375,714	301,585	26.55	3.37	1,536,162	72,372	51,935	4.77	3.43	2,794,151	650,190	77,630	29.27	3.49

Notes: Authors' calculations from the Registry Data. 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 5: Firms Run Concurrently by Serial Entrepreneurs, Registry Data, 1995-2015.

Type	Number of Firms (1)	Number of Firms of Entrepreneurs with Prior Firm Still Operating (2)	Concurrent Ratio (in %) (3)
Non-SE	14,428,235	–	–
1st-SE	2,417,998	–	–
2nd-SE	2,477,153	2,044,358	82.5%
3rd-SE	636,878	594,934	93.4%
4th-SE	218,323	211,460	96.9%
5th-SE	89,340	87,691	98.2%
6th-SE+	91,447	90,674	99.2%
Total 2nd-SE+	3,513,141	3,029,117	86.2%

Notes: Authors' calculations from the Registry Data. Concurrently run firms are those that are established while the previous firm is still operating.

Firms hire labor at a constant wage rate w. There exists a financial intermediary which takes deposits and offer loans. The financial contracts pay off at the end of the period. The intermediary offers a gross return R_s on savings deposits and charges a return R_b on lending to entrepreneurs.[8] There is a spread in interest rates between deposits and debt; $R_s < R_b$.[9] The borrowing-lending

[8]The economy can be interpreted as a small open economy insofar as the prices w, R_s, and R_b are taken as given.

[9]In the exposition of the model we abstract from output wedges. Introducing a common output wedge for all

spread is the only friction in the model.

The entrepreneur starts with equity $e \geq 0$ and an opportunity to operate (or start) one firm with potential TFP z. The entrepreneur has two alternative investment opportunities for her equity. She can either invest capital k in the new firm or invest in deposits s or both. She can also borrow b to finance the capital inputs. The entrepreneur's budget constraint is $k = e + b - s$. It is convenient to use this budget constraint to substitute out deposits from the problem; $s = e + b - k$. Conditional on having chosen to operate, the firm's objective is given by

$$\begin{aligned} \Pi &= \max_{k,n,b} \{y - wn - R_b b + R_s (e + b - k)\} \\ &\quad \text{subject to} \\ b &\geq 0, \qquad s = e + b - k \geq 0. \end{aligned}$$

Note first that since $R_s < R_b$, it will never be optimal to have positive borrowing and deposits simultaneously. An entrepreneur who is a net borrower will therefore always invest all his/her equity in the firm. Moreover, for simplicity we abstract from depreciation on capital.

The problem can be separated into three different cases: (1) positive deposits; (2) positive debt; and (3) constrained, i.e., zero deposits and zero debt. Thus, an entrepreneur is either constrained, choosing $k = e$ and $n = \arg\max_n \left\{ z^{1-\eta} \left(e^{1-\alpha} n^{\alpha} \right)^{\eta} - wn \right\}$, or unconstrained and choosing $(k, n) = \arg\max_{k,n} \{y - wn - R_i (k - e)\}$, where R_i is entrepreneur i's effective cost of capital, with $R_i = R_s$ for net depositors and $R_i = R_b$ for net borrowers. We summarize the optimal allocation in the following proposition.

Proposition 1. *Consider an entrepreneur with equity e and an option to operate one firm with TFP z. The entrepreneur will operate the firm if and only if TFP is sufficiently large, $z \geq z^*(e)$, where the entry threshold is given by*

$$z^*(e) = \begin{cases} z_b^*(e) & e \leq e_b^* \\ z_c^*(e) & \frac{e}{z} \in (k_b^*, k_s^*) \\ z_s^* & e \geq e_s^* = \frac{v}{1-\eta} \frac{(1-\alpha)\eta}{R_s} \end{cases}, \tag{2}$$

where

$$\begin{aligned} e_b^* &= \frac{\nu}{1-\eta} \frac{(1-\alpha)\eta}{R_b + (R_b - R_s) \frac{(1-\alpha)\eta}{1-\eta}} \\ e_s^* &= z_s^* k_s^* = \frac{v}{1-\eta} \frac{(1-\alpha)\eta}{R_s} \\ z_b^*(e) &= \frac{\nu - (R_b - R_s) e}{1-\eta} \left(\frac{R_b}{(1-\alpha)\eta} \right)^{\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{w}{\alpha\eta} \right)^{\frac{\alpha\eta}{1-\eta}} \\ z_s^* &\equiv \frac{v}{1-\eta} \left(\frac{(1-\alpha)\eta}{R_s} \right)^{-\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{\alpha\eta}{w} \right)^{-\frac{\alpha\eta}{1-\eta}} \\ z_c^*(e) &= \left(\frac{\nu + R_s e}{1-\alpha\eta} \right)^{\frac{1-\alpha\eta}{1-\eta}} (e)^{-\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{w}{\alpha\eta} \right)^{\frac{\alpha\eta}{1-\eta}}, \end{aligned}$$

and where $k_b^* < k_s^*$ and these constants are given by

$$k_j^* \equiv \left(\frac{(1-\alpha)\eta}{R_j} \right)^{\frac{1-\alpha\eta}{1-\eta}} \left(\frac{\alpha\eta}{w} \right)^{\frac{\alpha\eta}{1-\eta}},$$

firms would not affect any of our theoretical results.

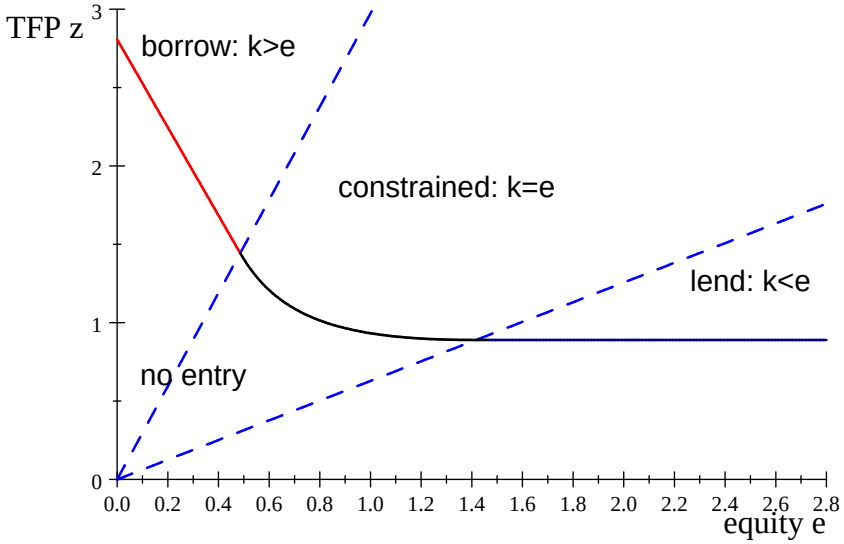
where $j \in \{b, s\}$. Moreover, the optimal installed capital in the firm is given by the function $k^*(z, e)$,

$$\frac{k^*(z,e)}{z} = \begin{cases} k_b^* & \frac{e}{z} \leq k_b^* \\ \frac{e}{z} & \frac{e}{z} \in (k_b^*, k_s^*) \\ k_s^* & \frac{e}{z} \geq k_s^* \end{cases} . \tag{3}$$

Proof. The proof is in the appendix. □

Figure 1 illustrates how the combination of e and z fall into four distinct regimes: no entry, unconstrained, constrained, and borrowing. The solid graph $z^*(e)$ marks the indifference between entry and no entry. The entrepreneur chooses to operate the firm if TFP is $z \geq z^*(e)$ and does not enter if z is below. Note that $z^*(e)$ is falling in e, especially for poor entrepreneurs who have low e. The reason is that the value of operating the firm is larger the more equity the entrepreneur has. Finally, when equity is sufficiently abundant, the threshold $z^*(e)$ is constant.

Figure 1: Entry Decision.



Notes: The figure shows the entry decision for an entrepreneur with equity e and the option to run a firm with TFP z.

Consider now the implied choices of debt and assets, given an allocation of e and z. Define the debt of a firm as assets minus equity, i.e. $d \equiv k - e$. It follows that the debt-equity ratio in the model is given by

$$\frac{d}{e} = \frac{k^*(z,e) - e}{e} = \begin{cases} \frac{k_b^*}{e} z - 1 & e \leq z k_b^* \\ 0 & e \in (z k_b^*, z k_s^*) \\ \frac{k_s^*}{e} z - 1 & e \geq z k_s^* \end{cases}$$

We conclude that the debt-equity ratio is monotone falling in equity and monotone increasing in TFP.

The following corollary summarizes the implications of Proposition 1.

Corollary 1. *The allocations implied by equations (2)-(3) yield the following theoretical predictions about the empirical relationship between equity, capital, debt, and TFP of firms.*

1. *Conditional on TFP, capital is monotone increasing in equity. Moreover, capital per efficiency unit (k/z) is monotone increasing in equity per efficiency unit (e/z).*

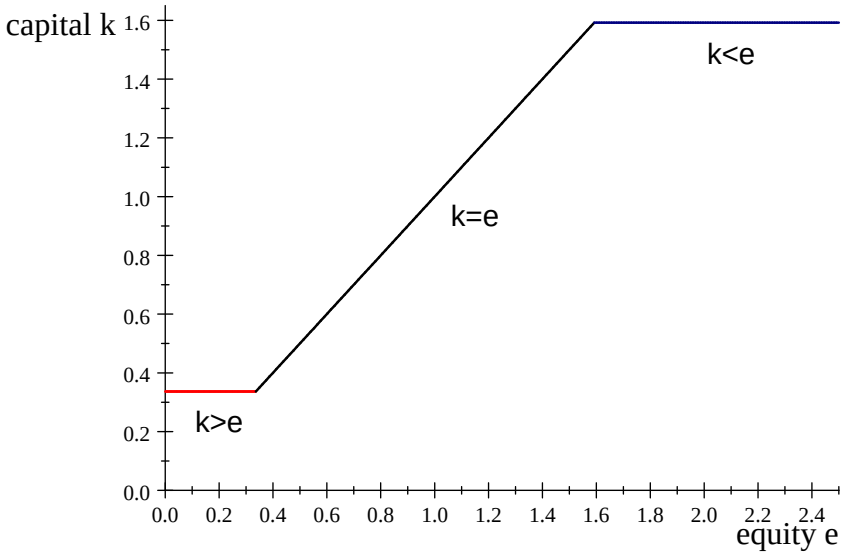
2. *Capital is monotone increasing in TFP.*

3. *The debt-equity ratio is monotone increasing in TFP and monotone decreasing in equity. Moreover, when equity is larger, the debt-equity ratio increases less steeply in TFP.*

Proof: Implications 1 and 2 follow directly from equation (3). Consider now implication 3. Suppose first that $e < zk_b^*$. From equation (3) the debt is $d = zk_b^* - e$, implying that d/e is strictly increasing in z, conditional on e. Next, suppose that $e > zk_s^*$. The debt is then $d = zk_s^* - e$, implying that d/e is strictly increasing in z conditional on e. Finally, suppose that $e \in [zk_b^*, zk_s^*]$. In this case $k = e$, so debt is zero and, hence, non-decreasing in z. QED

Figure 2 illustrates Part 1 of Corollary 1, i.e., the choice of investments as a function of equity (holding TFP constant).

Figure 2: Installed Capital.



Notes: The figure shows the installed capital as a function of equity e for a given level of TFP z.

Finally it is useful to consider a special case of this model when capital markets are perfect, i.e., when there is no borrowing-lending spread ($R_s = R_b$). In this case, capital would be proportional to TFP and independent of equity. Moreover, if the economy was going through a process of improvements in financial markets that involved a narrowing of the borrowing-lending spread, one would expect to see a steeper association (higher correlation) between capital and TFP and a lower correlation between capital and equity over time.

3.2 The Dynamic Model: Becoming a Serial Entrepreneur

We interpret the static model in the previous section as the first period in a two-period dynamic model. To simplify the problem, we assume that the entrepreneur consumes at the end of the second period, so all potential profits from the first period are saved for the second period. Having established the entrepreneurs' and firms' decisions in the first period, we now study the entrepreneurs' choice in the second period.

At the beginning of the period an entrepreneur has equity e and receives a stochastic draw z_2 for a potential new firm. In addition, those entrepreneurs who started and operated a firm in the first period may continue to do so in the second period. The productivity z_1 of the first firm is constant over time. An entrepreneur may choose to operate zero, one, or two firms in the second period. We assume that the entrepreneur can move capital and workers between firms at no cost and that the fixed cost ν has to be paid each period for each firm in operation. It follows that when the entrepreneur at the beginning of the second period has two potential firms available (one from each period), these firms are symmetric in the sense that the history is irrelevant – the only relevant aspect of each firm is their respective TFP.

The performance of young versus old SE firms and SE firms relative to non-serial firms (Non-SE) depend on how TFP for a potential entrepreneur draws are correlated over time. To obtain sharp predictions we make the following assumption.

Assumption 1. *Assume that the TFP of potential firms drawn in the first and second period are related via an AR(1) process,*

$$z_{i2} = \rho z_{i1} + \varepsilon_i, \tag{4}$$

where $\rho \in [0,1]$ captures the autocorrelation of TFP and the random component ε_i is drawn from a symmetric distribution with $E(\varepsilon) = 0$ and c.d.f. F_ε.

3.2.1 A frictionless benchmark

Consider first the case with perfect capital markets, i.e., when $R_s = R_b$. From Proposition 1, an entrepreneur will open a firm in the second period if and only if $z_2 \geq z_s^*$. Note that this decision rule is independent of equity and independent of the TFP draw z_1 for a possible firm in the first period.

To understand the relative performance of serial entrepreneurs in this setting it is useful to state a lemma on conditional expectations.

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

$$E[z|z \geq a, \rho z + \epsilon \geq b] \geq E[z|z \geq a],$$

where $a = z^*(e_0)$ and $b = z^*(e_1)$.

We sketch the proof of this lemma here. See the appendix for a complete proof of Lemma 1. The proof relies on showing that adding the condition that TFP in the second period is sufficiently large, $z_2 \geq b$ for some b which is monotone decreasing in z_1, changes the probability density function of z_1 conditional on operating in the first period ($z_1 \geq z^*(e_0)$) by multiplying the probability density function of z_1 by a weight that is increasing in z_1.

When setting $a = b = z_s^*$ in lemma 1, it is clear that 1st-SE firms will on average have higher TFP than non-serial firms provided that $\rho > 0$. A similar argument shows that 2nd-SE firms are on average also more productive than non-serial firms.[10] The intuition for this is that TFP for the firms of an entrepreneur who twice obtains draws above the common threshold z_s^* must first-order stochastic dominance TFP for firms of entepreneurs who obtained one draw above and one below the threshold.

The ranking of average TFP for the 1st-SE and the 2nd-SE depends on the persistence ρ of draws. In particular, if ρ is sufficiently close to unity, the 2nd-SE firm will on average have a higher

[10] To see this, express the second inequality as $z_2/\rho > \varepsilon/\rho + z_s^*$.

TFP. To see this, note first that the left tail of the realized distribution of ε is always truncated because observing a 2nd-SE in operation requires that $z_2 = \rho z_1 + \varepsilon \geq z_s^*$, which imposes a lower bound on ε. Second, with $\rho = 1$, the expected potential TFP for the 2nd-SE is $z_2 = z_1 + E(\varepsilon) = z_1$. This implies that there is positive selection for the 2nd-SE firm because the entrepreneur would choose to operate it only if the realization of ε were sufficiently large. Therefore, the the realized TFP for 2nd-SE that are put into operation must have an expected TFP larger than z_1.

We summarize these findings in a proposition (the proof is in the text).

Proposition 2. *Consider an entrepreneur who operated a firm in the first period with TFP z_1, and who has the option to start a potential firm in period 2 with TFP z_2. Suppose there are no financial frictions ($R_s = R_b$) and some persistence of TFP draws (ρ). Then both the 1st-SE and the 2nd-SE will have a larger expected TFP than non-serioal entrepreneurs. Moreover, the 2nd-SE will on average have a higher TFP than the 1st-SE if ρ is sufficiently large. Conversely, if $\rho = 0$ then non-serial and serial firms have the same expected TFP.*

3.2.2 Returning to financial frictions

Consider now the choices for entrepreneurs who face financial frictions in the form of a borrowing-lending spread ($R_s \leq R_b$).

The following proposition characterizes the optimal decisions for an entrepreneur who operated a firm in the first period with TFP z_1 and receives an option to start a new firm with TFP z_2. Moreover, the entrepreneur has equity e available. The proposition has two parts. The first part states conditions under which the entrepreneur chooses to become a SE. The second part concerns the decision to run two firms concurrently or to operate just the most productive firm.

Proposition 3. *Consider an entrepreneur with equity e who operated a firm in the first period with TFP z_1 and who has a draw of a potential firm in period 2 with TFP z_2.*

***Part A**: The entrepreneur will operate the 2nd-SE firm and become a SE if z_2 is sufficiently large. There exists a threshold function $Z : \mathbb{R}^2 \to \mathbb{R}$ such that the entrepreneur will operate the 2nd-SE firm if and only if $z_2 \geq Z(z_1, e)$. The threshold function Z, which is characterized in the appendix, is monotone decreasing in equity e and monotone increasing in TFP z_1. Moreover, Z satisfies $Z(z_1, e) \leq z_1$.*

***Part B**: Suppose e, z_1, and z_2 are sufficiently large so that $\min\{z_1, z_2\} \geq z^*(e/2)$. Then the entrepreneur will operate the two firms concurrently if z_1 is sufficiently close to z_2. Moreover, the number of concurrent firms is monotone decreasing in the absolute TFP difference $|z_2 - z_1|$. Conversely, if $\min\{z_1, z_2\} < z^*(e/2)$ then only one firm will operate. Conditional on TFP (z_1, z_2), the number of firms operated concurrently is monotone increasing in equity.*

We sketch the proof of Proposition 3 here, and in the appendix provide a complete proof of Proposition 3. The proof rests on three main steps, which we lay out now.

First, 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.[11] Since the firms are symmetric, this implies that the most productive firm will always be operated 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 $Z(z_1, e) \leq z_1$.

[11] 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.

Second, if the new firm is less productive than the first firm ($z_2 \leq z_1$), the entrepreneur will either operate both firms concurrently – and be recorded as a serial entrepreneur – or continue operating only the first one – and be recorded as a non-serial entrepreneur. Note that even if $z_2 < z_1$ it might be optimal to start the second firm and become a SE, provided that it is optimal to operate the two firms concurrently. Proposition 3 implies that if $z_2 < z_1$, then the entrepreneur will operate two firms concurrently and become a SE if z_2 is sufficiently large: $z_2 \in [Z(z_1, e), z_1]$. When equity is more abundant, the opportunity cost of equity is lower. Therefore, entrepreneurs with more equity are more likely to start the second firm. It follows that $Z(z_1, e)$ is monotone decreasing in e and that the number of firms operated concurrently is monotone increasing in e. In the proof of Proposition 3 we show that when the most productive firm has a TFP $z \in [z_s^*, z_b^*(0))$, there exists a threshold level of equity $\tilde{e}(z_1, z_2) \geq 0$ such that the entrepreneur will operate two firms concurrently if the entrepreneur has equity $e \geq \tilde{e}(z_1, z_2)$; one firm if $e < \tilde{e}(z_1, z_2)$ and $\max\{z_1, z_2\} \geq z^*(e)$; and zero firms if $\max\{z_1, z_2\} < z^*(e)$.[12]

Third, the TFP difference $|z_2 - z_1|$ between the firms matter. For a given amount of equity, 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. Therefore, the threshold $Z(z_1, e)$ is monotone increasing in z_1 while the number of concurrent firms is monotone decreasing in the TFP difference $|z_2 - z_1|$. In other words, the larger the difference in TFP, the lower the chance that the entrepreneur will operate both firms concurrently. Note that if $z_1 = z_2$, equity would be divided equally between the firms if they were to operate concurrently. In this case, both firms would operate if and only if $z_2 \geq z^*(e/2)$.

TFP for serial entrepreneurs :

With a positive borrowing-lending spread the predictions for the TFP of the 1st-SE and 2nd-SE firms are less sharp due to the role of equity.

the entrepreneur choosing to operate the new firm in the 2nd period implies that

$$z_2 = \rho z_1 + \varepsilon \geq Z(z_1, e_2),$$

where equity $e_2 = \Pi(z_1, e_1)$ is given by the accumulated equity after operating the 1st-SE firm for one period.

note first that if ρ is sufficiently large, then the left-hand side of the inequality (3.2.2) will increase faster in z_1 than the right-hand side, regardless of the effects of equity. therefore, the prediction of Proposition 2 will hold up provided that ρ is sufficiently large. Lemma 1 then implies that the TFP of the 1st-SE firm will become smaller than that of non-serial firms. Moreover, it will still be true that if ρ is sufficiently large the TFP of the 2nd-SE will be larger than that of the 1st-SE

As it turns out, the predictions for TFP become ambiguous when ρ is sufficiently small. To see this, recall that the threshold function $Z(z_1, e_2)$ is monotone increasing in first-period TFP z_1. Therefore, when ρ is sufficiently small, the right-hand side of the inequality (3.2.2) will grow faster in z_1 than the left-hand side of the equation. Lemma 1 then implies that if equity e_2 is held constant, the TFP of the 1st-SE firm will become smaller than that of non-serial firms and the TFP of the 2nd-SE will be larger.

[12]Note that the assumptions that at least one firm has TFP $z \geq z_s^*$ and equity being sufficiently abundant, guarantee that at least one firm will operate. Conversely, if both draws for potential firms had TFP $z < z_s^*$, then it would not be optimal to operate any firms, regardless of e.

Consider now the effect of equity e_2. Since the profits of 1st-SE is increasing in z_1, the accumulated equity e_2 will also be increasing in z_1. Since Z is falling in e_2, the accumulated equity is a force for lowering the right-hand side of the inequality (3.2.2) for more productive 1st-SE firms and hence a force for increasing the expected TFP for the 1st-SE, counteracting the effect of a larger z_1 on the first argument of $Z(z_1, e_2)$. We conclude that for ρ sufficiently small, the predictions for TFP are ambiguous.

TFP for concurrent vs. non-concurrent firms: Our theory has implications for how SE firms that are run concurrently differ from SE firms that are non-concurrent. Consider first the TFP of the 1st- and 2nd-SE firms. Part B of Proposition 3 states that conditional on e and the TFP of the 1st-SE firm, the probability that the firms will operate concurrently is falling in the TFP of the 2nd-SE firm. In other words, the more productive is the 2nd-SE firm, the larger is the chance that the 1st-SE firm will cease operation. Conversely, conditional on e and the TFP of the 2nd-SE firm, the more productive is the 1st-SE firm, the larger is the chance that the firms will be run concurrently.[13] This leads to our predictions about concurrent versus non-concurrent serial entrepreneurs, which we state in the following proposition.

Proposition 4. *TFP of 2nd-SE is lower for concurrently run SE firms than of 2nd-SE for non-concurrently run SE firms. Conversely, TFP of the 1st-SE firm is larger for concurrently run SE firms than of 1st-SE for non-concurrently run SE firms.*

The predictions of Proposition 4 are driven by a combination of two assumptions: decreasing return to scale and the presence of a scarce factor – capital in our model.[14] Intuitively, it is optimal to share this factor across concurrently run firms if they have relatively similar productivity, and to allocate all of it to the most productive firm if the difference in productivity is large.

4 Empirical Evidence from the Inspection Data

We now turn to the Inspection Data for the period 2008-2012 and show that the key theoretical predictions of the model developed in Section 3 are consistent with the empirical facts in China.

4.1 Theoretical Predictions Summarized

It is convenient to summarize the theoretical predictions of our model. Proposition 1 and Corollary 1 in Section 3.1 has predictions regarding debt, equity, TFP, and capital for each individual firm. Namely, conditional on equity in a firm, the more productive firms should have more capital and, hence, more debt. We label these predictions as follows,

- *Theoretical Prediction A*: Assets are increasing in TFP, conditional on equity.
- *Theoretical Prediction B*: Assets are increasing in equity, conditional on TFP.
- *Theoretical Prediction C*: Debt-equity ratio is increasing in TFP and decreasing in equity. The larger the equity, the smaller the increase in the debt-equity ratio with TFP.

Propositions 2 and the discussion in Section 3.2 contain the main results on how the firms of serial entrepreneurs differ from non-serial firms, which we summarize as follows,

[13] Note also that if the TFP of the 1st-SE firm is sufficiently higher than the TFP draw of the potential 2nd-SE firm, the entrepreneur would not start the 2nd-SE firm and she would be recorded as a non-serial entrepreneur.

[14] Note that Proposition 4 does not require Assumptions **??** and 1.

- *Theoretical Prediction D*: If ρ is sufficiently large, then capital and TFP of 2nd-SE firms are larger than capital and TFP of 1st-SE firms and capital and TFP of 1st-SE firms are larger than capital and TFP of Non-SE firms.

Proposition 4 contains the main results on how concurrently run firms of serial entrepreneurs differ from their non-concurrently run firms. This can be summarized in:

- *Theoretical Prediction E*: TFP of 1st-SE (2nd-SE) firms is higher (lower) for concurrently run 1st-SE (2nd-SE) firms than those run non-concurrently.

4.2 Measuring Firm TFP

Before testing the theoretical predictions, we outline how me measure (relative) TFP.

The Inspection Data do not have all the information required to compute a firm's level of TFP directly.[15] However, we can use data on capital and value added to calculate a firm's TFP *relative* to the average TFP in a group of firms that face the same wage rate w.[16] We focus on firms within a province-industry-year cell, and assume implicitly that all firms in a province-industry cell in a particular year pay the same wage rate w. The other variables are also computed relative to that variable's average of all firms in a province-industry-year cell.

Using the first-order condition for labor, equation (A-1), to derive an expression for a firm's labor demand n and substituting this into the production function (1) yields

$$y_i = z_i^{1-\eta} k_i^{(1-\alpha)\eta} \left(\frac{\alpha\eta}{w} y_i\right)^{\alpha\eta}.$$

This provides an expression for TFP as a function of capital, value added, and the wage rate,

$$z_i = y_i^{\frac{1-\alpha\eta}{1-\eta}} \left(\frac{w}{\alpha\eta}\right)^{\frac{\alpha\eta}{1-\eta}} k_i^{-\frac{(1-\alpha)\eta}{1-\eta}}.$$

The average TFP $\bar{z}$ in a province-industry-year cell is then

$$\bar{z} = \sum_i \omega_i y_i^{\frac{1-\alpha\eta}{1-\eta}} \left(\frac{w}{\alpha\eta}\right)^{\frac{\alpha\eta}{1-\eta}} k_i^{-\frac{(1-\alpha)\eta}{1-\eta}},$$

where ω_i is the relative weight in value added of each observation i. Then, the TFP of firm i relative to the average TFP $\bar{z}$ in a particular province-industry-year cell is:

$$\frac{z_i}{\bar{z}} = \frac{y_i^{\frac{1-\alpha\eta}{1-\eta}} k_i^{-\frac{(1-\alpha)\eta}{1-\eta}}}{\sum_i \omega_i y_i^{\frac{1-\alpha\eta}{1-\eta}} k_i^{-\frac{(1-\alpha)\eta}{1-\eta}}}. \tag{5}$$

This ratio can be computed using available data on firm i's value added y_i and capital k_i.[17]

4.3 Correlation of Assets and Debt-Equity Ratios with TFP

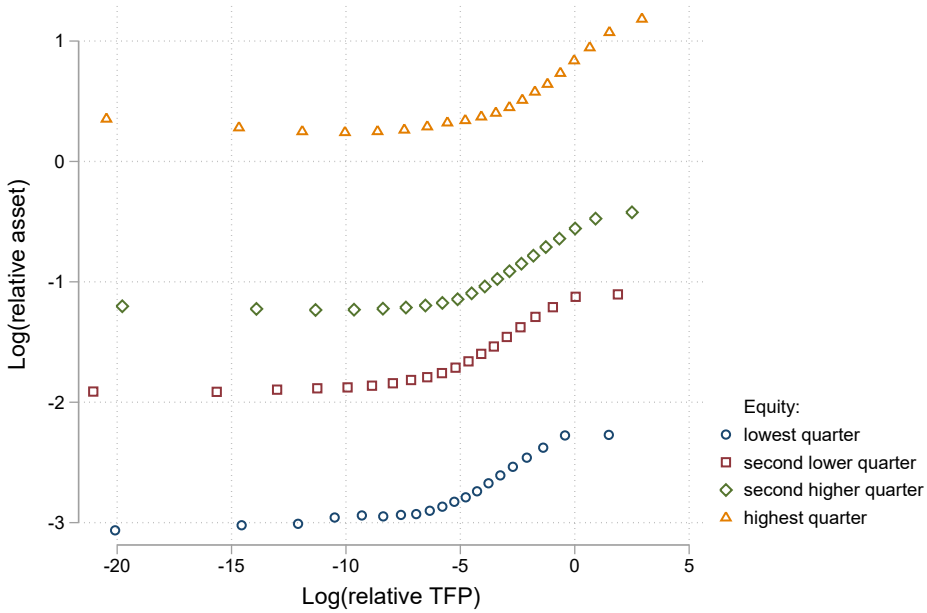
We start with the predictions regarding debt, equity, TFP, and capital for each individual firm.

[15] Before the calculation, we trim the inspection data by the bottom and top 1 percentile of assets. We also drop firms with zero assets and revenue.

[16] This calculation of TFP is robust to the introduction of an output wedge, as long as all firms in the group have the same wedge.

[17] We trim the bottom and top 1 percentile of computed TFP in following analysis.

Figure 3: Capital and Relative TFP, Inspection Data, 2008-2012.



Notes: Authors' calculations from the Inspection Data. The figure shows the relationship between assets and TFP. Firms are sorted into four quarters according to their equity. For each equity quarter, firms are ranked on TFP and sorted into twenty ventiles. Each point in the figure plots average TFP and average assets for firms in the ventile. All variables are computed relative to their averages of all firms in the same province-industry-year cell.

Figures 3 and 4 and Table 6 show that the Theoretical Predictions *A*-*B*-*C* are consistent with the data. The figures are constructed by first dividing the sample into four quarters of equity (with the first quarter containing the 25% of firms with the lowest equity, etc.) Then the firms in each quarter are again sorted based on their TFP into twenty ventiles. For each such ventile we then calculate average TFP, assets, and debt-equity ratio and present these in scatter plots in Figures 3-4.

Figure 3 and column (1) in Table 6 document the relationship between firms' assets and TFP. Not surprisingly, firms with higher TFP have more assets and are thus larger. This is consistent with Theoretical Prediction *A* above. However, the increase is much more pronounced for firms with TFP above the median than for firms below the median.

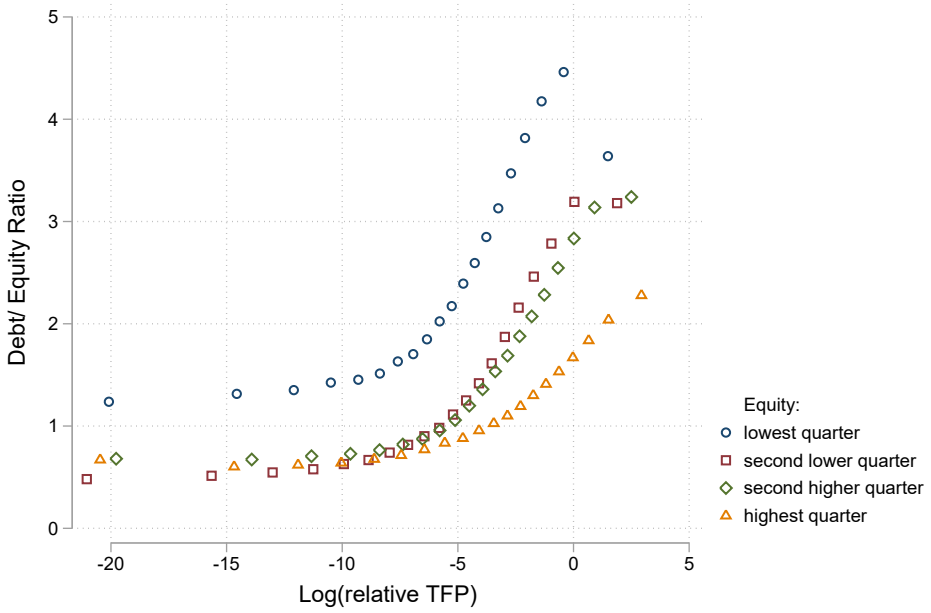
Figure 3 also shows that as we move from lower to higher equity quarters the entire profile of assets shifts upwards. This is in line with Theoretical Prediction *B*.

Figure 4 and column (2) in Table 6 document the relationship between firms' debt-equity ratio and TFP. The debt-equity profile is increasing with TFP within each quarter of equity. Moreover, as we move from lower to higher equity quarters, the entire debt-equity profile shifts downward and the slope with respect to TFP becomes flatter. These findings are consistent with Theoretical Prediction *C*.

4.4 Financial Performance of Non-SE and SE Firms

Serial entrepreneurs versus non-serial entrepreneurs. We now study the predictions for how serial and non-serial entrepreneurs differ from each other. The 2008-2012 Inspection Data

Figure 4: Debt-Equity Ratio and Relative TFP, Inspection Data, 2008-2012.



Notes: Authors' calculations from the Inspection Data. The figure shows the relationship between the debt-equity ratios and TFP. Firms are sorted into four quarters according to their equity. For each equity quarter, firms are ranked on TFP and sorted into twenty ventiles. Each point in the figure plots average TFP and average debt over average equity for firms in the ventile. All variables are computed relative to their averages of all firms in the same province-industry-year cell.

provide empirical support for the Theoretical Prediction *D*. Table 7 shows that there are indeed systematic differences between Non-SE, 1st-SE, and 2nd-SE firms. Two main facts stand out. First, 1st-SE firms have higher registered capital, assets, equity, revenue, and TFP than Non-SE firms. Second, 2nd-SE firms have higher registered capital, assets, equity, revenue, and TFP than 1st-SE firms. This is consistent with Theoretical Prediction *D* provided that ρ is sufficiently large.[18]

Concurrent and non-concurrent SE firms. Consider now the decision to operate SE firms concurrently or non-concurrently. A large fraction of the 2nd-SE firms, 86.5%, are ran concurrently with the 1st-SE firm, while in 13.5% of the cases the 1st-SE firm is closed when operating the 2nd-SE firm.

In Table 8 we consider TFP and equity of 1st-SE and 2nd-SE firms, depending on whether they are run concurrently or not. The table shows that SE firms that are operated concurrently differ systematically from SE firms that are operated non-concurrently. On the one hand, columns (1) and (2) in Table 8 show that 1st-SE firms that are closed down when the 2nd-SE firm is started have a 6% lower TFP and 7% lower equity than those 1st-SE firms that are run concurrently with the 2nd-SE firm. On the other hand, Columns (3) and (4) show that 2nd-SE firms that are currently operated by entrepreneurs who have closed down their first firm (1st-SE) have an 23% higher TFP and 16% lower equity than those 2nd-SE firms that are run concurrently with the 1st-SE firm. These patterns are consistent with Theoretical Prediction *E* of the model.

[18] In Table 12 below we show that the TFPs of the 1st and 2nd-SE firms of a serial entrepreneur are indeed positively correlated.

Table 6: 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***	0.16***
2nd quarter of equity	1.09***	-1.30***
3rd quarter of equity	1.68***	-1.39***
4th quarter of equity	3.10***	-2.23***
TFP*2nd quarter of equity	-0.00***	-0.03***
TFP*3rd quarter of equity	-0.00***	-0.04***
TFP*4th quarter of equity	-0.01***	-0.10***
Age	0.06***	0.15***
Age squared	-0.00***	-0.00***
Observations	12,476,788	12,476,788
Adjusted R-squared	0.64	0.04

Notes: Authors' calculations from the Inspection Data. 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 7: Financial Performance of Firms, Registry and Inspection Data, 2008-2012.

	Full Sample	Sample with Inspection Data				
	Log Registered Capital	Log Registered Capital	Log Assets	Log Equity	Log Revenue	Log Relative TFP
	(1)	(2)	(3)	(4)	(5)	(6)
1st SE	0.39***	0.35***	0.41***	0.36***	0.33***	0.11***
2nd-SE	0.69***	0.58***	0.68***	0.58***	0.53***	0.18***
Age	0.07***	0.10***	0.17***	0.12***	0.26***	0.41***
Age squared	-0.00***	-0.00***	-0.00***	-0.00***	-0.01***	-0.01***
Observations	34,458,350	12,476,788	12,476,788	12,476,788	12,476,788	12,476,788
Adjusted R-squared	0.05	0.06	0.11	0.08	0.08	0.03

Notes: Authors' calculations from the Registry and Inspection Data. The table compares the financial 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. *** − statistically significant at the 1% level.

This result indicates that the TFP draws for 1st-SE and 2nd-SE firms, together with the equity endowments of these entrepreneurs, are forces that determine whether a serial entrepreneur starts

Table 8: Financial Performance of Firms, Concurrent vs Non-concurrent SE Firms, Inspection Data, 2008-2012.

	1st-SE		2nd-SE	
	Log TFP	Log Equity	Log TFP	Log Equity
	(1)	(2)	(3)	(4)
Non-concurrent	-0.06***	-0.07***	0.23***	-0.16***
Age	0.37***	0.14***	0.62***	0.16***
Age square	-0.01***	-0.00***	-0.03***	-0.01***
Observations	2,254,408	2,254,408	1,826,093	1,826,093
Adjusted R-squared	0.03	0.08	0.02	0.04

Notes: Authors' calculations from the Inspection Data. The table compares the TFP and equity of 1st-SE (2nd-SE) firms that are run non-concurrently, relative to 1st-SE (2nd-SE) firms that are run concurrently. TFP and equity are computed relative to their averages of all firms in the same province-industry-year cell. *** − statistically significant at the 1% level.

subsequent firms and when the initial firm is closed down.

4.5 Auxiliary Predictions of the Model

We close this section by considering two auxiliary predictions of the model.

Capital intensity across firms owned by the same SE. Consider entrepreneurs who are running concurrent firms. The key mechanism of the model is that the entrepreneur uses revenue from the first firm to fund the second firm. Absent capital adjustment costs, the SE should equalize the marginal product of capital (MPK) across firms, implying that

$$\tilde{R}_1 = \tilde{R}_2 \tag{6}$$

$$(1-\alpha)\,\eta\frac{y_i}{k_i} = (1-\alpha)\,\eta\frac{y_i}{k_i} \tag{7}$$

The theoretical prediction of equation (7) is that if the firms are in the same industry, or if the industry capital intensity $(1-\alpha)\,\eta$ is similar for the SE firms when they are in different industries, then the capital-output ratios should be equalized across firms:

$$\frac{y_1}{k_1} = \frac{y_2}{k_2}.$$

In this case the correlation $corr\left(\ln\frac{y_1}{k_1}, \ln\frac{y_2}{k_2}\right)$ should be high.

We evaluate this prediction in four ways. We first restrict attention to serial entrepreneurs who operate two firms concurrently in the same 3-digit industry. The correlation in capital productivity (i.e., value added per unit of capital) across firms owned by the same entrepreneur is 0.28. Next, widening the sample to entrepreneurs who operate two firms concurrently in similar industries, i.e., same 1-digit, but different 3-digit industries, the correlation falls slightly to 0.20. Third, when

considering entrepreneurs with concurrent firms in industries with similar capital intensities, the correlation is 0.21. Here, we define sectors as having similar intensity if log of the capital intensity of the sector of the 2nd-SE firm is no more than five percent higher or lower than that of the 1st-SE firm, where we take the capital intensities from Hsieh and Klenow (2009). Finally, we expand the sample to include all concurrently run firms and allow the capital intensities to differ across sectors. Equation (7) then implies that we should evaluate the correlation $corr\left(\ln(1-\alpha_1)\frac{y_1}{k_1}, \ln(1-\alpha_2)\frac{y_2}{k_2}\right)$, which is 0.19 in our data. All these correlations are significantly different from zero at a 1% level of significance. By contrast, the correlation is zero for any two randomly drawn firms.

We conclude that this behavior is consistent with serial entrepreneurs pooling capital across firms.

Increasing role of SE over time. Over time, the share of SE firms in the total number of firms will increase. This is driven by two forces:

1. More entrepreneurs will have had time to start a second firm (given that no potential entrepreneurs had an existing firm when entering period 1).

2. Existing entrepreneurs accumulate more equity over time. This increases the probability they will start firms.

Both forces contribute to increasing the fraction of firms operated by serial entrepreneurs over time. Table 3 documented the increased importance of SE firms over the 1995-2015 period in terms of number of firms and total registered capital. Since SE firms are larger and more productive, over time they have also contributed to a larger share of output.

5 Sectoral and Geographical Migration Patterns for Serial Entrepreneurs

The analysis so far has highlighted the importance of equity, individual ability, firm productivity shocks, and financial frictions for understanding individual's decisions to become an entrepreneur and then a serial entrepreneur. In this section we focus on additional dimensions of the decisions of serial entrepreneurs relating to sectoral and geographical choices of 2nd-SE firms. As we shall see, factors such as sectoral learning, upstream-downstream sectoral linkages and input-output complementarities, and diversification of risk play a significant role in determining the sector of the 2nd-SE firm.

5.1 Preliminary Facts

We start by documenting the distribution of serial and non-serial firms across sectors and the sectoral and geographical location choices (migration patterns) for the second firm.

Industrial distribution of entrants. Table 9 reports − separately for Non-SE, 1st-SE, and 2nd-SE firms − the distribution across industries for new entrants in 2005 and 2010. We report two measures of the distribution of entrants: unconditional and conditional. Overall, the unconditional distribution across sectors is similar among these types of firms. The unconditional share measures the actual distribution of new entrants. A large fraction of them, more than 30%, go into Wholesale and Retail Trade, around 20% go into Manufacturing, and around 10% go into Enterprise and

Business Service. In order to control for the underlying distribution of firms across sectors, we compute a conditional share that measures the distribution of entrants relative to the distribution of all firms across industries in the previous year. A measure above (below) one means that firms are more (less) likely to enter that sector relative to the existing sectoral distribution of firms. The main message then is that firms of serial entrepreneurs, both 1st-SE and 2nd-SE, are more likely than the Non-SE firms to enter Finance, Real Estate, Enterprise and Business Service, and R&D, sectors that represent 20% of all firms.

Table 9: Share of Entrants in Different Industries, Non-SE and SE Firms, Registry Data, 2005 and 2010.

Industry	2005						2010					
	Unconditional share			Conditional share			Unconditional share			Conditional share		
	Non-SE	1st-SE	2nd-SE	Non-SE	1st-SE	2nd-SE	Non-SE	1st-SE	2nd-SE	Non-SE	1st-SE	2nd-SE
Agriculture	2.32	2.09	2.05	1.31	1.18	1.16	3.35	2.62	2.54	1.42	1.11	1.08
Mining	0.77	0.94	0.99	1.08	1.31	1.38	0.33	0.43	0.54	0.48	0.63	0.78
Manufacturing	23.04	20.88	22.83	0.77	0.70	0.76	18.49	15.86	18.41	0.73	0.63	0.73
Power	0.41	0.36	0.54	0.84	0.74	1.10	0.18	0.18	0.33	0.39	0.40	0.73
Construction	5.48	5.46	4.87	1.17	1.16	1.04	5.86	5.48	4.86	1.12	1.05	0.93
Wholesale and Retail	34.40	34.05	31.33	1.00	0.98	0.91	39.16	38.23	34.45	1.15	1.12	1.01
Transportation	3.07	3.18	2.93	1.43	1.49	1.37	2.70	2.62	2.32	1.02	0.99	0.87
Accommodation	1.43	1.49	2.17	0.89	0.92	1.34	1.11	1.23	1.67	0.77	0.85	1.16
IT	3.79	3.62	3.17	1.17	1.12	0.98	3.35	3.38	2.89	0.94	0.95	0.81
Finance	0.19	0.27	0.41	0.94	1.32	2.02	0.30	0.54	0.95	1.00	1.79	3.13
Real Estate	2.26	3.08	4.17	0.82	1.13	1.52	3.00	4.21	5.80	0.97	1.37	1.88
Enterprise & Business Service	10.70	12.14	12.24	1.38	1.57	1.58	11.01	13.42	13.60	1.13	1.38	1.40
R&D	6.18	6.90	6.90	1.20	1.34	1.34	6.38	7.32	7.51	1.07	1.23	1.26
Public Facility	0.46	0.46	0.52	0.89	0.89	1.00	0.36	0.38	0.45	0.79	0.82	0.97
Resident service	3.41	2.99	2.73	1.17	1.03	0.94	2.82	2.42	1.97	0.97	0.83	0.68
Education	0.18	0.20	0.17	1.43	1.60	1.34	0.11	0.13	0.11	0.84	0.97	0.84
Social Work	0.17	0.19	0.24	1.46	1.69	2.10	0.08	0.08	0.11	0.62	0.59	0.83
Entertainment	1.64	1.62	1.66	1.36	1.34	1.37	1.38	1.45	1.48	0.94	0.98	1.00
Public administration	0.07	0.08	0.06	0.86	0.96	0.81	0.01	0.00	0.00	0.31	0.19	0.19
NGO	0.02	0.02	0.03	0.31	0.30	0.35	0.00	0.00	0.00	0.08	0.03	0.02

Notes: Authors' calculations from the Registry Data. For a particular SE group, the unconditional share of a sector in a given year, is the number of new established firms in that sector divided by the total number of all newly established firms. For a particular SE group, the conditional share of each sector is the ratio of unconditional share divided by the fraction of a given sector in the stock of firms one year before.

Geographical and sectoral location for 2nd-SE firms. Consider now the geographical and sectoral location of the 2nd-SE firm and any differences with the 1st-SE firm. As reported in Table 10, we find that serial entrepreneurs usually establish their second firm in the same prefecture as their first firm: 72.1% of the serial entrepreneurs remain in the same prefecture where they established their first firm, 9.5% establish their second firm in the same province, but a different prefecture, and 18.3% establish their second firm in a different province. However, the 2nd-SE firm is more likely to be in a different 3-digit sector than the 1st-SE firm: only 15.6% of the 2nd-SE firms are established in the same 3-digit industry as the 1st-SE firm. Around 25% of the 2nd-SE firms are started in an industry similar (i.e., the same 1-digit code, but a different 3-digit code) to the one of the 1st-SE firm while around 60% of the 2nd-SE firms are started in an industry that is distant (i.e., different 1-digit code) to the one of the 1st-SE firm.

In Table 11 we separate serial entrepreneurs into local − those that establish their 1st-SE firm in the prefecture in which they were born − and non-local. While the main patterns documented in Table 10 are robust, we find that local serial entrepreneurs are more likely than non-local ones

to start their 2nd-SE firm in the same prefecture (81.8% vs 60.9%). On the other hand, local and non-local serial entrepreneurs are equally likely to start their 2nd-SE firm in a similar or distant 3-digit industry.

Table 10: Geographical and Sectoral Location, 1995-2015.

3-digit Industry	Same	Similar	Distant	Same (%)	Similar (%)	Distant (%)	Total(%) (%)
Same Prefecture	421,404	608,156	1,452,195	12.25	17.68	42.21	72.14
Same Province	43,010	79,044	205,805	1.25	2.30	5.98	9.53
Different Province	71,931	153,351	405,138	2.09	4.46	11.78	18.33
Total(%)				15.59	24.43	59.97	100.00

Notes: Industries are similar if they have the same 1-digit, but different 3-digit, codes. Industries are distant if they have a different 1-digit code.

Table 11: Geographical and Sectoral Location, by Local and Non-local SEs, 1995-2015.

First firm in birth place	Total	3-digit Industry	Same (%)	Similar (%)	Distant (%)	Total (%)
No	1,533,638	Same Prefecture	11.39	14.58	34.88	60.85
		Same Province	1.72	3.06	7.62	12.40
		Different Province	3.22	6.69	16.84	26.75
		Total(%)	16.33	24.33	59.34	
Yes	1,814,352	Same Prefecture	13.06	20.30	48.46	81.82
		Same Province	0.85	1.63	4.54	7.03
		Different Province	1.14	2.57	7.44	11.15
		Total(%)	15.05	24.51	60.44	

Notes: Industries are similar if they have the same 1-digit, but different 3-digit, codes. Industries are distant if they have a different 1-digit code.

5.2 Theory: Determinants of Sectoral Choices

So far, we have analyzed entrepreneur behavior in a one-sector model. This section extends the model to one of multiple sectors. We focus exclusively on entrepreneurs who have operated a firm in the first period, and study their sectoral choice for the second firm. Namely, what determines the sector in which the serial entrepreneur starts firms (2nd-SE) after having started the first firm (1st-SE)? Moreover, how do serial entrepreneurs who switch sectors differ from those who stay in the sector of the first firm?

We analyze three mechanisms for sectoral choice: (i) selection through learning about entrepreneurial abilities; (ii) considerations of diversification of risk; and (iii) upstream-downstream sectoral linkages and input-output complementarities.

5.2.1 Learning Sector-Specific Abilities

We now assume that there are several sectors $s \in S = \{1, 2, ..., N\}$ producing the same homogeneous good. A firm established in a particular sector must remain in that sector. Following Jovanovic (1979), an entrepreneur has different abilities in each sector, which are ex-ante unknown. After operating the first firm (1st-SE) in a sector s, the entrepreneur is free to choose to obtain the draw for a potential new firm in any sector $s' \in S$.

Given an initial sector s, there are three types of sectors for the second firm: the same sector (s), similar sectors (denoted S^+), and distant sectors (denoted S^-). These sectors are mutually exclusive. We focus on a mechanism where the persistence of TFP across firms is lower the further away one moves from the sector of the first firm.

The key assumption is that productivity of a second firm in sector s' depends on the sector s of the first firm and the productivity of the first firm, z_{1s}. If the entrepreneur chooses to make a TFP draw in the same sector s as the first firm, the TFP process will be the same as in equation (4), i.e., $z_{2s} = \rho z_{1s} + \varepsilon$, where $\rho > 0$. If the entrepreneur chooses to make a TFP draw in a sector similar to the sector s of the first firm, the TFP for the 2nd-SE firm $s^+ \in S^+$ will follow the process $z_{2s^+} = \rho^+ \cdot z_{1s} + \bar{z} + \varepsilon$, where the persistence ρ^+ is assumed to be lower than for the same sector ($\rho^+ < \rho$). Moreover, when operating in a similar sector, the entrepreneur gets an additive gain $\bar{z}$. The motivation for this assumption is that having operated a firm in sector s will give a direct and additive productivity gain in similar sectors s^+ due to for example complementarities.[19] Finally, if the entrepreneur chooses to make a TFP draw in a sector distant from the sector s of the first firm, the TFP for the second firm $s^- \in S^-$ will be $z_{2s^-} = \rho^- \cdot z_{1s} + \varepsilon$, where the persistence ρ^- is assumed to be lower than for the similar sectors ($\rho^- < \rho^+$). For simplicity, we assume that the stochastic innovation ε to TFP is independent and identically distributed across sectors.

Summing up, given section s and TFP z_{1s} for the 1st-SE firm, the TFP for the 2nd-SE firm is given by

$$z_2 \quad = \quad \begin{cases} \rho z_{1s} + \varepsilon & \text{if stay in same sector } s \\ \rho^+ \cdot z_{1s} + \bar{z} + \varepsilon & \text{if switch to similar sector } s^+ \in S^+ \\ \rho^- \cdot z_{1s} + \varepsilon & \text{if switch to distant sector } s^- \in S^- \end{cases}$$

We assume that all sectors are ex-ante identical in the sense that the distribution of the TFP draw for the initial firm and the unconditional expectation of total profits are the same for all initial sectors $s \in S$.

The optimal choice of where to sample a TFP draw for the firm in the 2nd period is characterized in the following proposition.

Proposition 5. *Consider an entrepreneur who operated a firm in sector s with TFP z_{1s} in the first period.*

- ***Part A: Sector choice**. If TFP of the 1st-SE firm is sufficiently large, $z_{1s} > \bar{Z}$, the entrepreneur remains in the same sector s. If z_{1s} is sufficiently low, $z_{1s} < \underline{Z}$, the entrepreneur switches to a distant sector $s^- \in S^-$. For intermediate values of TFP, $z_{1s} \in \left(\underline{Z}, \bar{Z}\right)$, the entrepreneur switches to a similar sector $s^+ \in S^+$. The entrepreneur is indifferent between sector s and S^+ (S^+ and S^-) when $z_{1s} = \bar{Z}$ ($z_{1s} = \underline{Z}$). The thresholds are defined as $\bar{Z} \equiv \bar{z}/\left(\rho - \rho^+\right) \geq 0$ and $\underline{Z} \equiv -\bar{z}/\left(\rho^+ - \rho^-\right) \leq 0$.*

[19] We could have alternatively assumed that both the same sector s and the similar sector $s^+ \in S^+$ get the additive gain $\bar{z}$. The qualitative predictions of Proposition 5 below are robust to such an alternative setup.

- ***Part B: TFP***. *Average TFP for the 1st-SE firm is highest for entrepreneurs who stay in the same sector, intermediate for those who go to similar sectors, and lowest for those who migrate to distant sectors. If R_s is sufficiently close to R_b, the same ranking must also apply to the average TFP for the 2nd-SE firm.*

Proof. The optimal choice maximizes z_2 because profits are monotone increasing in z_2. Therefore, the entrepreneur remains in the same sector rather than switching to a similar sector if $\rho z_{1s} + \varepsilon > \rho^+ \cdot z_{1s} + \bar{z} + \varepsilon$, which is satisfied if

$$z_{1s} > \bar{Z} \equiv \frac{\bar{z}}{\rho - \rho^+} \geq 0.$$

When $z_{1s} = \bar{Z}$ the entreprepreneur is indifferent. Moreover, the entrepreneur chooses a distant sector over a similar sector if $\rho^+ \cdot z_{1s} + \bar{z} + \varepsilon \geq \rho^- \cdot z_{1s} + \varepsilon$, which is satisfied if

$$z_{1s} < -\frac{\bar{z}}{\rho^+ - \rho^-} \equiv \underline{Z} < 0$$

When $z_{1s} = \underline{Z}$ the entreprepreneur is indifferent. Since $\bar{z} \geq 0$, it follows immediately that $\bar{Z} \geq 0 > \underline{Z}$. This establishes the ranking of expected TFP for the 1st-SE firm. To prove that the ranking of expected TFP for the 2nd-SE firm is the same as for the 1st SE firm, we note that the negative selection due to equity is arbitrarily small when R_s is sufficiently close to R_b. The ranking then follows immediately from the productivity persistence channel and $\rho > \rho^+ > \rho^-$. □

Proposition 5 shows that the difference in persistence induces threshold behavior in terms of TFP: when TFP of the first firm is above a threshold $\bar{Z}$, the entrepreneur stays in the current sector, while the entrepreneur switches to a distant sector if initial TFP is below $\underline{Z}$ and to a similar sector if TFP is intermediate. Note that the complementary gain $\bar{z}$ is necessary to generate some migration to similar sectors. If there were no complementarity gain, i.e., $\bar{z} = 0$, the entrepreneur would remain in s if $z_{1s} \geq 0$ (in which case persistence is beneficial) and switch to a distant sector otherwise (in which case persistence is harmful). Thus, the complementarity gain compensates for the disadvantage of an intermediate persistence.

This threshold behavior in sector choice induces positive selection for the entrepreneurs who remain in the same sector and negative selection for those who search for potential firms in different sectors. This captures the spirit of the Jovanovic (1979) learning model. In fact, his model can be interpreted as a special case of our model when $\rho = 1$, $\rho^- = 0$, and $\bar{z} = 0$. The predictions for TFP of the 1st-SE firm follow immediately from the ranking of the thresholds. The average TFP draw for potential firms in the second period have the same ranking as for the 1st-SE firm due to the maintained assumption that $\rho > \rho^+ > \rho^-$. However, the predictions about the *observed* average TFP of the 2nd-SE firm are more subtle. The deterministic component of z_2 induces positive correlation between z_1 and z_2 while the effect of retained earnings from the first period induces negative correlation due to the negative selection of 2nd period firms for richer entrepreneurs (higher equity implies lower threshold). If financial frictions are sufficiently small, i.e., when R_s is sufficiently close to R_b, the deterministic component must dominate, guaranteeing the same ranking of average TFP for the 2nd-SE firm as for the 1st-SE firm.

5.2.2 Diversification of Risk

We now explore determinants of sector choice for the 2nd-SE firm over and above learning about abilities. We start with risk diversification and illustrate the mechanism with the aid of a simple portfolio model.

To simplify the exposition, we focus on entrepreneurs who started and operated a firm in sector s in the first period and who have decided to solicit TFP draws for potential firms in a new sector $s' \neq s$.[20] We make three changes to the model relative to the previous analysis. First, we assume that the entrepreneur has linear-quadratic preferences over final wealth W, given by the net savings plus profits in the firms. It follows immediately that the objective function of the entrepreneur can be expressed as a function of the mean and variance of W,

$$E\{u(W)\} = a \cdot E(W) - \frac{b}{2} \cdot Var(W),$$

where a and b are positive parameters.[21]

Second, we now assume that the entrepreneur i obtains one (idiosyncratic) draw $z_{i,s'}$ for every sector $s' \neq s$ and chooses which of these firms to operate after having observed all draws. Third, to embed a meaningful portfolio diversification motive, we assume that output of a firm i in sector s has a sector-specific return to capital δ_s in addition to the regular idiosyncratic component of production, $y_{i,s}$,

$$Y_{i,s} = y_{i,s} + \delta_s k_{i,s},$$

where $y_{i,s} = z_{i,s}^{1-\eta} \left(k_{i,s}^{1-\alpha} n_{i,s}^{\alpha} \right)^{\eta}$ is the regular idiosyncratic production (cf. equation (1)) and $k_{i,s}$ and $n_{i,s}$ are the factor inputs to the firm. The sector-specific returns $\delta_{s'}$ have the same univariate distribution for all sectors, although the covariance with initial sector, $Cov(\delta_{s'}, \delta_s)$, can differ across sectors. Without loss of generality, we normalize the mean realization of δ to zero.

Since output in each firm is additive in the idiosyncratic production and sector-specific return, the final wealth is additively separable in idiosyncratic and sector-specific terms. Let $\Pi_i = W_i - (\delta_s k_{i,s} + \delta_{s'} k_{i,s'})$ denote the profits net of the sector-specific returns. Note that decisions are made *before* the realization of the sector-specific return $\delta_{s'}$ but *after* the realization of the idiosyncratic components. Therefore, Π_i is deterministic. It follows that expected utility is given by

$$E\{u(W_i)\} = a \cdot \Pi_i - 2b \cdot \left[Var(\delta_s) + Cov\left(\delta_s, \delta_{s'}\right) \right].$$

Note that the expected utility is falling in the covariance between the sector-specific returns to capital. We state the main predictions of this section in the following proposition.

Proposition 6. *Consider the problem for an entrepreneur who has an existing firm in sector s and a set of idiosyncratic draws potential firms $\{z_{s'}\}_{s' \neq s}$. The probability that the entrepreneur chooses sector s' is falling in the covariance $Cov(\delta_{s'}, \delta_s)$. Moreover, conditional on choosing sector s', the average TFP of the 2nd-SE firm is increasing in $Cov(\delta_{s'}, \delta_s)$.*

Proof. 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 s' will be preferred more often than sector $\tilde{s}$. Moreover, when sector $\tilde{s}$ is chosen, then it must be that sector $\tilde{s}$ 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. □

[20] For simplicity we now abstract from the similar sectors, implying that s'^{-}.

[21] We implicitly assume that the range for W is such that utility is increasing in W for all realizations of W.

5.2.3 Upstream-Downstream Integration and Input-Output Complementarities

A natural extension of our simple multi-sector model in Section 5.2.2 is to allow for input-output linkages and trade in intermediate goods.

Consider two firms that have large potential gains from trade with each other. Rather than modeling such trade and input-output linkages explicitly, we simply appeal to Williamson (1975) transaction-cost theory and postulate that having joint ownership of these firms can mitigate the potential information asymmetries and transaction costs of trade.[22] This implies that an entrepreneur with a firm in sector s has a comparative advantage of operating in sectors that trade with firms in sector s.

If the only difference across potential sectors s' is the strength of their linkages with sector s, then it follows immediately that sectors with stronger links will be chosen more often. Note, however, that it is difficult to obtain sharp predictions for TFP of the 2nd-SE firm. The reason is that the theory is not informative about which firm benefits from the linkages, be it the 1st-SE, 2nd-SE, or both.

5.3 Empirics: Determinants of Sectoral Choices

We start by summarizing the theoretical predictions regarding sector choice.

- *Theoretical Prediction G*: Proposition 5 implies that average TFP for 1st-SE firms is larger for SE entrepreneurs whose 2nd-SE firm is in the same sector as the 1st-SE, intermediate for SE with 2nd-SE in similar sectors, and lowest for SE with 2nd-SE in distant sectors. If financial frictions are sufficiently small, this ranking applies also for the 2nd-SE firm.

- *Theoretical Prediction H*: Proposition 6 implies that when entrepreneurs choose a distant sector for their 2nd-SE firm, they are more likely to locate in a sector s' whose average return on capital has a lower covariance with the average return on capital in sector s of the 1st-SE firm. Moreover, the average TFP of the 2nd-SE firm is increasing in this covariance.

- *Theoretical Prediction I*: Entrepreneurs are more likely to start a 2nd-SE firm in sectors which are more integrated with or have stronger input-output linkages with the sector of the 1st-SE firm than in sectors with weak links.

5.3.1 Testing the Learning Mechanism

We first document that the persistence of TFP shocks of serial firms is larger for firms started in the same sector than for entrepreneurs started in different sectors. Recall that this is a key assumption in Proposition 5. Altogether, we have observations on 292,549 entrepreneurs. For non-concurrent SE, we use the TFP of the 1st SE in their last year of operation, and the first year that 2nd SEs report, which is typically the year they are established. For concurrent SEs, use information on 1st and 2nd firms for all years they both report. Table 12 shows that the persistence in TFP shocks is higher for firms in the same 3-digit industries, lower for the firms of serial entrepreneurs that are in similar 3-digit industries, and even lower for serial firms that are in distant 3-digit industries. This confirms that the assumption underlying Proposition 5 is supported in the data.

Consider now the implications from Proposition 5 regarding the ranking of TFP for the serial entrepreneurs who stay in the same sector versus switching to similar or distant sectors. Table

[22] This might be considered as a hybrid approach to mitigating transaction costs, in between pure trade and full vertical integration.

Table 12: Persistence in TFPs for 1st- and 2nd-SE Firms, Conditional on Industry, Inspection Data.

	Log 2nd-SE TFP		
	Same Industry	Similar Industry	Distant Industry
	(1)	(2)	(3)
Log 1st-SE TFP	0.33***	0.24***	0.13***
Age of 1st-SE	0.31***	0.34***	0.29***
Age difference	0.31***	0.33***	0.29***
Observations	52,934	76,223	163,392
Adjusted R-squared	0.11	0.08	0.03

Notes: The table reports the persistence in the TFP of 1st- and 2nd-SE firms. TFP is computed relative to the average of all firms in the same province-industry-year cell. Industries are similar if they have the same 1-digit, but different 3-digit, codes. Industries are distant if they have a different 1-digit code. *** − statistically significant at the 1% level.

13 shows that these predictions are born out in the Inspection Data: the TFP of both 1st- and 2nd-SE firms are more than 110% higher when both firms are in the same 3-digit industry as compared to SE firms in distant 3-digit sectors, where "distant" is defined as a different 1-digit industry. Further, the TFP of the 1st-SE and 2nd-SE firm are, respectively, around 18% and 25% higher when both firms are in the same 3-digit industry as compared to SE firms in similar 3-digit industries, where "similar" is defined as the same 1-digit industry but different 3-digit industry. This empirical evidence is consistent with Theoretical Prediction *G*.

5.3.2 Testing the Mechanisms of Diversification and Linkages

We now explain how we measure the correlation of returns across sectors, input-output linkages, input-output complementarities, and excess probabilities of sector choice.

Measuring Covariance of sector-specific returns. The diversification theory requires that we measure the returns on firms in each sector, and the joint distribution (the variance-covariance matrix) of these returns.

We construct an empirical measure of the return on capital in sector i in period t as:

$$r_{i,t} = \frac{profits_{i,t}}{assets_{i,t}},$$

where profits and assets are from the Inspection Data over the 2010-2012 period.[23] We calculate average returns for each 3-digit industry and use the empirical realizations to estimate the covariance matrix of returns.

[23] We drop the financial crisis period.

Table 13: TFPs for 1st- and 2nd-SE Firms, Conditional on Industry, Inspection Data.

	log 1st-SE TFP	log 2nd-SE TFP	
	(1)	(2)	(3)
Similar Industry	-0.18***	-0.25***	-0.25***
Distant Industry	-1.08***	-1.11***	-1.12***
Distant Industry * Covariance			0.37***
Age	0.34***	0.67***	0.67***
Age squared	-0.01***	-0.03***	-0.03***
Observations	292,549	292,549	292,549
Adjusted R-squared	0.03	0.03	0.03

Notes: The table compares the TFP of 1st-SE (2nd-SE) firms that are in the same 3-digit industry, relative to 1st-SE (2nd-SE) firms that are in similar or distant 3-digit industries. Industries are similar if they have the same 1-digit, but different 3-digit, codes. Industries are distant if they have a different 1-digit code. TFP is computed relative to the averages of all firms in the same province-industry-year cell. The variable Covariance is the covariance of the return of assets between each two sectors. This variable is standardized to have mean zero and a standard deviation of one. The notation *** signifies statistically significance at the 1% level.

Upstream and downstream integration. We capture the downstream and upstream sectoral linkages using the methodology in Fan and Lang (2000). Taking a serial entrepreneur with a 1st-SE firm in industry i and a 2nd-SE firm in industry j, the "upstream" index is defined as the dollar value of industry j's output required to produce 1 dollar's worth of industry i's output while the "downstream" index is defined as the dollar value of industry i's output required to produce 1 dollar's worth of industry j's output. We use the 2007 Chinese Input-Output tables to compute these indices.[24]

Input and output complementarity. In order to study any potential input and output complementarity links between the firms of serial entrepreneurs, we construct the following two indices. The "output complementarity" index is the correlation coefficient between b_{ik} and b_{jk}, where b_{ik} (b_{ik}) is the percentage of industry i (j) output supplied to each intermediate industry k. This index captures the degree to which industries i and j share outputs. The "input complementarity" index on the other hand is defined as the correlation coefficient between v_{ik} and v_{jk}, where v_{ik} (v_{ik}) is the percentage of inputs from each intermediate industry k used in industry i (j) output. This index captures the degree to which industries i and j share inputs. We use the 2007 Chinese Input-Output tables to compute these indices.

Excess probability measure. In order to study the quantitative importance of the measures described above in determining the sectoral choice of a 2nd-SE firm, we construct an excess probability measure: the normalized probability of starting the 2nd-SE firm in sector j, given that the

[24]The 2007 Chinese Input-Output tables have 135 sectors that cover most of the 2-digit and 3-digit manufacturing sectors and 1-digit service sectors.

1st-SE firm is in sector i. Consider serial entrepreneurs with a 1st-SE firm in industry i and a 2nd-SE firm in industry j. We calculate the percentage of serial entrepreneurs that move from i to j each year from 1995-2015 when they start their 2nd-SE firm − this is computed as the number of serial entrepreneurs from i to j divided by total number of serial entrepreneurs in industry i. This measure is then normalized by the share of industry j in total incumbents last year.

Table 14: Sectoral Choice and Business Linkages, 1995-2015.

	Excess Probability				
	(1)	(2)	(3)	(4)	(5)
Downstream Integrated	0.52***				0.47***
Upstream Integrated		0.57***			0.46***
Complementarity			0.51***		0.41***
Covariance				-0.03*	-0.11***
Observations	364,716	364,716	364,716	364,716	364,716
Adjusted R-squared	0.02	0.02	0.02	0.01	0.04

Note: We control for the sector of the 1st-SE firm and the year the 2nd-SE firm is established. The weight for regressions is the number of new entrants of each sector of the 1st-SE.

Findings. Table 14 reports the results of a regression of the excess probability measure on our measure of covariance, downstream and upstream integration, and complementarity.[25] In the regression, we control for the sector of the 1st-SE firm and the year the 2nd-SE firm is established. The results reported in column (5) indicate that serial entrepreneurs are more likely to start their 2nd-SE firm in a sector that is upstream integrated, downstream integrated, complementary, and with a negative covariance index with the sector of their 1st-SE firm. These results confirm Theoretical Predictions G and I.

Finally, the third column of Table 13 shows that the TFP of the 2nd-SE firm is increasing in the covariance between returns in the sectors of the 1st-SE and 2nd-SE firms. This confirms the second part of Theoretical Prediction G. Note that the measure of covariance in the regression is standardizedÂ so that this variable has mean zero and a standard deviation equal to one. The coefficient of 0.37 therefore implies that increasing this variable (the covariance) by one standard deviation (of the cross-sectional dispersion in covariance) will increase TFP by 37%. This effect is effect is significant, both from an economic and a statistical point of view.

6 Conclusion

There is an extensive literature studying entrepreneurship, however much less is known about serial entrepreneurship. In the paper, we draw on data on the universe of all firms in China to document key facts about entrepreneurship and serial entrepreneurship in China since the early 1990s. We then examine these data through the lens of a model of serial entrepreneurship in which

[25] Input and output complementarity are combined into one measure.

potential entrepreneurs face capital market frictions in the form of a borrowing-lending spread. Our model generates sharp predictions relating to the effect of endowments, abilities and capital market frictions on the likelihood of both entrepreneurship and serial entrepreneurship, differences between serial and non-serial firms, and 1st- and 2nd-serial firms. We extend the model to study migration patterns for serial entrepreneurs in terms of what sector they locate their 2nd-SE firm. The theoretical predictions are borne out by the data.

Our results suggest that ability is a major driver of serial entrepreneurship: Not only are SEs more productive, but the fact that they become successively more productive with the creation of new firms suggests that entrepreneurial ability is persistent. We also find evidence that financial frictions are important for explaining prominent features of serial entrepreneurship in China, especially in the context of entrepreneurs choosing to operate firms concurrently or in sequence. Furthermore, serial entrepreneurs who switch sectors are less productive, which we interpret as additional evidence for persistence of productivity and the role of sector-specific learning. The exact choice of sector, on the other hand, is driven by risk diversification and sectoral linkages, hinting at the presence of other types of frictions in the economy and possible tradeoffs in these choices.

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APPENDICES

A Tables

Table A-1: Reporting Ratio of Inspection Data, Different Type of Entrepreneur.

Year	Non-SE	1st-SE	2nd-SE
2008	30.48%	32.59%	30.73%
2009	33.10%	35.17%	33.03%
2010	35.07%	36.97%	34.11%
2011	37.84%	39.87%	35.92%
2012	39.60%	41.53%	37.42%

Table A-2: Number of Firms in the Inspection Data, 2008-2012.

Year	Number of Firms
2008	1,641,828
2009	2,001,297
2010	2,411,502
2011	2,966,918
2012	3,455,243
Total	12,476,788

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

Year	Total (Trillion)	Unregistered(%)	Individual(%)			Enterprise(%)		Share of baseline sample: (2)+(3)
			Single	Multiple	No citizenship ID	Single	Multiple	
		(1)	(2)	(3)	(4)	(5)	(6)	
1995	10.38	56.13	2.80	7.34	0.94	16.89	15.90	10.14
1996	11.48	54.26	2.83	8.78	0.99	16.39	16.74	11.61
1997	12.62	52.14	2.97	10.28	1.12	16.30	17.18	13.26
1998	13.83	49.79	3.18	12.01	1.15	16.02	17.84	15.20
1999	15.58	48.26	3.26	13.09	1.10	16.77	17.53	16.35
2000	17.43	45.61	3.39	14.48	1.09	17.70	17.72	17.87
2001	19.33	42.87	3.63	16.21	1.13	17.90	18.26	19.84
2002	21.51	40.67	3.78	17.70	1.26	18.02	18.57	21.48
2003	25.21	37.62	3.94	18.88	1.17	20.19	18.21	22.82
2004	28.37	35.49	4.29	20.50	1.21	19.28	19.22	24.79
2005	31.52	34.21	4.52	22.06	1.31	18.40	19.51	26.58
2006	34.93	33.02	4.93	23.13	1.34	17.86	19.72	28.06
2007	40.74	34.11	5.02	22.80	1.30	17.01	19.75	27.83
2008	45.09	33.17	5.26	23.26	1.38	16.84	20.09	28.53
2009	51.07	31.40	5.47	24.41	1.40	16.72	20.60	29.88
2010	59.47	29.12	5.73	25.96	1.42	16.58	21.19	31.69
2011	69.15	27.09	5.82	27.58	1.37	16.28	21.86	33.39
2012	78.53	25.72	5.98	28.21	1.33	16.29	22.47	34.20
2013	91.35	25.04	6.13	28.93	1.31	15.70	22.87	35.07
2014	114.76	21.95	7.50	31.69	1.79	14.70	22.37	39.19
2015	137.33	19.81	9.16	33.14	1.97	13.70	22.21	42.30

B Proof of Proposition 1

Consider first an unconstrained entrepreneur. Since $s > 0$, she must have $b = 0$ and $k < e$. The entrepreneur's problem is

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

The first-order conditions are given by

$$\alpha\eta y = wn, \tag{A-1}$$
$$(1-\alpha)\eta y = R_s k, \tag{A-2}$$

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. (A-1)-(A-2) and are given by equation (A-3),

$$\begin{aligned}y^* &= z \cdot \bar{y}(R_s, w) \\ k^* &= z \frac{(1-\alpha)\eta}{R_s} \cdot \bar{y}(R_s, w) \equiv z k_s^* \\ n^* &= z \frac{\alpha\eta}{w} \cdot \bar{y}(R_s, w)\end{aligned} \tag{A-3}$$

and where profits are $\Pi(z, e, 1) = z \cdot (1-\eta) \cdot \bar{y}(R_s, w) + R_s e$ and the input composite $\bar{y}$ is given by

$$\bar{y}(R_s, w) \equiv \left(\frac{(1-\alpha)\eta}{R_s}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}}.$$

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 $\Pi(z, e, j) - \nu \geq R_s e$ implies a cutoff z_s^* such that all potential entrepreneurs with $z \geq z_s^*$ will choose to operate firms, where s denotes "saver" and z_s^* is given by

$$z_s^* \equiv \frac{v}{1-\eta} \left(\frac{(1-\alpha)\eta}{R_s}\right)^{-\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{w}{\alpha\eta}\right)^{\frac{\alpha\eta}{1-\eta}}.$$

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_s (since higher returns on deposits increase the alternative value of equity). The unconstrained entrepreneur will install a capital stock given by $k^*(z, e) = z k_s^*$ (see equation (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) $z \geq z_s^*$ and (2) $e \geq z \cdot k_s^*$. Namely, both TFP and equity must be sufficiently large. Moreover, denote the lower bound on equity for an unconstrained entrepreneur as $e_s^* \equiv z_s^* k_s^* = \frac{v}{1-\eta} \frac{(1-\alpha)\eta}{R_s}$.

Next, consider an entrepreneur with positive debt ($b > 0$). Since $R_s < R_b$, this entrepreneur has $s = 0$ and $k > e$. A borrower solves the problem

$$\Pi(e, z; 2) = \max_{k,n} \{y - wn - R_b (k - e)\}$$

The relevant rate of return is R_b. The first-order conditions and the optimal allocations are given by equations (A-1)-(A-2) and (A-3), where R_s is replaced by R_b.

Consider now entry for the borrowers. Their TFP threshold for operating the firm is that the return on equity in the firm is larger than or equal to the opportunity cost of investing the equity in deposits earning a rate R_s. Namely, the threshold z_b^* (where the subscript b denotes "borrower") is given by the solution to the equation $\Pi(z_b^*, e, 2) - \nu = R_s e$. This implies

$$\begin{aligned}R_s e &= (1-\eta) z \cdot \bar{y}(R_b, w) + R_b e - \nu \\ &\Rightarrow \\ z_b^*(e) &= \left(\frac{R_b}{(1-\alpha)\eta}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{w}{\alpha\eta}\right)^{\frac{\alpha\eta}{1-\eta}} \frac{1}{1-\eta} \left[\nu - (R_b - R_s) e\right]\end{aligned}$$

Note that the threshold is linear and strictly falling in e. This is because the return on capital in the firm, R_b, exceeds the return on deposits. Therefore, the value of operating a firm is larger the larger is e.

The borrowing entrepreneur will invest $k^*(z,e) = zk_b^*$ (see equation (3)). It follows that the potential entrepreneur will be a borrowing entrepreneur and operate the firm if and only if two conditions are simultaneously satisfied: (1) $z \geq z_b^*(e)$; and (2) $e < z \cdot k_b^*$. In other words, the entrepreneur will be a borrowing entrepreneur if TFP is sufficiently large and equity sufficiently low. It is convenient to define the constant e_b^* as the solution to the equation $e_b^* = z_b^*(e_b^*) k_b^*$, i.e.,

$$e_b^* \equiv \frac{\nu}{1-\eta} \frac{(1-\alpha)\eta}{R_b + (R_b - R_s)\frac{(1-\alpha)\eta}{1-\eta}} < e_s^*.$$

Finally, consider a constrained entrepreneur who has $k = e$ and $s = b = 0$. This entrepreneur solves the problem

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

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

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

where the subscript c denotes "constrained."

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

$$k_b^* \leq \frac{e}{z} < k_s^*.$$

Note that the return to equity for constrained entrepreneurs is in between R_s and R_b. Moreover, equity is smaller than the capital installed for the unconstrained entrepreneur and larger than that of a borrowing entrepreneur: $e < zk_s^*$ and $e > zk_b^*$.

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 $\Pi(e,z,0) - \nu \geq R_s e$. This condition implies a threshold z_c^* given by

$$z_c^*(e) \geq \left(\frac{\nu + R_s e}{1-\alpha\eta} \right)^{\frac{1-\alpha\eta}{1-\eta}} (e)^{-\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{w}{\alpha\eta} \right)^{\frac{\alpha\eta}{1-\eta}}$$

Equity affects the threshold for constrained entrepreneurs in two opposing ways. On the one hand, a larger equity increases the value of the firm. This tends to reduce the threshold. On the other hand, a larger equity increases 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

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

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

C Proof of Proposition 3

Before turning to the proof of Proposition 3, it is useful to derive the optimal choice of operating two firms concurrently or just one firm.

C.1 Operating two firms concurrently

The following proposition characterizes the choice for an entrepreneur who has the choice between operating one firm or two firms concurrently in the second period. For convenience we relable the two (potential) firms as h and l, where

h indicates the firm with high TFP and l the firm with low TFP ($z_b \geq z_l$). This is without loss of generality because the fixed cost of operation must be paid every period and capital is fully reversible. Thus, in the second period the timing of arrival of the potential firm is irrelevant.

Proposition 7. *Consider an entrepreneur who has the option to operate two firms with TFP $z_b \geq z_l$. The entrepreneur will operate at least one firm if and only if $z_b \geq z^*(e)$. The entrepreneur will operate two firms concurrently if z_l is sufficiently large, $z_l \geq Z(z_b, e)$, where the function Z is monotone increasing in z_b and monotone falling in e. Z is implicitly defined by the following conditions.*

1. ***Rich entrepreneur**: Suppose $e \geq (z_l + z_b) k_s^*$. Then the entrepreneur will operate two firms concurrently if and only if $z_l \geq z_s^*$. In this case, the capital allocation in firm $j \in \{h, l\}$ is $k_j = z_j k_s^*$ and total debt is $d = (z_l + z_b) k_s^* - e < 0$, i.e., positive deposits.*

2. ***Constrained if operating two firms**. Suppose $e \in ((z_l + z_b) k_b^*, (z_l + z_b) k_s^*)$. The entrepreneur will operate two firms concurrently if z_l is sufficiently close to z_b. The conditions are as follows.*

   (a) *Positive deposits when operating one firm. Suppose $e \geq z_b k_s^*$. The entrepreneur will operate two firms concurrently if*

   $$(1 - \alpha\eta) \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} (z_l + z_b)^{\frac{1-\eta}{1-\alpha\eta}} (e)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} \geq z_b \cdot (1 - \eta) \cdot \left(\frac{(1-\alpha)\eta}{R_s}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}} + R_s e + \nu$$

   (b) *Constrained if operating one firm. Suppose $e < z_b k_s^*$. The entrepreneur will operate two firms concurrently if*

   $$(z_l + z_b)^{\frac{1-\eta}{1-\alpha\eta}} \geq (z_b)^{\frac{1-\eta}{1-\alpha\eta}} + \left(\frac{w}{\alpha\eta}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} \frac{\nu}{1-\alpha\eta} (e)^{-\frac{(1-\alpha)\eta}{1-\alpha\eta}}.$$

   If the entrepreneur operates two firms concurrently, the capital allocation in firm $j \in \{h, l\}$ and total debt will be

   $$\begin{aligned} k_j &= \frac{z_j}{z_l + z_b} e, \\ d &= 0. \end{aligned}$$

3. ***Borrowing if operating two firms**. Suppose $e \leq (z_l + z_b) k_b^*$. If the entrepreneur operates two firms concurrently, the capital allocation in firm $j \in \{h, l\}$ and total debt will be*

   $$\begin{aligned} k_j &= z_j k_b^*, \\ d &= (z_l + z_b) k_b^* - e > 0. \end{aligned}$$

   The entrepreneur will operate two firms concurrently if z_l is sufficiently close to z_b. The conditions are as follows.

   (a) *Positive deposits when running one firm. Suppose $e \geq z_b k_s^*$. The entrepreneur will operate two firms if*

   $$z_l \geq z_b \left(\left(\frac{R_b}{R_s}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} - 1 \right) + [(1-\alpha)\eta]^{-\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{w}{\alpha\eta}\right)^{\frac{\alpha\eta}{1-\eta}} \frac{[\nu - (R_b - R_s) e]}{1-\eta}.$$

   (b) *Borrowing if running two firms, constrained if running one firm. Suppose $e \in (z_b k_b^*, z_b k_s^*)$. The entrepreneur will operate two firms concurrently if*

   $$(z_l + z_b) \cdot \left(\frac{(1-\alpha)\eta}{R_b}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}} \geq \frac{1-\alpha\eta}{1-\eta} \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} (z_b)^{\frac{1-\eta}{1-\alpha\eta}} (e)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} + \frac{\nu - R_b e}{1-\eta}$$

   (c) *Poor entrepreneur: borrowing even when running just one firm. Suppose $e \leq z_b k_b^*$. The entrepreneur will operate two firms concurrently if*

   $$z_l \geq z^*(0).$$

Propostion 1 implies that if $z_h < z^*(e)$ then it is optimal to not operate any firms. Conversely, if $z_h \geq z^*(e)$ then it is better to operate firm h then to not operate any firms. Finally, since operating firm l can be optimal only if $z_l \geq z_s^*$, it follows that $z_l \geq z_s^*$ is a necessary condition for it being optimal to operate both firms concurrently.

From now on, we maintain the assumption that $z_h \geq z^*(e)$ and $z_l \geq z_s^*$. Consider opimal decisions for different levels of equity e.

Suppose first that $e \geq (z_l + z_b) k_s^*$. Propostion 1 implies that since $z_l \geq z_s^*$, it is better to operate each firm with capital $z_l k_s^*$ and $z_b k_s^*$, respectively, than depositing the equity earning rate R_s. Since equity is sufficient to fund the firms and still deposit $e - (z_l + z_b) k_s^* \geq 0$, this allocation is also feasible. This lower bound on z_l is independent of e and z_b. This completes the proof or Part 1 of Proposition 7.

Suppose now that $(z_l + z_b) k_b^* < e < (z_l + z_b) k_s^*$. Propostion 1 then implies that if the entrepreneur is operating both firms then she will be constrained ($b = s = 0$). The optimal employment would be set 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

$$(1-\alpha)\eta (z_l)^{1-\eta} \frac{\left(k_l^{1-\alpha} n_l^{\alpha}\right)^{\eta}}{k_l} = (1-\alpha)\eta (z_h)^{1-\eta} \frac{\left(k_h^{1-\alpha} n_h^{\alpha}\right)^{\eta}}{k_h}$$

which in turn implies $k_l = \frac{z_l}{z_h} k_h$. Since we hypothesize $k_l + k_h = e$, it follows that $e = \left(\frac{z_l}{z_b} + 1\right) k_h$, implying

$$k_l = \frac{z_l}{(z_l + z_h)} e \qquad \text{and} \qquad k_h = \frac{z_h}{(z_l + z_h)} e.$$

The total profits when operating two firms are then

$$\Pi\left(\frac{z_l}{(z_l + z_b)} e, z_b; 0\right) + \Pi\left(\frac{z_b}{(z_l + z_b)} e, z_b; 0\right) - 2\nu,$$

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

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

Maintaining that $e \in ((z_l + z_b) k_b^*, (z_l + z_b) k_s^*)$, we now consider two cases. Suppose first that equity is sufficiently large, $e \geq z_b k_s^*$, so the entrepreneur is unconstrained when operating one firm. Thus, $e \in [\max\{z_b k_s^*, (z_l + z_b) k_b^*\}, (z_l + z_b) k_s^*)$. In this case, the entrepreneur would operate two firms if and only if

$$\Pi\left(\frac{z_l}{(z_l + z_b)} e, z_l; 0\right) + \Pi\left(\frac{z_b}{(z_l + z_b)} e, z_b; 0\right) - 2\nu \geq \Pi(0, z_b; 1) + R_s e - \nu, \tag{A-5}$$

where the function $\Pi(z, e; 1)$ denotes profits net of the operating cost ν from a lending entrepreneur operating a firm with TFP z and equity e,

$$\Pi(z, e, 1) \equiv z \cdot (1 - \eta) \cdot \left(\frac{(1-\alpha)\eta}{R_s}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}} + R_s e.$$

The condition (A-5) is equivalent to the inequality

$$(1 - \alpha\eta) \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} (z_l + z_b)^{\frac{1-\eta}{1-\alpha\eta}} (e)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} \geq z_b \cdot (1 - \eta) \cdot \left(\frac{(1-\alpha)\eta}{R_s}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}} + R_s e + \nu \tag{A-6}$$

We observe that the left-hand side is monotone increasing in z_l, implying that inequality (A-6) is satisfied if and only if z_l is sufficiently large. Next, note that the left-hand side of inequality (A-6) is increasing steeper in e than the right-hand side. The reason is that the return on equity is larger for a constrained entrepreneur than for a saving

entrepreneur (whose marginal return is R_s). Therefore, a larger e relaxes the condition (A-5). To show that the inequality (A-6) becomes tighter when z_b is larger, we differenciate the left-hand side of inequality (A-6) w.r.t. z_b,

$$\begin{aligned}
&\frac{\partial}{\partial z_b}\left\{(1-\alpha\eta)\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}}(z_l+z_b)^{\frac{1-\eta}{1-\alpha\eta}}(e)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}}\right\}\\
= \quad & (1-\eta)\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}}\left(\frac{z_b}{z_l+z_b}\right)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}}\left(\frac{e}{z_b}\right)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}}\\
\leq \quad & (1-\eta)\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}}(k_s^*)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} = (1-\eta)\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}}\left(\frac{(1-\alpha)\eta}{R_s}\right)^{\frac{(1-\alpha)\eta}{1-\eta}},
\end{aligned}$$

which in turn is equal to the derivative of the right-hand side of inequality (A-6) w.r.t. z_b.

Suppose now the case when equity is sufficiently small that the entrepreneur would be constrained even when operating one firm ($e \in (z_b k_b^*, z_b k_s^*)$). Thus, the parameters are such that $e \in ((z_l+z_b)\,k_b^*, z_b k_s^*)$. In this case, the entrepreneur would operate two firms if

$$\Pi\left(\frac{z_l}{(z_l+z_b)}e, z_b; 0\right) + \Pi\left(\frac{z_b}{(z_l+z_b)}e, z_b; 0\right) - 2\nu \geq \Pi(e, z_b; 0) - \nu. \tag{A-7}$$

Standard algebra establishes that the condition (A-7) is equivalent to the following inequality,

$$(z_l+z_b)^{\frac{1-\eta}{1-\alpha\eta}} \geq (z_b)^{\frac{1-\eta}{1-\alpha\eta}} + \left(\frac{w}{\alpha\eta}\right)^{\frac{\alpha\eta}{1-\alpha\eta}}\frac{\nu}{1-\alpha\eta}(e)^{-\frac{(1-\alpha)\eta}{1-\alpha\eta}} \tag{A-8}$$

The inequality (A-8) is satisfied if and only if z_l is sufficiently large. Moreover, the right-hand side of (A-8) is falling in e, relaxing the condition (A-7). Finally, the right-hand side of inequality (A-8) is increasing steeper in z_b than the left-hand side. Therefore, a larger z_b tightens the condition (A-7). This completes the proof or Part 2 of Proposition 7.

Finally, suppose that $e < (z_l+z_b)\,k_b^*$. In this case the entrepreneur would be a borrower ($b>0$) if operating two firms. Conditional on operating two firms, the optimal allocations are given by equations (A-1)-(A-2)-(A-3) with R_b as the relevant rate of return and installed capital $k^*(z_i, e) = z_i k_b^*$ in firm i. This is consistent with equity being less than installed capital when both firms are operated, i.e., $e < (z_l+z_b)\,k_b^*$. The entrepreneur will prefer to operate two firms if profits with two firms exceed those of operating only firm h. We must now separate three cases that differ in what the allocation would be if only one firm is operated.

Assume first that $e \leq z_b k_b^*$. Namely, the entrepreneur would be borrowing even when running just one firm. The choice between operating both firms or operating just the most productive one is then given by the following inequality condition

$$\Pi(0, z_l; 2) + \Pi(e, z_b; 2) - 2\nu \geq \Pi(e, z_b; 2) - \nu, \tag{A-9}$$

where the $\Pi(z, e; 2)$ denotes profits net of the operating cost ν for a borrowing entrepreneur operating a firm with TFP z and equity e, i.e.,

$$\Pi(z, e, 2) \equiv z\cdot(1-\eta)\cdot\left(\frac{(1-\alpha)\eta}{R_b}\right)^{\frac{(1-\alpha)\eta}{1-\eta}}\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}} + R_b e.$$

To obtain condition (A-9) we exploit the fact that $\Pi(e, z; 2) = \Pi(0, z; 2) + eR_b$. Condition (A-9) is then equivalent to the inequality $\Pi(0, z_l; 2) \geq \nu$. Thus, the entrepreneur will operate two firms concurrently if and only if $z_l \geq z^*(0)$ where z^* is defined in Proposition 1. This consition is independent of e and z_b.

Second, suppose that $e \in [z_b k_s^*, (z_l+z_b)k_b^*)$. Namely, equity is sufficiently abundant that the entrepreneur would be unconstrained if operating only one firm. but sufficiently scarce that she would be borrowing if operating both firms. The choice between operating both firms or just the most productive one is then given by the following inequality condition

$$\Pi(0, z_l; 2) + \Pi(0, z_b; 2) + R_b e - 2\nu \geq \Pi(0, z_b; 1) + R_s e - \nu. \tag{A-10}$$

Standard algebra establishes that condition (A-10) is equivalent to the following inequality,

$$z_l \geq z_b\cdot\left(\left(\frac{R_b}{R_s}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} - 1\right) + [(1-\alpha)\eta]^{-\frac{(1-\alpha)\eta}{1-\eta}}\left(\frac{w}{\alpha\eta}\right)^{\frac{\alpha\eta}{1-\eta}}\frac{[\nu - (R_b - R_s)\,e]}{1-\eta}.$$

This inequality is satisfied if and only if z_l is sufficiently large. Moreover, the right-hand side of this inequality is increasing in z_b and falling in e. Therefore, condition (A-10) becomes tighter when z_b increases and more relaxed when e increases.

Finally, suppose $e \in (z_b k_b^*, z_b k_s^*)$. Namely, equity is sufficiently scarce so the entrepreneur would be constrained if operating only one firm (again, we maintain the assumption that the entrepreneur would be borrowing if operating both firms, so $e < (z_l + z_b) k_b^*$). The choice between operating both firms or operating just the most productive one is then given by the following inequality condition

$$\Pi(0, z_l; 2) + \Pi(0, z_b; 2) + R_b e - 2\nu \geq \Pi(e, z_b; 0) - \nu,$$

which can be expressed as

$$(z_l + z_b) \cdot (1-\eta) \cdot \left(\frac{(1-\alpha)\eta}{R_b}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\eta}} + R_b e \geq (1-\alpha\eta)\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} (z_b)^{\frac{1-\eta}{1-\alpha\eta}} (e)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} + \nu. \qquad \text{(A-11)}$$

The inequality (A-11) is satisfied if and only if z_l is sufficiently large becasue the left-hand side of (A-11) is linearly increasing in z_l. Note that the return on capital (and equity) for the constrained entrepreneur must be smaller than R_b, otherwise the entrepreneur would be a borrower. Therefore, the left-hand side of (A-11) increases steeper in e than the right-hand side, so the inequality (A-11) becomes more relaxed with a larger e. To show that the inequality (A-11) becomes tighter when z_b is larger, we differenciate the right-hand side w.r.t. z_b,

$$\begin{aligned} &\frac{\partial}{\partial z_b}\left\{(1-\alpha\eta)\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} (z_b)^{\frac{1-\eta}{1-\alpha\eta}} (e)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} - \nu\right\} = (1-\eta)\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} \left(\frac{e}{z_b}\right)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} \\ \geq\ & (1-\eta)\left(\frac{\alpha\eta}{w}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} (k_b^*)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}} = (1-\eta)\left(\frac{\alpha\eta}{w}\right)^{\frac{\eta\alpha}{1-\eta}} \left(\frac{(1-\alpha)\eta}{R_b}\right)^{\frac{(1-\alpha)\eta}{1-\eta}}, \end{aligned}$$

which in turn is equal to the derivative of the left-hand side w.r.t. z_b. This completes the proof or Part 3 of Proposition 7.

C.2 Proof of Part A and B of Proposition 3

Part A: Since it was optimal to operate the first firm in the first period, it must be better to operate this firm in the second period than not operating any firms. Since investments are fully reversible and the operating cost must be paid every period, the most productive firm will always be operated. Therefore, $z_2 > z_1$ is a sufficient condition for the second firms to be operated and the entrepreneur becoming a SE. This implies that the lower bound on TFP of the second firm, Z, satisfies $Z(z_1, e) \leq z_1$, where the function Z is defined in Proposition 7. Consider now the case when $z_2 \leq z_1$. From Proposition 7, the entrepreneur will become a SE if and only if $z_2 \geq Z(z_1, e)$. Moreover, the function Z is monotone increasing in z_1 and falling in e.

Part B: Note first that if $z_1 = z_2$ then equity would be divided equally across firms if they were to operate concurrently. Therefore, both firms would operate if and only if $z_1 = z_2 \geq z^*(e/2)$. Since the threshold $Z(z, e)$ is increasing in the first argument z, it follows that the number of concurrent firms is monotone decreasing in the difference $|z_2 - z_1|$. If $\min\{z_1, z_2\} < z^*(e/2)$ then Proposition 1 implies that it would not be optimal to operate the least productive firm even if it were allocated half the equity, which is at least as much capital that is optimal for the least productive firm. Proposition 1 also implies that if $\max\{z_1, z_2\} \geq z^*(e)$, then it is better to operate the most productive firm than to not operate any firms.

QED

D Proof of Lemma 1

Lemma 1 amounts to proving that if $\rho \geq 0$ then

$$E[z | z \geq a, \rho z + \epsilon \geq b] \geq E[z | z \geq a],$$

where $a = z^*(e_0)$ and $b = z^*(e_1)$.

The main idea is to show that (1) adding the condition $\rho z+\epsilon \geq b$ 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 unconditional pdf and cdf of z as $i(z)$ and $I(z)$, and pdf and cdf of ϵ as $j(z)$ and $J(z)$, then the pdf conditional on $z \geq a$ can be expressed as

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

Then pdf of z conditional on $z \geq a, \rho z+\epsilon \geq b$ is

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

where $h(z)=1-J(b-\rho z)$ is an increasing functions of 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

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

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

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

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

$$\begin{aligned} E[z|F] &= \int z dF(z) = \int z dG(y) < \int y dG(y) = \int z dG(z) \\ &= E[z|G]. \end{aligned}$$

Finally, recall from Corollary 1 that conditional on operating one and only one firm, the installed capital is monotone increasing in TFP. Since average TFP of the 1st-SE firm is larger than the average TFP of the Non-SE, it follows that the initially installed capital of the 1st-SE is larger than that of the Non-SE firm. QED