Alternative Finance and Firms' Development: the Case of China

Noëmie Lisack *

European University Institute

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Abstract

Throughout the 2000's, fast-growing emerging economies have remained relatively underdeveloped in terms of credit markets, with a capital allocation process which is not fully competitive. Still, young small enterprises are developing tremendously. How did these firms circumvent obstacles to investment financing? Beside retained earnings and bank loans, this paper focuses on the crucial role played by alternative sources of funding, including non-listed equity, family, friends and informal banking institutions, and suggests a model where heterogenous firms choose optimally how much to invest and how to finance it. Using Chinese data from 2002 and 2003 for calibration, I quantify the extent to which alternative sources of funding alleviate credit constraints faced by Chinese firms. I find that alternative financing options increase the steady-state aggregate level of capital by 17%, and the steady-state aggregate production by 8%. In addition, the short-term average production growth of newborn firms starting with low capital increases by 6 to 23 percentage points in the presence of alternative funding sources.

JEL Classification: E22, O16, O17
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*Villa San Paolo - Via della Piazzuola 43, I-50133 Firenze, Italy; e-mail: noemie.lisack@eui.eu

Introduction

Over recent decades, emerging market economies have seen a tremendous economic growth: China's GDP has increased by 9.6% per year on average since 1995, India's GDP by 6.8% over the same period. Since the institutional environment in these countries is relatively poor, this fact tends to contradict the relationship between legal environment, financial institutions and economic growth highlighted by, among others, Levine (1999) and Demirgüç-Kunt and Maksimovic (1998). How can we account for these flourishing economies, given the fundamental uncertainties on property rights, access to financing and law enforcement?

To be able to invest and grow, enterprises must find efficient ways to bypass the limitations of financial institutions. As suggested by Allen et al. (2005), when facing important obstacles in obtaining bank loans or issuing equity, enterprises may resort to alternative sources of funding, like non-listed equity, most of it being related to family and friends circles. While it is sometimes more easily accessible for the borrower, such a financing mode may as well be in the interest of the lender. Indeed, lending within a restricted social circle rather than through larger banking institutions allows lenders to monitor borrowers more closely, and to use alternative threats to obtain repayment, like social pressure, reputation or even physical constraint. In China, the well-known example of the prosperous city Wenzhou shows how a clan-like social organisation and strong mercantile traditions spurred the creation and growth of enterprises. For the (mostly small) firms that face difficulties accessing the credit market, the presence of alternative financing sources through non-listed equity, trade credit, family or friends and moneylenders is crucial to finance investment.

The role of such alternative sources of funding in alleviating financial constraints is at the center of this paper. I propose modelling and quantifying the importance of alternative funding sources for firms' investment and growth, with a specific focus on the Chinese case. Misallocations are indeed well-anchored in the history of Chinese formal credit markets[1], which renders the study of alternative financing especially interesting in this country. I first set up a partial equilibrium model of optimal investment financing. In order to maximize their dividends, heterogenous firms choose how much to invest and how to finance it, between retained earnings, official bank loans and alternative funding. The model I present focuses on credit markets as one specific cause for capital misallocation. In this framework, I study how this market's malfunction can be partially overcome by accessing alternative finance through family, friends and non-listed equity. I then calibrate the model's parameters according to empirical values and stylized facts for China, where the issue of efficient credit distribution has been very acute despite important and on-going reforms.

The contribution of this paper is twofold. First, while the current literature considers only equity, bonds and retained earnings, I add the possibility for firms to access alternative sources

[1] As will be detailed in section 2.1, loan applications from private enterprises have long been disregarded by Chinese state-owned banks – who control the bulk of the credit distributed in China. This is one of the main reasons why small private firms still face significant obstacles when looking for financing.

of funding to finance their investment, thus including non-listed equity, family and friends and informal sources in the model. In my set-up, firms have an unequal access to this additional funding source, to reflect the randomness of contacts and networks. Many papers have dealt with resource misallocation and its impact on the aggregate economy (see, for instance, Restuccia and Rogerson (2008) and Hsieh and Klenow (2009)); however they generally do not study carefully alleviation mechanisms. Second, for the case of China, I provide a quantitative evaluation of the contribution of this alternative funding source to the aggregate production and capital accumulation. Such an evaluation has not been done before, as studies on investment's financing in China are either only qualitative, or focus on financial constraints faced by firms rather than on the way to bypass those constraints.

This set-up allows me to replicate Chinese data and to carry-out counter-factual experiments to assess the importance of access to alternative funding for firms' development. I compare two scenarios: (1) the benchmark case where enterprises can choose between retained earnings, bank loans and alternative funding to finance their investment, and (2) the case where only retained earnings and bank loans are available. The results show that during the early 2000s, the availability of alternative sources of funding has increased Chinese long-run aggregate capital level by 17% and long-run aggregate production by 8%. In terms of development of small young firms over the first 6 years of their activity, the presence of these alternative sources of funding implies an average production growth that is 6 to 23 percentage points higher and an average capital growth that is 13 to 50 percentage points higher. The stationary distribution of firms across capital size also contains a higher number of smaller firms when alternative finance is not an option, since young firms face more obstacles to grow in size.

As highlighted by the above results, this alternative funding renders small young firms more dynamic in terms of production and capital growth, and contributes to a higher long-run level of aggregate production and capital. This partly explains the surprising coexistence of a tremendous economic growth and malfunctioning formal credit institutions in emerging countries. In the case of China, tightening the regulation standards of non-bank lending institutions could therefore be detrimental to this economic dynamism, by preventing enterprises from bypassing financing constraints. Improving regulation should go hand in hand with a more efficiently allocated bank credit, in order to prevent regulation from having a biased impact on young private firms.

The next section reviews previous the related literature. Section 2 presents the data and some important stylized facts. Section 3 is devoted to the theoretical model used in this paper. Section 4 turns to the calibration of the model and the results.

1 Related literature

This study is connected to three strands of literature. The first one relates to mainly theoretical and structural papers that tackle resources allocation, firm's development and economic growth.

Second, many qualitative studies examine the link between general institutions' quality and development. Finally, numerous papers focus on specific countries and provide empirical evaluations of the presence of financial constraints faced by local enterprises, and of its alleviating factors.

First, focusing on resource allocation, Restuccia and Rogerson (2008) and Hsieh and Klenow (2009) look at the impact of misallocations that can be triggered by political preferences, regulation or credit constraints; they model misallocation by imposing heterogenous tax rates on output, capital and labor. However, they do not set up any microeconomic modeling for the funding decision of firms. Greenwood et al. (2013) suggest a microeconomic framework based on incomplete information and costly monitoring technology. In this set-up, all funding for capital investment must be obtained through financial intermediaries, and there is only one competitive sector for financial intermediation. Song et al. (2011) model the Chinese economic transition through a reallocation of resources from financially integrated (i.e. state-owned) firms to entrepreneurial (i.e. private and credit constrained) ones, but do not take into account the presence of alternative funding sources alleviating firms' credit constraints. The model I present here emphasizes a different aspect of capital misallocation and fund-raising decision: the constrained choice of the funding source. My objective is not to quantify the impact of capital misallocation, but to estimate to what extent alternative sources of funding alleviate this misallocation. In this regard, my study is closer to Moll (2014) and Song et al. (2011), although entrepreneurs in my model use access to alternative funding sources instead of self-financing to bypass financial constraints.

Further on the theoretical side, there is an abundant literature related to heterogenous agent models, with, for instance, Aiyagari (1994). The theoretical framework used here is relatively similar to Cooper et al. (2010), who set up a model to estimate the impact of labor regulation in China. Their study focuses on the labor input for production, while mine is centered on the capital input. Further studies focus on firm's financing constraints and choices: Cabral and Mata (2003) explain the size distribution of firms by the presence of financial constraints; Cooley and Quadrini (2001) use financial frictions in a firm dynamics model to explain stylized facts about the link between firm age, size and growth. Regarding the firm's choice of funding source for investment, Jermann and Quadrini (2006) consider that debt is preferred to equity for tax reasons, while Covas and Haan (2012) introduce quadratic costs for equity issuance.

Second, the finance-growth nexus and more generally the importance of institutions' quality has been studied among others by Allen et al. (2010), who compare China and India's institutional frameworks. In a similar direction, Allen et al. (2012b) examine the role of informal finance in the economic development of China. The latter support the view that the alternative financing sector, which they define as every non-bank source of funds, plays an essential role in explaining the high growth observed in China for more than one decade[2]. However, these studies are mostly based on

[2]Allen et al. (2005) and Allen et al. (2008) provide similar studies, while Allen et al. (2012a) focus on financing sources of Indian firms.

qualitative evidence and do not include any modelling. More recently, Degryse et al. (2013) use Chinese data to empirically show that informal finance has a positive impact on sales growth of small firms, and no impact for large firms.

Finally, regarding empirical estimations of the extent of financial constraints, I focus here on case studies related to China. For instance, Ayyagari et al. (2010) examine the performance difference between Chinese firms financed by banks and financed through informal sources, showing that the collateral required by formal banks is an important obstacle for private firms to obtain loans and that firms financed using bank loans are associated with higher sales growth. Du and Girma (2009), Girma et al. (2008) and Demetriades et al. (2008) conduct similar studies on the relationship between firm size, firm growth and source of finance. They conclude that formal and alternative finance sources are complementary in supporting different types of firms, and that the financial sources have a significant impact on firms' growth. Poncet et al. (2010) and Héricourt and Poncet (2009) suggest methods to test if Chinese firms are credit constrained, separating between private and state-owned firms. However, they do not use the origin of funds obtained by the firms to operate their test: they estimate an investment Euler equation, following Harrison and McMillan (2003) with no specific assumption regarding the formal or informal source of external funding.

2 Data and stylized facts

2.1 Chinese context

Since China has gradually opened up with the coming to power of Deng Xiaoping in 1978, entrepreneurship has developed tremendously. The progressive loosening of regulatory constraints, coupled with privatizations, mergers and closures of State-Owned Enterprises (hereafter, SOE), favored the growth of the private sector, consisting mainly in young, small and medium enterprises.

Still, the current characteristics of the Chinese credit market are deeply rooted in Chinese post-World War II history and go hand in hand with resources misallocations that may impact output production and efficiency. Until 1998, state-owned banks did not grant credit to private enterprises, observing what is known as the "political pecking order". Since then, the official stand regarding credit distribution has changed, but credit constraints are still present. As found by Du and Girma (2009), the "big four" State-owned Chinese banks tend to grant more credit to large firms than to Small and Medium Enterprises (hereafter, SME), discriminating not only against private firms, but also against smaller firms in general.

The size of a firm is indeed crucial to obtain formal financial credit for many reasons. First, Chinese banks usually require collateral when granting a loan, and generally accept only land or buildings. Given the specific features of the Chinese land ownership system, in particular that the land is mainly owned by the state, private SME are unlikely to be able to provide land as

collateral. Second, interest rates charged by the banks and the amount of credit available in the Chinese economy were mainly set by the monetary authorities until 2004. Hence, banks were not able to match their interest rates with the risk profile of the borrower and were instead forced to adjust their credit supply by changing quantity or choosing their borrowers. Since large enterprises, and even more SOE, are considered less risky than smaller firms, banks tend to favor them when distributing loans.

In this context, SME are often viewed as more productive than large ones, which are often SOEs. They should therefore attract more investment, and be able to raise more funds both through bank loans and financial markets. However, access to financial markets remains insufficiently developed to offer enough capital to Chinese firms, and firms mainly resort to bank loans or retained earnings to finance themselves, or need to find funding through alternative non-market sources.

To bypass credit constraints and finance their investment, SME may resort to other sources. They primarily use retained earnings, but also more informal means: non-listed equity, family and friends, or informal banking institutions, from trust companies to pawnshops, or even clan organizations (e.g. entrepreneurs from the coastal city Wenzhou). Obtaining funding from equity has the advantage that it requires neither collateral, nor very high interest payments. Similarly, informal lenders usually do not require the same kind of collateral as banks, though they often use other means to insure repayment, like reputation, trust or violence. They further require higher interest rates, close to 100% per year in some extreme cases, which limits the amount and loan duration the borrower can get. The data presented in the next section give us more details regarding these alternative ways to finance investment.

2.2 Data presentation

Firm-level data come from the Enterprise Surveys conducted by the World Bank[3] in many countries in the 2000s. These surveys are mainly focused on small and medium sized enterprises (SME), although they also include some large enterprises. Regarding China, surveys were conducted over 1548 enterprises in 2002 and 2400 enterprises in 2003. A new survey (data from 2012) has been released recently; however the variables included in it are not easily comparable with previous surveys. Also, the situation of Chinese financial markets and available sources of funding has considerably evolved within the last 10 years. For these reasons, I decided to keep the focus of this paper on the situation of firms at the start of the 21^{st} century. The samples used by the World Bank in 2002 and 2003 correspond broadly to the overall distribution of Chinese enterprises. They provide firm-level data on many aspects of the firms' situation, including the ownership structure, production, labor, investment and financing. Not all variables are filled in for both years. Consequently, I will be using data from 2002 to estimate the production function and data from 2003 regarding investment's financing. Both samples (2002 and 2003) are very similar

[3]These data are available at `http://www.enterprisesurveys.org/`.

regarding their composition (see Table 16 in Appendix A for a comparison), so I can use both of them without inconsistency.

Detailed data on sources of financing are available only in the 2003 survey, and are presented across firm size and ownership status respectively in Tables 1 and 2. I define firm size categories as follows: small firms have less than 50 employees, medium ones between 50 and 250, large ones between 250 and 1000, and very large above 1000 employees. Alternatively, I used total sales to define the size of a firm and obtained very similar results (see Table 17 in Appendix A). For the ownership status, I consider the owner of the largest share of the firm and distinguish between state-owned, private, collective and foreign enterprises in the following way: a firm is classified in a category when 50% or more are owned by this category of owners[4]. For almost all the firms present in the sample, this rule is sufficient to determine their ownership status. The unsettled cases are classified one by one.

	All	Small	Medium	Large	Very large
internal/retained earnings	24.37	22.12	27.80	26.07	16.32
local banks	32.38	20.29	28.56	41.49	45.66
foreign-owned banks	0.20	0.05	0.37	0.09	0.17
investment funds	0.87	1.38	0.61	0.93	0.61
trade credit	1.65	1.80	0.95	1.60	3.33
equity, sale of stock to employees	4.79	5.94	5.31	3.72	3.48
equity, sale of stock to legal-persons	13.03	20.40	12.27	10.61	7.03
equity, public issue of marketable share to outside investors	2.00	0.65	1.21	1.70	6.92
family, friends	9.41	16.10	11.72	3.95	2.11
informal sources	2.95	3.43	2.89	3.00	2.23
others	8.35	7.84	8.32	6.85	12.14
Observations	839	199	307	215	117

Table 1: Sources of funding for new investment, by firm size (% of total new investment)

In the raw data, the highest contribution to investment funding is attributed to "others", with a share of about 40%. The high share of this category is mainly driven by enterprises that declare obtaining 100% of their funding from other sources than the ones enumerated in the survey. Since it is not possible to obtain any further detail on the content of these other sources, I consider firms declaring 100% funding from "others" as missing values. In Tables 1 and 2, I present statistics including only the enterprises getting less than 100% of their financing from "other" sources[5]. The highest source of funds is bank loans, with 32% of investment funds coming from local banks. The share of investment financed through bank loans is clearly increasing with size and with state ownership. Smaller firms compensate this fact by a more intensive use of retained earnings and alternative sources of funding, notably funds provided by family and friends, and non-listed equity.

[4]For collective firms, I refer to the share of the firm that is collectively owned

[5]I loose 503 observations from this manipulation.

	Foreign	Private	Collective	SOE
internal/retained earnings	31.52	24.21	33.67	19.83
local banks	22.64	28.83	41.85	52.89
foreign-owned banks	0.34	0.23	0	0.00
investment funds	2.41	0.51	0	2.19
trade credit	5.74	1.66	0	0.04
equity, sale of stock to employees	5.17	5.65	0	1.27
equity, sale of stock to legal-persons	17.98	13.41	15.70	8.17
equity, public issue of marketable share to outside investors	1.72	2.12	0.00	1.91
family, friends	3.62	11.69	6.67	1.19
informal sources	2.59	3.02	0	3.41
others	6.26	8.66	2.11	9.11
Observations	58	630	27	124

Table 2: Sources of funding for new investment, by firm ownership status (% of total new investment)

The use of retained earnings is relatively low compared to other countries (both developing and developed) where similar surveys have been conducted[6]. Note that the shares financed by foreign banks or investment funds are very small, which confirms the limited presence of foreign banks in the country in 2003, and the slow introduction of financial innovations.

2.3 Distribution of firms across uses of finance sources

To define some stylized facts able to drive the model set-up, I regroup these various sources of funding into 3 categories:

- retained earnings: corresponds to the retained earnings defined in the data
- bank loans: contains loans from local banks and foreign banks, and investment funds
- alternative sources: regroups family and friends, all equity items, trade credit and informal sources

Using these 3 categories, I study more in details their use across different types of firms. Indeed, the average shares of sources of finance presented in Tables 1 and 2 hide large discrepancies across firms: most of them tend to use only a subset of the available sources, with a non-negligible proportion financing their investment using only one source of funds. Tables 3 and 4 report, for each financing possibility, the share of enterprises not using it at all (declaring 0% of their investment funds coming from it), and the share of enterprises using only one of the sources to finance their investment, by size and by status. Similar results are presented in Table 18 in Appendix A, using total sales to define firms' size.

[6]See Table 21 in Appendix A for the break down of funding sources in Germany in 2005. Using similar size categories as for China, retained earnings are more heavily used by firms of all sizes, and leasing (inexistant in China in 2003) is also used. On the opposite, family and friends are almost inexistant as source of funding, informal sources disappear, and equity is less used except for very large firms.

		All	Small	Medium	Large	Very large
not using (0%)	internal/retained earnings	61.98	68.84	58.63	58.60	64.96
	bank loans	52.92	69.35	58.96	40.93	31.62
	alternative	53.64	39.43	54.68	60.82	62.37
using only (100%)	internal/retained earnings	16.57	16.58	19.87	16.28	8.55
	bank loans	20.14	14.07	18.57	24.65	25.64
	alternative	26.61	41.71	26.97	17.01	17.20
	observations	839	199	307	215	117

Table 3: Sources of financing: share (%) of enterprises declaring not using one financing source, or using only one finance source, by size

		Foreign	Private	Collective	SOE
not using (0%)	internal/retained earnings	56.90	60.63	59.26	71.77
	bank loans	63.79	56.35	48.15	31.45
	alternative	53.85	47.97	70.37	77.98
using only (100%)	internal/retained earnings	27.59	15.40	25.93	15.32
	bank loans	17.24	15.71	29.63	41.94
	alternative	30.77	28.97	18.52	14.68
	observations	58	630	27	124

Table 4: Sources of financing: share (%) of enterprises declaring not using one financing source, or using only one finance source, by status

More than half of the firms do not use all of the financing sources available. This share is the highest for funds coming from retained earnings, which 61% of the enterprises do not use, followed by alternative financing, which is not used by 53% of the firms. Combining this to the fact that 26% of the firms use only alternative funding to finance their investment, there are only 21% of firms partially using alternative sources to finance their investment. Such a distribution of uses of alternative sources suggests that there is an important fixed entry cost. If we consider the use of bank loans, this stylized fact is less pronounced, so that the presence of some fixed costs in this sector is less striking.

2.4 Bank loans and collateral

The Enterprise Survey also contains questions regarding the application for bank loans, and their accessibility. Tables 5 and 6 provide the average answers to a subset of these questions. Clearly, providing collateral seems to be a bigger obstacle for smaller firms. 72% of the loan applications of small firms were turned down because of lack of collateral, whereas this was the case for only 52% of very large firms. Furthermore, 27 % of small firms that did not apply for a loan, were discouraged because some collateral was required. Among firms currently having a loan, collateral was less often required for smaller firms: this can be explained by the fact that smaller firms did not obtain loans when collateral was required. The impact of the firm status on the loan application

(cf. Table 6) is slightly weaker than that of size. Similar results, separating firms by total sales, are provided in Table 19 in Appendix A.

		Small	Medium	Large	Very large
if having a loan, was...	collateral needed	41.06	59.33	68.24	63.73
if did not apply for a loan, is it because...	procedure cumbersome	27.44	26.54	22.29	13.89
	collateral required	27.09	27.47	22.60	16.67
	interest rates too high	17.73	15.67	17.51	20.83
	reject expected	22.68	16.11	17.34	12.68
if application rejected, was it because...	lack of collateral	72.31	71.88	66.67	52.63

Table 5: Some facts about bank loans requirements and applications, by size (% of firms)

		Foreign	Private	Collective	SOE
if having a loan, was...	collateral needed	53.10	58.55	64.41	61.89
if did not apply for a loan, is it because...	procedure cumbersome	27.96	26.78	15.38	20.61
	collateral required	23.91	27.57	15.09	22.42
	interest rates too high	19.57	17.20	13.21	17.07
	reject expected	13.98	19.77	11.32	18.75
if application rejected, was it because...	lack of collateral	66.67	71.71	56.25	66.67

Table 6: Some facts about bank loans requirements and applications, by status (% of firms)

Table 7 presents the mean of the interest rates charged on bank loans, as well as the average collateral pledged as a share of granted loan. We can notice that across size, the interest rates charged vary only slightly. This seems to confirm the fact that, interest rates being set by the government, banks have little leeway to adjust them with respect to the risk profile of the borrower. Banks tend therefore to adjust the quantity, by providing less credit to SME, considered as riskier. The pattern of interest rates varies also little across status, and across amount invested (see Tables 8 and 9).

We can notice that smaller firms tend to provide more collateral as a share of their loan (see Table 7). This is related to the amount of the loan provided: if the amount lent is smaller, it is more easily covered it by collateral. However, this can also reflect the constraints faced by SME: if they face higher collateral requirements, they may have to reduce the total amount of the loan to satisfy them. Looking at Table 9 gives similar results: enterprises investing smaller amounts (note that those firms are also smaller in size) provide a collateral covering 90% of their loan, whereas those investing higher amounts cover only 75% of their loan with collateral.

	All	Small	Medium	Large	Very large
interest rate	5.53	6.25	5.37	5.48	5.46
collateral (% of loan)	83.80	90.86	83.55	84.39	77.48
Observations	666	80	262	221	102

Table 7: Average interest rate and collateral required for bank loans, by firm's size

	Foreign	Private	Collective	SOE
interest rate	5.01	5.56	5.65	5.58
collateral (% of loan)	80.03	84.58	71.30	85.38
Observations	49	458	30	129

Table 8: Average interest rate and collateral required for bank loans, by firm's status

3 Modeling investment decision and financing choice

I set up here a partial equilibrium model, focused on the investment decision and its financing at the firm level. The objective of the firm is to maximize its life-time dividends. To achieve this goal, it plans its investment and has three different ways of financing it: it can (1) use retained earnings (which are thus subtracted from its dividends), (2) borrow from the formal banking sector paying for the interest rate, or (3) obtain funding from an alternative source (this regroups all financing means that are not included in the official banking sector: non-listed equity, family and friends, trade credit, informal moneylenders...) at a variable cost. The firm may be credit constrained on the formal sector: banks require collateral and are only willing to grant a loan equal to some share of this collateral. If the firm wants to obtain more funds than that, it will turn to alternative providers of funds. The collateral of the firm consists in its capital from the current period, which it can pledge to obtain a loan today. This set-up summarizes quite realistically the situation of a Chinese firm needing to finance its investment. The production function is a usual Cobb-Douglas function with capital and labor as inputs. The main features of the model are described more in details in subsections 3.1 to 3.3.

	0-100	100-1000	1000-10000	>10000
interest rate	5.53	5.74	5.58	5.20
collateral (% of loan)	90.33	88.32	83.04	75.21
Observations	86	174	180	98

Table 9: Average interest rate and collateral required for bank loans, by amount invested (in thousand yuan)

3.1 Bank loans

As seen in section 2.4, the interest rate charged by banks vary very little across firm's size, status and amount invested. Hence, it seems reasonable to define a unique interest rate $1+r$ in the model, which is charged to all types of firms. Where does the credit constraint come from? Since smaller firms are expected to be more risky, banks tend to impose higher requirements, as seen in Tables 7 to 9. Setting up a collateral requirement in my model seems therefore to correspond better to the banks' behaviour.

Simple collateral constraint

There are many ways to define the collateral in this setting: current profit (today), expected profit (tomorrow), personal cash invested, capital owned today, capital owned tomorrow. I choose to define the firm's collateral constraint in terms of the capital currently owned by the firm. Indeed, conditioning the bank loans on the amount of reinvested profits would make reinvestment too attractive for the firms compared to what we observe in the data. Furthermore, as seen in part 2, banks tend to favor loans granted to larger firms, even when profit opportunities of SMEs are higher, so that a collateral constraint related to expected profit would not correspond well to this situation. Since capital is mainly constituted of seizable assets, it seems to be best suited to be pledged as collateral by the firms. Hence, the collateral constraint is written as:

$$qb' \leq \theta k$$

where b' is the amount to be reimbursed tomorrow, q is the price of the loan, k is the firm's capital today and θ is a constant.

3.2 Alternative funding

As seen in section 2.3, the distribution of alternative funding gives us some hint on how to model it. To be able to use alternative funding, a firm has to pay a variable cost, that depends on its relationship with the lender. It then pays an interest rate on the loan obtained.

Access to alternative funding

Access to alternative funding sources depends on family, friends, networks that help firms in finding potential investors. Therefore it can be seen as some random ability that depends on external stable conditions (social and wealth background of the entrepreneur's family, relationships). The difficulty in obtaining financing from these sources depends mainly on the degree of anonymity in the relationship between the lender and the borrower. To reflect this degree of anonymity, I use the variable $\varphi \geq 0$: on a more straightforward way, φ represents the easiness of access to alternative funding. At its birth, each firm draws a realisation of the random variable φ from the cumulative distribution function $P(.)$. Then, when the firm wants to use some alternative funding, it pays a

cost that is proportional to the degree of anonymity: its total cost is $\varphi c(a)$. In this case, a higher value of φ means worse access to alternative funding (higher anonymity in the relationship). The value of φ remains fixed for the whole activity period of the firm.

Cost of alternative funding

Cooley and Quadrini (2001) include a linear cost of issuing equity in their model, while Covas and Haan (2012) suggest the use of a quadratic cost. As shown by Cooper and Haltiwanger (2006) in the case of investment, to reproduce both inaction and bursts of investment, a combination of different forms of adjustment costs is needed: fixed costs, convex costs and irreversibility costs. The case I consider here is relatively similar: I am trying to reproduce both the absence of use of alternative funding for a relatively large share of enterprises, and its very intensive use for some of them. Hence, it seems reasonable to include both a fixed cost of resorting to alternative financing, and a quadratic cost related to the amount of investment financed with this source. The quadratic cost reflects two facts: first, when resorting to family or friends to finance investment, the amount you can obtain is clearly bounded, since family and friends have a limited wealth. Second, when issuing non-listed equity, a firm can only reach a limited number of potential investors, because it does not beneficiate from the easy accessibility and guaranties provided by public financial markets, and the cost of issuance increases with the amount to be issued. I therefore specify the following functional form for the cost of alternative funding $c(a)$:

$$c(a) = F\mathbf{1}_{a>0} + \eta a^2$$

where a is the amount to be reimbursed, F and η are constants and $\mathbf{1}_{a>0}$ is a dummy variable equal to 1 when $a > 0$ and 0 otherwise.

A firm willing to finance part of its investment through alternative funding has to pay immediately this cost $\varphi c(a)$, and obtains a loan at the interest rate φr_a.

3.3 Default

If it is not able to reimburse its current debt, the firm is forced to default and to exit the market. In this case, it obtains a negative profit[7] today, and has zero profit for all future periods, as is written below in equation (2). The firm takes this possibility into account in its expected continuation value, weighted by the probability p that it defaults next period, as defined in equation (11). Note that the amount to be reimbursed tomorrow (bank loan and alternative funding) is decided today, so that the only uncertainty regarding default tomorrow comes from the productivity shock faced by the firm.

[7] I assume full liability here. In the stationary equilibrium, default is very unfrequent, so that assuming partial liability would lead to similar results.

3.4 The program of the firm

This section summarizes the set-up described above and presents the optimization program of the firm. The notations are as follows.

Production

The production function is a simple Cobb-Douglas function using capital k and labor l as inputs: $f(A,k,l) = Ak^{\alpha}l^{\gamma}$. A is the shock faced by the firm at each period. It encompasses its productivity, as well as the other non-specified inputs (intermediate inputs for instance). α and γ are respectively the elasticities of output with respect to capital and labor, with $\alpha + \gamma \leq 1$. All firms produce the same homogenous good regardless of their type, and this good is defined as the numeraire.

Sources of finance for investment

- ret is the amount of retained earnings reinvested yesterday to build today's capital.
- b is the amount borrowed yesterday from the formal banking sector, with interest rate r. It is constrained by the pledgeable collateral of the firms.
- $q = \frac{1}{1+r}$ is defined for notation simplicity as the price of the asset sold by the enterprise to the bank.
- a is the amount borrowed from alternative sources. There is no collateral required, but a cost $c(a)$ function of the amount obtained and an interest rate to pay. This corresponds to both informal finance and equity shown in section 2.
- φ reflects the inequality across firms in terms of access to alternative sources of funds (see more details above).
- $\varphi c(a) = \varphi(F\mathbf{1}_{a>0} + \eta a^2)$ is the cost of alternative financing sources, composed of a fixed cost and a quadratic costs.
- φr_a is the interest rate on the alternative funding.
- $q_a(\varphi) = \frac{1}{1+\varphi r_a}$ is defined as the price of the loan obtained from alternative sources.
- d is the total amount of debt to be reimbursed by the firm today: $d = a + b$.
- $k = (1-\delta)k_{-1} + ret + qb + q_a(\varphi)a$ is the total capital used for production today. For simplicity, capital is considered as irreversible, and can only be decreased through depreciation (with a rate δ).
- w is the wage that prevails on the labor market, and is taken as given by the firm.

Value function

The value function of a firm at each period can be written as the following function, where V^D and V^{ND} are respectively the values of defaulting and not defaulting:

$$V(\varphi, A, k, d) = \begin{cases} V^D(\varphi, A, k, d) & \text{if } V^D(\varphi, A, k, d) < 0 \\ V^{ND}(\varphi, A, k, d) & \text{otherwise.} \end{cases} \tag{1}$$

The corresponding definitions of default and non-default values are specified below in equations (2) to (10). The firm faces an exogenous death probability denoted ξ at every period. If it dies, the firm exits the market and obtains 0 as dividend for the death period. $\mathbb{E}$ stands for the expectation. As mentioned earlier, since capital and debt tomorrow are decided today and φ is stable across time, the only uncertainty faced by the firm comes from its productivity tomorrow and the eventuality of death.

$$V^D(\varphi, A, k, d) = \max_l \{f(A, k, l) - d - wl\} \tag{2}$$

$$\begin{aligned} V^{ND}(\varphi, A, k, d) = \max_{l, ret', b', a'} \{ & f(A, k, l) - d - wl - \varphi c(a') - ret' \\ & + \beta(1-\xi)\left[p\mathbb{E}V^D(\varphi, A', k', d') + (1-p)\mathbb{E}V^{ND}(\varphi, A', k', d')\right]\} \end{aligned} \tag{3}$$

such that

$$\begin{aligned} k' &= (1-\delta)k + ret' + qb' + q_a(\varphi)a' && (4) \\ d' &= b' + a' && (5) \\ ret' + \varphi c(a') &\leq f(A, k, l) - d - wl && (6) \\ qb' &\leq \theta k && (7) \\ ret' &\geq 0 && (8) \\ b' &\geq 0 && (9) \\ a' &\geq 0 && (10) \end{aligned}$$

The probability of default (given that the firm did not die) is defined as:

$$\begin{aligned} p &= P(\text{default}) \\ &= P(f(A', k', l') - d' - w'l' < 0) \\ &= P\left(A'k'^{\alpha}l'^{\gamma} - w'l' < d'\right) \end{aligned} \tag{11}$$

Constraint (6) ensures that the amount of retained earnings plus the costs of accessing alternative funding are not greater than the current profit (in other words, it imposes non-negative

dividends). Equation (7) imposes that the firm cannot borrow from the formal banking sector more than a share θ of its current capital. It thus defines the collateral constraint imposed on the firm.

Labor market equilibrium

For simplicity, the labor supply is exogenously fixed and the wage w adjusts to obtain equilibrium on the labor market. Since introducing a hand-to-mouth consumer-worker in the model would add complexity while leading to similar results, I prefer a specification with an exogenous labor supply.

3.5 Some intuition

Default value

In the event of a default, the firm still hires some labor to produce during the current period but does not manage to reimburse its debt and therefore exits the market at the end of the period, without investing. Obviously, the labor decision does not involve any intertemporal arbitrage and the optimal labor demand can be easily determined analytically as a function of current capital, productivity and wage:

$$l^* = \left(\frac{\gamma A k^\alpha}{w}\right)^{\frac{1}{1-\gamma}} \tag{12}$$

The default value is then:

$$V^D(\varphi, A, k, d) = (Ak^\alpha)^{\frac{1}{1-\gamma}} \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} (1-\gamma) - d \tag{13}$$

Non-default case

To get a better overview of the input and funding choices we can expect from the firm, I provide here some further elements regarding its arbitrage decision. I set up the Lagrangian of the problem below, denoting λ and μ the multipliers respectively associated with constraints (6) and (7).

$$\begin{aligned}
\mathcal{L} &= Ak^\alpha l^\gamma - d - wl - \varphi c(a') - ret' \\
&+ \beta(1-\xi)\left[p\mathbb{E}V^D(\varphi, A', k', d') + (1-p)\mathbb{E}(V^{ND}(\varphi, A', k', d'))\right] \\
&+ \lambda(Ak^\alpha l^\gamma - d - wl - \varphi c(a') - ret') + \mu(\theta k - qb')
\end{aligned}$$

Similarly to the default case, the optimal labor demand can be easily analytically derived and is equal the labor demand in the default case:

$$l^* = \left(\frac{\gamma A k^\alpha}{w}\right)^{\frac{1}{1-\gamma}} \tag{14}$$

From the first order conditions of the problem and the envelop theorem, I obtain equations (15) to (17) defining the optimal levels of retained earnings, bank loan and alternative funding. To simplify the notations, I do not write the state variables of the value functions, so that $\mathbb{E}V^{ND}$ corresponds to $\mathbb{E}V^{ND}(\varphi, A', k', d')$, $\mathbb{E}V^{D}$ corresponds to $\mathbb{E}V^{D}(\varphi, A', k', d')$, and so on (note that all these value functions concern the future period, hence the expectation operator $\mathbb{E}$).

$$p\frac{\partial \mathbb{E}V^D}{\partial k'} + (1-p)\frac{\partial \mathbb{E}V^{ND}}{\partial k'} + \frac{\partial p}{\partial ret'}(\mathbb{E}V^{ND} - \mathbb{E}V^D) = \frac{1+\lambda}{\beta(1-\xi)} \tag{15}$$

$$p\frac{\partial \mathbb{E}V^D}{\partial k'} + (1-p)\frac{\partial \mathbb{E}V^{ND}}{\partial k'} + \frac{1}{q}\frac{\partial p}{\partial b'}(\mathbb{E}V^{ND} - \mathbb{E}V^D) = \frac{1+\mathbb{E}\lambda'(1-p)}{q} + \frac{\mu}{\beta(1-\xi)} \tag{16}$$

$$p\frac{\partial \mathbb{E}V^D}{\partial k'} + (1-p)\frac{\partial \mathbb{E}V^{ND}}{\partial k'} + \frac{1}{q_a(\varphi)}\frac{\partial p}{\partial a'}(\mathbb{E}V^{ND} - \mathbb{E}V^D) = \frac{1+\mathbb{E}\lambda'(1-p)}{q_a(\varphi)} + \frac{(1+\lambda)\varphi c'(a')}{q_a(\varphi)\beta(1-\xi)} \tag{17}$$

Equations (15) to (17) respectively display the first order conditions for retained earnings, bank loan and alternative funding. Each of these equations can be interpreted easily: the left-hand side is the marginal gain obtained from increasing slightly the amount invested today (i.e. the capital tomorrow), while the right-hand side is the marginal cost of increasing the investment today, which depends on how the investment is financed.

Propositions 1 and 2 give us a better understanding of the firm's funding decisions.

Proposition 1. *If $\beta(1-\xi) \geq q$ (resp. $\beta(1-\xi) \geq q_a(\varphi)$), the firm prefers to finance investment through retained earnings rather than through bank loan (resp. alternative sources) provided that she does not hit the non-negative dividends constraint* (6).

See proof in Appendix B.1.

The intuition of the proof is the following. When $\beta(1-\xi) \geq q$ and the non-negative dividends constraint is not binding, using retained earnings rather than bank loan is relatively cheaper in terms of cost. The expected benefit is composed of three terms: the marginal impact of an increased capital on (1) the expected value of default, (2) the expected value of non-default; (3) the marginal impact of increased retained earnings or bank loans on the probability of default. The first two terms (1) and (2) are equal for both sources of funding. The last term (3) changes depending on the funding instrument: retained earnings decrease the default probability, while bank loans increase the default probability for most parameter values. Using retained earnings instead of bank loans keeps low the default probability and is therefore more beneficial than bank loans; which makes retained earnings unambiguously preferred to bank loans as long as the firm does not hit the non-negative dividends constraints. The result for alternative finance is proved following a similar reasoning.

Note that when $\beta(1-\xi) < q$, the firm's preference between retained earnings and bank loans is ambiguous. Indeed the sign of the marginal cost and benefits difference between those two sources

of funding depends on the parameters and cannot be analytically determined. The intuition behind this fact is the following. When $\beta(1-\xi) < q$ and the collateral constraint is not binding, using bank loans rather than retained earnings is cheaper in terms of cost. However, in terms of future expected benefit, preference between bank loans and retained earnings is unclear, since using bank loans increases the probability of default tomorrow and the probability that the non-negative dividends constraint will be binding tomorrow, while using retained earnings decreases these two probabilities. Which of these various effects dominates cannot be determined analytically.

Comparing alternative funding and retained earnings in the case where $\beta(1-\xi) < q_a(\varphi)$ leads to similarly inconclusive results.

Proposition 2. *For all φ such that $q \geq q_a(\varphi)$, the firm prefers to finance investment through bank loans rather than through alternative sources, provided that she does not hit the collateral constraint* (7).

See proof in Appendix B.2. The mechanism is similar to the proof of Proposition 1: when $q \geq q_a(\varphi)$, for all possible values of φ and of the cost of access to alternative funding, the cost of using bank loan is smaller than the cost of using alternative funding. In terms of marginal benefit, increasing capital through those two funding sources has the same impact on the expected values of default and non-default. They also both increase the probability of default tomorrow, but using alternative sources increases it more than using bank loans. Therefore, firms prefer to use bank loans, until they hit the collateral constraint.

Here again, when $q < q_a(\varphi)$, the results are ambiguous and we cannot analytically determine the firm's preference between bank loans and alternative sources. In this case, the expected benefit of using alternative sources is higher than the one of bank loans. However, the cost of using alternative funding depends on the values of φ and a', so that we do not know whether banks loans or alternative sources are more costly to use. Therefore we cannot determine analytically which of these two effects dominates.

Figure 1 gives a representation of the funding choice when $\beta(1-\xi) > q > q_a$ and $\varphi \geq 0$. In this case, retained earnings are preferred to bank loans, that are preferred to alternative funding. Therefore, the marginal cost for retained earnings (light blue dashed line) is always smaller than the marginal cost for bank loans (dark blue dashed-dotted line), which is always smaller than the marginal cost of alternative funding (red solid line). The firm finances investment until it either hits a constraint, or the marginal benefit of investment is lower than its marginal cost. The global marginal cost curve is represented by the thick black curve. In this case, the decision sequence is as follows: first, the firm uses retained earnings, as long as it does not hit the non-negative dividends constraint (6) (threshold $\bar{r}$). It then switches to bank loans provided that it does not hit the collateral constraint (7) (threshold $\bar{b}$). Then, it may want to switch to alternative sources, but that can be the case only if $\varphi = 0$: otherwise it already hits the non-negative savings constraint and cannot pay the cost of accessing the alternative funding. The total amount invested is i^*.

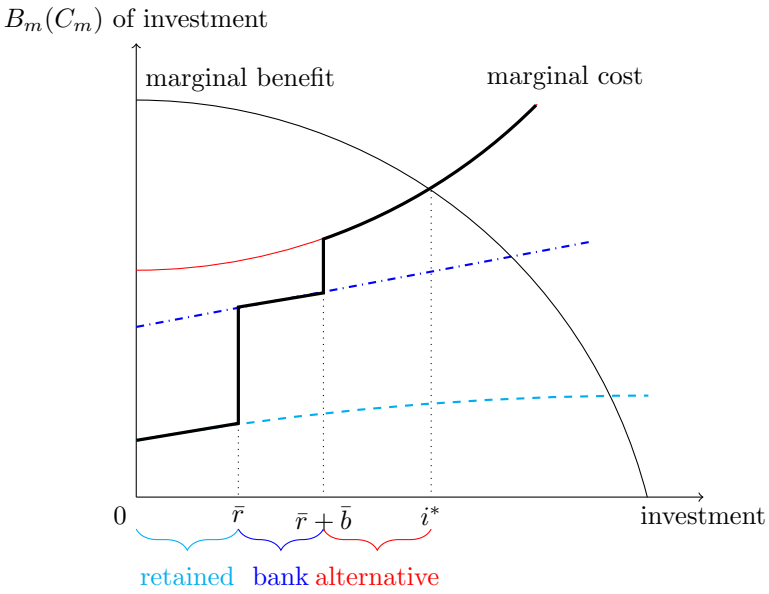


Figure 1: Case of $\beta(1-\xi) > q > q_a$ and $\varphi \geq 0$

4 Calibration and Results

The discount rate and the depreciation rate of capital are set following to the literature, while the interest rate of the bank loan is directly obtained from the data. The parameters defining the production function and the technology shock are estimated using the data. The rest of the parameters (tightness of the collateral constraint, costs of accessing to alternative funding, interest rate of alternative funding and death probability) are defined to match moments from the data.

4.1 Parameterization of the model

As presented in section 2.4, the data provide the interest rate charged by the formal banking sector, denoted r. Tables 7 and 8 report the average interest rate faced by the firms on loans obtained from the banking sector. From Table 7, I set $r = 5.53\%$, corresponding to $q = 0.9475$. I set the value of the discount factor β to 0.99, as is common in the literature.

Regarding the depreciation rate δ, there are some studies using depreciation rates either for China or for other developing countries, among which only a few actually estimate the depreciation rate. Their results are summarized in Table 10. Although a depreciation rate close to 5% is often used (for instance by Hsieh and Klenow (2009)), many studies that estimate the depreciation rate in China find higher results. Bai et al. (2006) obtain an average depreciation rate of about 10% for the period ranging from 1997 to 2003, Sun and Ren (2008)'s rates range between 8% and 26%, while Wu (2009) obtains estimates between 3.6% and 17%. Furthermore, Udry and Anagol (2006) show theoretically that financially constrained firms tend to hold assets that depreciate faster,

which is confirmed empirically by Schündeln (2012). The latter also shows that younger firms have a higher depreciation rate. Given that my study is mainly focused on young firms that may suffer from financial constraints, it seems reasonable to set δ to 10% for the calibration.

Source	Depreciation rate	Country
Bai et al. (2006)	8% for structures 24% for machinery avg 10.52% for 1997-2003	China
Raychaudhuri (1996)	6.7%	Indian industries
OECD (2000)	4%	China
Wang and Yao (2003)	5%	China
Hsieh and Klenow (2009)	5%	China and India
Schündeln (2012)	from 8% to 14%	Indonesia
Sun and Ren (2008)	17% for equipment 8% for structure 26% for auto	China
Wu (2009)	from 3.6% to 17% avg 5.2 % for manufacturing avg 4.0 % for services total avg 4.6%	China

Table 10: Depreciation rates estimated or assumed by various studies

4.2 Calibration of the production function

To calibrate the elasticity of output with respect to capital and labor (α and γ respectively), I estimate a production function using data from 2002. Indeed, missing values for capital in 2003 do not allow to use that year for the estimation. Many papers have been written on how to estimate a Cobb-Douglas type production function. As noted, among the first ones, by Marschak and Andrews (1944), a simple OLS regression provides biased coefficients, due to the endogeneity caused by the possible correlation between inputs and unobserved productivity shocks. Hence, I use here two approaches, respectively suggested by Olley and Pakes (1996) (hereafter OP) and Levinsohn and Petrin (2003) (hereafter LP), that take this simultaneity into account. OP use investment as a proxy for the productivity shock, whereas LP suggest to use intermediate inputs such as energy or materials. The 2002 data give information on firms' output, capital, labor, investment, materials and energy consumption from 1 to 3 years before the survey, and can therefore be used as panel data.

investment	energy	materials
64.21 %	40.37%	70.13%

Table 11: Share of non-missing and non-zero values for possible proxy variables (percent of total number of observations)

One of the general advantages of LP's approach is to avoid the issue of missing values due to null investment. However, in my data, there are surprisingly much more missing values for energy than for investment (cf. Table 11). Hence, I favor investment or materials as proxy variables, and I do not use the data regarding energy. In their approach, OP correct both for endogeneity and for sample selection issues due to firms' exit (for instance if they stop their activity during the survey). Since data from the Investment Climate Survey have all been collected at one time, there is no exit, and I do not apply the part of OP's algorithm that corrects for it. Still, it doesn't mean that the selection issue is solved: all firms for which I have data in 1999, 2000 or 2001 are firms that have survived at least until 2002, and I have no information regarding firms that shut down before 2002. My sample is therefore inevitably biased by this selection effect.

	Levinsohn & Petrin		
	(1)	(2)	(3)
	All	Manufacturing	Services
labor	0.0966***	0.103***	0.373***
	(0.0318)	(0.0298)	(0.0763)
capital	0.699***	0.524***	0.599***
	(0.110)	(0.143)	(0.180)
N	3034	2563	471

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Estimation of the production function coefficients with LP's methods for different samples

	Olley & Pakes		
	(1)	(2)	(3)
	All	Manufacturing	Services
labor	0.252**	0.253***	0.386***
	(0.0255)	(0.0277)	(0.0672)
capital	0.459***	0.511***	0.428***
	(0.101)	(0.130)	(0.121)
N (first step)	2505	1988	517
N (second step)	1460	1165	295

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Estimation of the production function coefficients with OP's methods for different samples

Tables 12 and 13 present the results of the estimation of the production function for both methods. Results obtained with OLS and fixed effects are shown in Table 22 in Appendix A for the whole sample, as a reference to compare with more robust approaches. The variable used for

output here corresponds to value added (materials have been subtracted). The theory says that coefficients estimated with OLS should be biased upwards for labor and downwards for capital. This is confirmed by the results obtained using LP's method, with materials as proxy. In Table 12, column (1), the estimated coefficient of capital for the whole sample equals 0.699, and is significantly higher than the ones obtained by least squares (Table 22 in Appendix A, columns (1) and (2)). Using the investment as proxy as suggested by OP (Table 13) does not bring the same effects: the coefficients for capital are all lower than OLS coefficients, and coefficients for labor are similar. However, the coefficients obtained for capital with OP's method remain higher than the ones obtained with a simple fixed effects regression. Looking more carefully at the results, OP's method seems to yield more reasonable and stable coefficients estimates. Although both approaches obtain quite high capital elasticities, the OP coefficients are more plausible, with a capital coefficient around 0.45 and a labor coefficient around 0.3, whereas the coefficients obtained with LP are very low for labor (around 0.1 for the whole sample) and surprisingly high for capital (around 0.7). For this reason, I will favor OP's results in the continuation of my work. The calibrated values of parameters α and γ are therefore respectively 0.46 and 0.25, as obtained for the whole sample.

OP's procedure also provides estimated series for the productivity of each firm at the available dates. I use these series to estimate the autoregressive coefficient of the productivity process, and obtain $\rho = 0.67$. To calibrate the productivity shock process of my model, I use a discrete Markov-Chain process with a transition matrix such that the theoretical autoregressive coefficient associated to it is relatively close to 0.67. The transition matrix and the state space I use for the calibrated model are specified below.

$$T = \begin{pmatrix} 0.30 & 0.42 & 0.18 & 0.1 & 0 \\ 0.10 & 0.45 & 0.30 & 0.15 & 0 \\ 0.01 & 0.15 & 0.68 & 0.15 & 0.01 \\ 0 & 0.15 & 0.30 & 0.45 & 0.10 \\ 0 & 0.005 & 0.195 & 0.50 & 0.30 \end{pmatrix}$$

$$S = \begin{pmatrix} 0.2 & 0.8 & 1.0 & 1.2 & 2.1 \end{pmatrix}$$

4.3 Further Parameters: Matching moments

The remaining parameters are calibrated in order to match the moments highlighted in section 2. For simplicity, I consider a discrete distribution over two possible values for φ: 0.1 and 1, so that only the following probability has to be calibrated: $p_0 = P(\varphi = 0.1)$. The parameters to be calibrated are then:

- θ: tightness of the collateral constraint to obtain bank loans
- F: fixed cost of accessing alternative funding

- η: quadratic cost of accessing alternative funding
- r_a: interest rate to pay on alternative funding
- p_0: probability that $\varphi = 0.1$
- ξ: exogenous death probability

To achieve this, I solve for the stationary equilibrium of the model presented in section 3 with value function iterations, and then I compute the corresponding moments using firms' stationary distribution. The procedure followed is described below. After solving the model for the optimal policy functions (decisions for ret', b' and a'), the firms' stationary distribution over productivity, capital, debt and labor is computed for each possible value of φ. I then build four size categories according to the quantity of labor employed by the firms, similarly to the data presented in section 2. The size thresholds are set so that the shares of each of the four categories in the firms' stationary distribution across labor are the same as in the data. This means that, if 23% of the enterprises are small in the data, the bottom 23% of the firms in the stationary distribution are classified as small, and so on. This is clearly not the only way to create size categories: for instance, I could also set the highest threshold using the share of very large enterprises in the data, and then compute the other size thresholds proportionally to the thresholds in the data. However, the bottom threshold in the data is equal to 0.05% of the highest one, and there is not enough variation in the model's labor demand size to allow for such a small threshold. Finally, optimal investment decisions and its financing are computed for each firm, and averaged within size categories. I also calculate the share of firms that *do not* use one of the funding sources and the share of firms that use *only* one of this sources, to compare these values with the ones presented in section 2.

To identify the 6 parameters mentioned above, I need to match at least 6 moments from the data. Since this study is mainly centered on the use of alternative funds and bank loans, I focus on moments concerning these two funding sources. Table 14 presents the moments from the data to be matched.

	small firms	medium firms	large firms
share of bank loans in investment funding	24%	33%	48%
share of alternative sources in investment funding	53%	36%	24%
share of firms not using alternative funding	39%	55%	60%

Table 14: Moments from the data

q	β	δ	α	γ	F	r_a	η	θ	p_0	ξ
0.9434	0.99	0.1	0.46	0.25	0	0.0821	0.01	0.2	0.2	0.15

Table 15: Calibrated parameter values

The calibrated values of the parameters are presented in Table 15. These values imply that, depending on the value of φ, $q_a = 0.99$ or 0.92, so that $\beta(1-\xi) = 0.84 < q$ and $\beta(1-\xi) < q_a$. As a consequence, the results highlighted in Proposition 1 do not apply in this case. Furthermore, the results of Proposition 2 apply only for firms with costly access to alternative funding, i.e. with $\varphi = 1$.

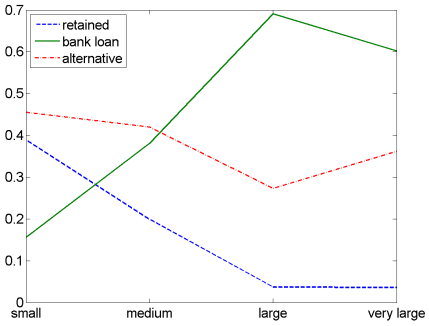
4.4 Results

Figure 2 shows the share of investment financed by each of the three sources of funding, the share of firms not using one of them and the share of firms using only one of them. The calibration manages to reproduce the financing patterns of small to large firms: small firms use indeed more alternative sources and less bank loans, while large firms use predominantly bank loans to finance their investment. Furthermore, as seen in the data, the share of firms not using alternative sources is increasing with size, while the share of firms not using bank loans decreases. However, the behavior of very large firms remains at odds with the data, those firms using more alternative funding than what is empirically observed. This is true for the shares in investment financing (figure 2a), but also for the share of firms not using one source of funding and using only one source of funding (figures 2b and 2c). Surprisingly, none of the firms use only retained earnings to finance their investment, which does not correspond to the data. Note however that this characteristic of funding choice, as well as very large firms' behavior, are not targeted in the calibration exercise.

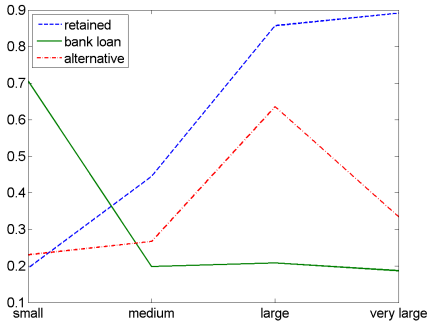
How important is the access to alternative sources of funding for firms' development? The results presented in Figure 3 show how firms finance their investment when the alternative sources of funding are not accessible at all. Here again, due to the collateral constraint, the use of bank loans to finance investment is increasing with size, while the use of retained earnings is decreasing. The behavior of very large firms remains at odds with this pattern, notably with a smaller share of investment funded through bank loans than large firms.

To evaluate more precisely how the presence of alternative sources of funding alleviates credit constraints for small firms, I simulate the average path of a new-born firm with little capital and various starting productivity levels, and compare it in two situations: (1) the baseline calibrated model, where the firm has access to alternative funding at some cost depending on its type (I call this scenario "with" in the next figures) and the calibration where no firm has access to alternative funding at any cost (called "without" in the figures).

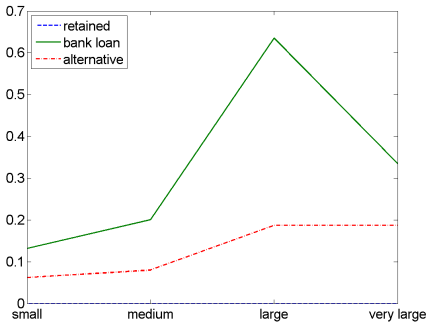
Panel 4 shows the capital accumulation pattern of a new-born firm starting with low capital and respectively low, medium or high productivity (figures 4a to 4c). Clearly, the unavailability of alternative funding slows down the capital accumulation and delays the reach of the optimal stationary level of capital. The average short-term growth of capital (over the first 6 periods) is 13 (resp. 50) percentage points higher when firms have access to alternative funding and start with a low (resp. high) productivity. From an aggregate perspective, alternative funding allows to



(a) Source of funding as share of investment

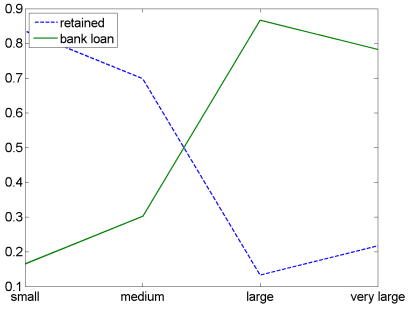


(b) Share of firms not using one source of funding

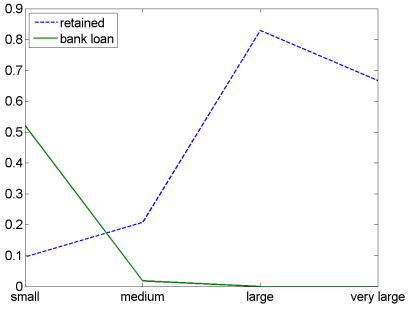


(c) Share of firms using only one source of funding

Figure 2: Calibrated moments

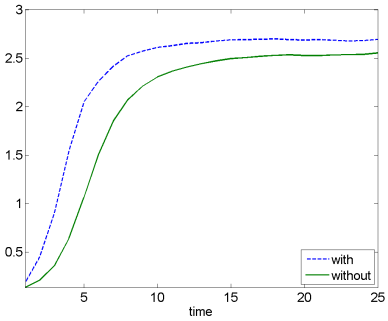


(a) Source of funding as share of investment

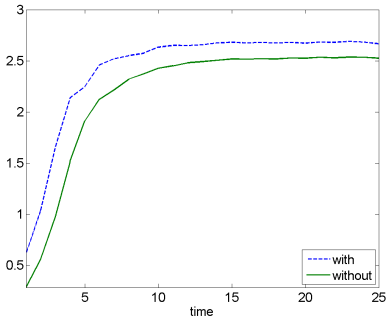


(b) Share of firms not using one source of funding

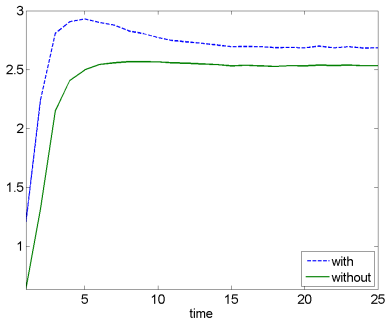
Figure 3: Calibrated moments, without access to alternative funding



(a) Starting with low productivity



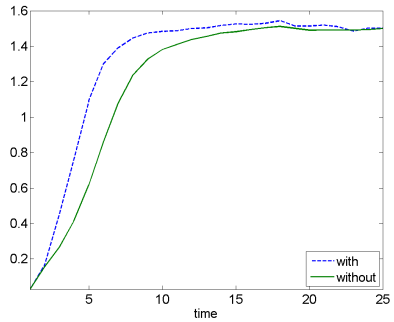
(b) Starting with medium productivity



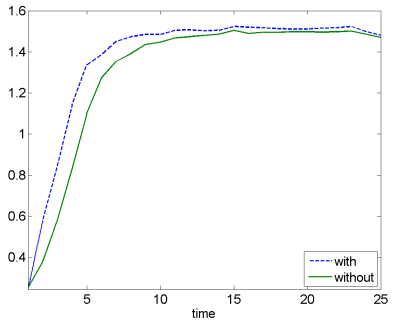
(c) Starting with high productivity

Figure 4: Average capital accumulation path of a new-born firm starting with low capital

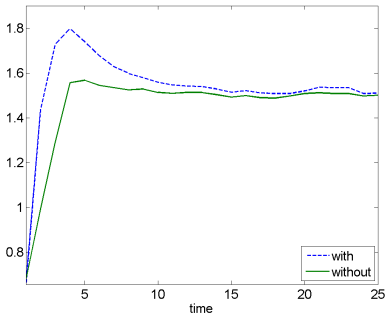
increase the steady-state aggregate level of capital by 17% compared to a scenario where alternative sources are not available. The overshooting pattern of capital accumulation when firms have access to alternative funding and start with a high productivity is interesting: those firms have a very high initial productivity and invest a lot because they expect to keep a high productivity for the next periods. With time, the average productivity of those firms lowers to the aggregate average productivity, forcing them to decrease their capital level.



(a) Starting with low productivity



(b) Starting with medium productivity

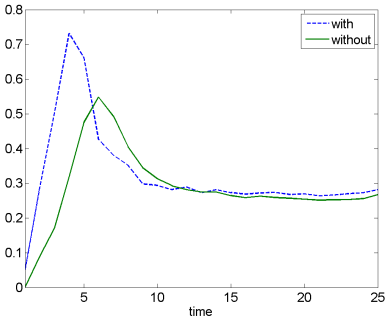


(c) Starting with high productivity

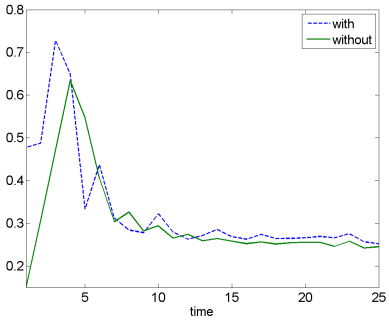
Figure 5: Average production path of a new-born firm starting with low capital

These patterns are similar when examining production (cf. Panel 5): the steady state level of production is reached later when firms cannot use alternative sources of funding. The average short-term growth of production of new-born firms over the first 6 periods is 23 percentage points (resp. 6) higher when firms have access to alternative funding and start with low (resp. high) productivity. Having access to alternative financing also increases the total aggregate production by 8% compared to a situation without alternative funding. These numbers are significantly lower than the impact on aggregate capital: this reflects the decreasing marginal returns to scale of the production function in the model. Having access to more (cheaper) capital allows to invest more, but the marginal gain in terms of production is smaller.

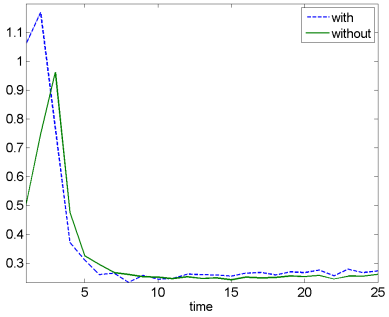
The average investment patterns are less smooth. We can see on Panel 6 that firms having



(a) Starting with low productivity



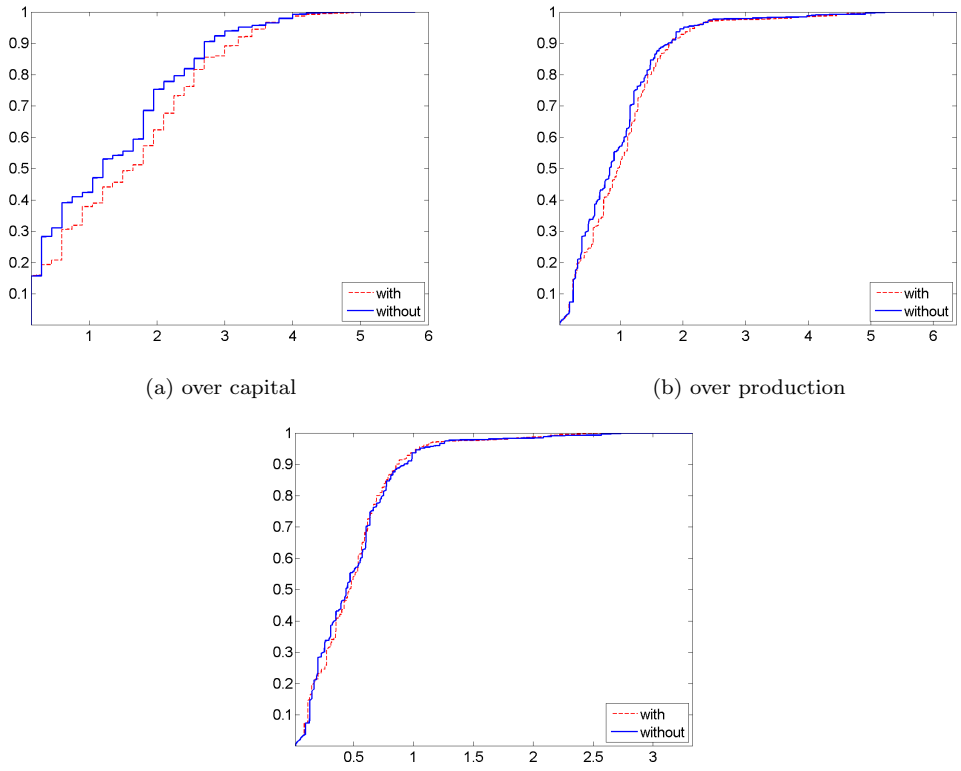
(b) Starting with medium productivity



(c) Starting with high productivity

Figure 6: Average investment path of a new-born firm starting with low capital

access to alternative funding invest more in the short-run (up to 5 periods). In the medium run however (5 to 10 periods), they invest less than firms not having access to alternative sources, since the latter are catching up on investment they could not carry out earlier because of credit constraints.



(a) over capital

(b) over production

(c) over labor

Figure 7: Cumulative distribution function of firms over various characteristics, at the stationary equilibrium, with and without access to alternative funding

Finally, Panel 7 shows the stationary distributions of firms across capital, production and labor when they have access to alternative funding at some cost (thin red line) and when they do not have access to alternative funding at all (thick blue line). As could be expected, the difference between the two scenarios is less striking when examining stationary distributions than when studying the average transition path of a small new-born firm. Indeed, part of the distortions induced by the collateral constraint and the non-negative dividend constraint are naturally corrected at the steady state, when most of the firms have reached a large enough size not to be constrained on their investment choice. The impact of the presence of alternative financing on the distribution of firms across capital and production is quite intuitive. Without access to alternative funding,

the stationary distribution of firms includes more small-size firms (in terms of capital) and less large-size firms. This is also true when measuring the size of firms in terms of production, although the effect if much smaller. Last, the distribution of firms across labor is similar in both scenarios.

Conclusion

This paper studies the access to investment funding for Chinese enterprises and the importance of non-bank, non-retained earnings sources. According to a 2002-2003 World Bank survey, larger firms tend to use more bank loans, while smaller firms are facing more credit constraints and rather resort to retained earnings or further alternative sources (non-listed equity, family and friends) to finance their investment. Using a partial equilibrium model, I quantify the extent to which the availability of alternative funding sources contributes to small firms' development and aggregate production. The model set-up focuses on the choice of the source of investment funding of enterprises facing collateral constraints, idiosyncratic productivity shocks and different costs of access to alternative sources of funding. Solving for the stationary equilibrium and calibrating the parameters so as to reproduce stylized facts from the data, I obtain that having access to alternative sources of funding increases the aggregate long-run capital stock by 17%, and the aggregate production by 8%. It also fastens the development of new-born, small firms, in terms of production growth over the first 6 years, by 5 to 23 percentage points, and increase their capital stock growth by 13 to 50 percentage points over the first 6 years.

From this exercise, we can conclude that the availability of alternative funding allowed Chinese firms to develop faster in terms of capital size and production, hence favoring a higher long-run aggregate level of capital and production. These results relate to policy issues regarding the regulation of non-banking institutions and the liberalization of banks' credit allocation system. A tightening of the regulation of alternative funding institutions could undermine the dynamism of firms that cannot obtain formal bank loans, and needs therefore to be conducted in parallel to a reform of the Chinese banking system. The set-up of this paper does not allow to conduct more detailed policy experiments regarding bank loans' attribution, interest rate setting or non-bank regulations. However, these questions remain highly topical in China and call for further research.

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Appendix

A Tables

Statistics	2002	2003
Number of observations	1548	2400
Year starting operations in China (average)	1987	1987
Year starting operations in China (median)	1993	1993
Publicly listed companies (% of firms)	1.74	2.48
Private held, limited companies (% of firms)	23.43	30.95
Cooperative (% of firms)	15.73	17.77
Other (% of firms)	59.10	48.81
SOE (% of firms)	22.91	23.30
Manufacturing sector (% of firms)	65.89	67.04
Services sector (% of firms)	34.11	32.96
Number of workers one year ago (average)	541	542
Number of workers two years ago (average)	639	504
Number of workers three years ago (average)	511	NA
Total sales one year ago (thousand RMB)	207309	202616
Total sales two years ago (thousand RMB)	175525	189135
Total sales three years ago (thousand RMB)	148582	147502
Capital one year ago (thousand RMB)	19800	NA
Capital two years ago (thousand RMB)	17500	NA
Capital three years ago (thousand RMB)	16200	NA
Energy consumption one year ago (thousand RMB)	6167095	NA
Energy consumption two years ago (thousand RMB)	5437916	NA
Energy consumption three years ago (thousand RMB)	3218342	NA

Data issued from the 2002 and 2003 Enterprise Survey conducted by the Workd Bank, available at `http://www.enterprisesurveys.org/`

Table 16: Descriptive statistics comparing the composition of 2002 and 2003's samples of the Enterprise Survey - China

The firm size categories across annual total sales are defined as follows:

- Very Small: annual total sales in 2002 below 2500 000 Yuan
- Small: annual total sales in 2002 between 2500 000 and 10 000 000 Yuan
- Medium: annual total sales in 2002 between 10 000 000 and 50 000 000 Yuan
- Large: annual total sales in 2002 above 50 000 000 Yuan

	Very Small	Small	Medium	Large
internal/retained earnings	18.64	20.38	29.05	26.63
local banks	21.75	29.01	35.48	39.22
foreign-owned banks	0.05	0.00	0.57	0.08
investment funds	1.22	1.40	0.85	0.34
trade credit	1.19	1.75	0.30	3.15
equity, sale of stock to employees	6.53	7.65	3.34	3.15
equity, sale of stock to legal-persons	16.86	15.38	10.95	10.76
equity, public issue of marketable share to outside investors	0.16	0.65	1.06	4.96
family, friends	21.06	12.96	7.29	0.85
informal sources	4.88	2.38	3.35	1.53
others	7.66	8.45	7.76	9.32
Observations	188	154	236	261

Table 17: Sources of funding for new investment, by firm sales

		Very Small	Small	Medium	Large
not using (0%)	internal/retained earnings	74.47	67.53	54.66	56.32
	bank loans	69.68	59.09	48.73	41.00
	alternative	39.39	42.54	60.77	64.41
using only (100%)	internal/retained earnings	14.36	14.29	18.64	17.62
	bank loans	16.49	18.18	22.46	21.84
	alternative	44.85	31.34	19.14	17.12
	observations	188	154	236	261

Table 18: Sources of financing: share (%) of enterprises declaring not using one finance source, or using only one finance source, by sales

		Very Small	Small	Medium	Large
if having a loan, was...	collateral needed	45.05	50.35	64.37	69.02
if did not apply for a loan, is it because...	procedure cumbersome	25.43	28.18	25.00	22.16
	collateral required	26.08	31.16	23.99	19.76
	interest rates too high	17.61	17.30	13.33	22.16
	reject expected	22.66	21.25	13.21	12.80
if application rejected, was it because...	lack of collateral	66.67	67.69	80.00	62.07

Table 19: Some facts about bank loans requirements and applications

	Very Small	Small	Medium	Large
interest rate	5.92	5.92	5.26	5.43
collateral (% of loan)	94.97	81.51	82.97	81.49
Observations	90	114	220	242

Table 20: Average interest rate charged on bank loans, by sales

	All	Small	Medium	Large	Very large
internal/retained earnings	50.73	53.81	43.52	35.01	24.55
local banks	21.13	19.01	25.08	32.72	42.73
foreign-owned banks	1.51	0.98	2.87	4.04	6.36
Leasing	10.85	10.49	12.62	12.50	5.45
investment funds	0.50	0.43	0.33	1.38	0
trade credit	4.17	4.25	5.53	2.39	0
credit card	0.89	0.96	0.90	0.37	0
equity, sale of stock	9.33	9.01	8.98	11.29	20.91
family, friends	0.83	0.99	0.16	0.32	0
informal sources	0	0	0	0	0
others	0.05	0.06	0	0	0
Observations	1177	935	122	109	11

Table 21: Sources of funding for new investment for Germany in 2005, by firm size (in terms of employment)

	Least squares		Fixed effects	
	(1)	(2)	(3)	(4)
	All	All	All	All
labor	0.255***	0.306***	0.201***	0.224***
	(0.0233)	(0.0232)	(0.0364)	(0.0365)
capital	0.543***	0.554***	0.408***	0.360***
	(0.0143)	(0.0140)	(0.0342)	(0.0352)
age		-0.0180***		0.0613***
		(0.00149)		(0.0117)
Constant	5.927***	5.752***	8.405***	8.112***
	(0.162)	(0.159)	(0.567)	(0.566)
N	3288	3285	3288	3285

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 22: Estimation of the production function coefficients with OLS and fixed effects

B Proofs

B.1 Proof of Proposition 1

Proof. From equations (15) and (16), let us define the marginal benefit of investing (the same for all sources of funding) as:

$$B_m(ret') = B_m(b') = B_m(a') = p\frac{\partial \mathbb{E}V^D}{\partial k'} + (1-p)\frac{\partial \mathbb{E}V^{ND}}{\partial k'}$$

The marginal cost of investment differs across sources of funding and can be written as:

$$\begin{aligned}
C_m(ret') &= \frac{1+\lambda}{\beta(1-\xi)} + \frac{\partial p}{\partial ret'}(\mathbb{E}V^{ND} - \mathbb{E}V^D) \\
C_m(b') &= \frac{1+\mathbb{E}\lambda'(1-p)}{q} + \frac{1}{q}\frac{\partial p}{\partial b'}(\mathbb{E}V^{ND} - \mathbb{E}V^D) + \frac{\mu}{\beta(1-\xi)} \\
C_m(a') &= \frac{1+\mathbb{E}\lambda'(1-p)}{q_a(\varphi)} + \frac{1}{q_a(\varphi)}\frac{\partial p}{\partial a'}(\mathbb{E}V^{ND} - \mathbb{E}V^D) + \frac{(1+\lambda)\varphi c'(a')}{q_a(\varphi)\beta(1-\xi)}
\end{aligned}$$

Step 1: Sign of $(\mathbb{E}V^{ND} - \mathbb{E}V^D)$

To show that $\mathbb{E}V^{ND} - \mathbb{E}V^D \geq 0$, we can apply the following reasoning:

$$V^{ND}(\varphi, A, k, d) - V^D(\varphi, A, k, d) = \max_{ret', b', a'} -\varphi c(a') - ret' + \beta(1-\xi)[p\mathbb{E}V^D(\varphi, A', k', d') + (1-p)\mathbb{E}V^{ND}(\varphi, A', k', d')]$$

If the firm chooses not to invest in all future periods ($ret = b = a = 0$ forever), the default

probability p becomes zero as the firm does not borrow, and we have:

$$\begin{aligned} -\varphi c(a') - ret' &+ \beta(1-\xi)[p\mathbb{E}V^D(\varphi, A', k', d') + (1-p)\mathbb{E}V^{ND}(\varphi, A', k', d')] \\ &= \beta(1-\xi)[p\mathbb{E}V^D(\varphi, A', k', d') + (1-p)\mathbb{E}V^{ND}(\varphi, A', k', d')] \\ &= \beta(1-\xi)\mathbb{E}V^{ND}(\varphi, A', (1-\delta)k, 0) \end{aligned}$$

Iterating forward, we obtain:

$$\begin{aligned} -\varphi c(a') - ret' &+ \beta(1-\xi)[p\mathbb{E}V^D(\varphi, A', k', d') + (1-p)\mathbb{E}V^{ND}(\varphi, A', k', d')] \\ &= \mathbb{E}\sum_{\tau=1}^{+\infty} \beta^\tau (1-\xi)^\tau f(A_{t+\tau}, (1-\delta)^\tau k, l^{*\gamma}) - wl^* \\ &\geq 0 \end{aligned}$$

(The optimal choice of labor demand always yields a non-negative profit if the firm has no debt). Since this is true for the specific policy of zero investment forever, we have:

$$\begin{aligned} V^{ND}(\varphi, A, k, d) - V^D(\varphi, A, k, d) &= \max_{ret', b', a'} \{-\varphi c(a') - ret' \\ &+ \beta(1-\xi)[p\mathbb{E}V^D(\varphi, A', k', d') + (1-p)\mathbb{E}V^{ND}(\varphi, A', k', d')]\} \\ &\geq \mathbb{E}\sum_{\tau=1}^{+\infty} \beta^\tau (1-\xi)^\tau f(A_{t+\tau}, (1-\delta)^\tau k, l^{*\gamma}) - wl^* \\ &\geq 0 \end{aligned}$$

This is true for all possible values of the state variables φ, A, k and d, hence it is also true in expectations, and therefore $\mathbb{E}V^{ND} - \mathbb{E}V^D \geq 0$.

Step 2: Sign of $\frac{1}{q}\frac{\partial p}{\partial b'} - \frac{\partial p}{\partial ret'}$

Let us denote $G_A(.)$ the cumulative distribution function of the shock A' knowing A and g_A its density. Using the optimal value of labor demand, we can express the default probability as follows:

$$\begin{aligned} p &= P\left(A' < \frac{d'^{1-\gamma} w^\gamma}{k'^\alpha \gamma^\gamma (1-\gamma)^{1-\gamma}}\right) \\ &= G_A\left(\frac{d'^{1-\gamma} w^\gamma}{k'^\alpha \gamma^\gamma (1-\gamma)^{1-\gamma}}\right) \end{aligned}$$

It is then easy to see that:

$$\begin{aligned} \frac{1}{q}\frac{\partial p}{\partial b'} - \frac{\partial p}{\partial ret'} &= \left(\frac{(1-\gamma)d'^{-\gamma}k'^\alpha - d'^{1-\gamma}\alpha q k'^{\alpha-1}}{q k'^{2\alpha}} + \frac{d'^{1-\gamma}\alpha}{k'^{\alpha+1}}\right)\frac{w^\gamma}{\gamma^\gamma(1-\gamma)^{1-\gamma}} g_A\left(\frac{d'^{1-\gamma}w^\gamma}{k'^\alpha\gamma^\gamma(1-\gamma)^{1-\gamma}}\right) \\ &= \underbrace{\frac{1}{qk'^\alpha}\left(\frac{w(1-\gamma)}{d'\gamma}\right)^\gamma}_{>0} \underbrace{g_A\left(\frac{d'^{1-\gamma}w^\gamma}{k'^\alpha\gamma^\gamma(1-\gamma)^{1-\gamma}}\right)}_{\geq 0} \end{aligned}$$

Step 3: Conclusion

Assuming that $\beta(1-\xi) \geq q$ and that the non-negative dividends constraint (equation (6)) does not bind (i.e. $\lambda = 0$), the difference between the marginal costs for retained earnings and bank loan is then:

$$\begin{aligned} C_m(b') - C_m(ret') &= \underbrace{\frac{1+\mathbb{E}\lambda'(1-p)}{q} - \frac{1+\lambda}{\beta(1-\xi)}}_{\geq 0} + \underbrace{\left(\frac{1}{q}\frac{\partial p}{\partial b'} - \frac{\partial p}{\partial ret'}\right)}_{\geq 0} \underbrace{(\mathbb{E}V^{ND} - \mathbb{E}V^{D})}_{\geq 0} + \underbrace{\frac{\mu}{\beta(1-\xi)}}_{\geq 0} \\ &\geq 0 \end{aligned}$$

Step 4: Repeated proof for alternative funding

A similar proof applies for the comparison between retained earnings and alternative sources. As previously, we have:

$$\frac{1}{q_a(\varphi)}\frac{\partial p}{\partial a'} - \frac{\partial p}{\partial ret'} = \underbrace{\frac{1}{q_a(\varphi)k'^{\alpha}}\left(\frac{w(1-\gamma)}{d'\gamma}\right)^{\gamma}}_{>0} \underbrace{g_A\left(\frac{d'^{1-\gamma}w^{\gamma}}{k'^{\alpha}\gamma^{\gamma}(1-\gamma)^{1-\gamma}}\right)}_{\geq 0}$$

Assuming that the non-negative dividend constraint (6) does not bind (i.e. $\lambda = 0$), we obtain:

$$\forall \varphi \text{ s.t. } \beta(1-\xi) \geq q_a(\varphi),$$

$$\begin{aligned} C_m(a') - C_m(ret') &= \underbrace{\frac{1+\mathbb{E}\lambda'(1-p)}{q_a(\varphi)} - \frac{1+\lambda}{\beta(1-\xi)}}_{\geq 0} + \underbrace{\left(\frac{1}{q_a(\varphi)}\frac{\partial p}{\partial a'} - \frac{\partial p}{\partial ret'}\right)}_{\geq 0} \underbrace{(\mathbb{E}V^{ND} - \mathbb{E}V^{D})}_{\geq 0} + \underbrace{\frac{(1+\lambda)\varphi c'(a')}{q_a(\varphi)\beta(1-\xi)}}_{\geq 0} \\ &\geq 0 \end{aligned}$$

□

B.2 Proof of Proposition 2

Proof. Assuming that $q \geq q_a(\varphi)$:

$$\begin{aligned} \frac{1}{q_a(\varphi)}\frac{\partial p}{\partial a'} - \frac{1}{q}\frac{\partial p}{\partial b'} &= \frac{q - q_a(\varphi)}{q q_a(\varphi) k'^{\alpha}}\left(\frac{w(1-\gamma)}{d'\gamma}\right)^{\gamma} g_A\left(\frac{d'^{1-\gamma}w^{\gamma}}{k'^{\alpha}\gamma^{\gamma}(1-\gamma)^{1-\gamma}}\right) \\ &\geq 0 \end{aligned}$$

Assuming further that the collateral constraint (7) does not bind (i.e. $\mu = 0$), we obtain :

$$\begin{aligned} C_m(a') - C_m(b') &= \underbrace{\frac{1+\mathbb{E}\lambda'(1-p)}{q_a(\varphi)} - \frac{1+\mathbb{E}\lambda'(1-p)}{q}}_{\geq 0} + \underbrace{\left(\frac{1}{q_a(\varphi)}\frac{\partial p}{\partial a'} - \frac{1}{q}\frac{\partial p}{\partial b'}\right)(\mathbb{E}V^{ND} - \mathbb{E}V^{D})}_{\geq 0} \\ &+ \underbrace{\frac{(1+\lambda)\varphi c'(a')}{q_a(\varphi)\beta(1-\xi)}}_{\geq 0} - \underbrace{\frac{\mu}{\beta(1-\xi)}}_{=0} \\ &\geq 0 \end{aligned}$$

□