Alternative Finance and Credit Sector Reforms: the Case of China

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Abstract

This paper studies firms' optimal investment decisions and their choice of financing sources in a general equilibrium framework with heterogeneous firms. Besides retained earnings and bank loans, I focus on the crucial role played by alternative sources of funding, including family, friends, non-listed equity and informal banking institutions. While small young enterprises face important difficulties to finance their investment, these alternative financing sources allow them to partially bypass credit constraints. The model I develop can account for the financing patterns observed in Chinese data. In this framework, I quantify the impact of various reforms of the credit distribution sector on the aggregate economy and enterprise trajectories. Liberalizing the banking sector increases the steady-state aggregate level of capital by 10%, and the steady-state aggregate production by 5%. In addition, the short-term production growth of small, new-born firms increases by up to 7 percentage points on average. Tightening the regulation of the alternative finance sector, even if simultaneous to a bank liberalization, remains detrimental to small, young enterprises.

JEL Classification: E22, O16, O17
Keywords: informal finance, banking reform, heterogeneous agents, credit constraints, China

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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 Demirguç-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? How would reforms towards a more competitive credit distribution impact the economy both in terms of aggregate situation and enterprise trajectories?

Answering these questions requires to fully understand the patterns of investment financing. To be able to invest and grow, enterprises must find 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 family, friends, or other external sources. 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 family or friends, trade credit, non-listed equity and moneylenders is crucial to bypass credit constraints and finance investment.

The role of such alternative sources of funding in alleviating financial constraints and the influence of credit sector reforms are at the center of this paper. I propose modelling alternative funding sources and quantifying the impact of a banking liberalization for firms' investment, with a specific focus on the Chinese case. Misallocations are indeed well-rooted in the history of Chinese formal credit markets, which renders the study of alternative financing and banking reforms especially interesting in this country. Retail banking interest rates have long been set by the government, while banks were advised to direct loans towards large state-owned enterprises.[1] Reforming the banking sector towards a more market-based functioning is an on-going process in China, and interest rates are not fully liberalized yet. To model this situation, I first set up a general equilibrium framework where heterogeneous firms choose how much to invest and how to finance it, between retained earnings, official bank loans and alternative funding. This model focuses on credit markets as one specific cause for capital misallocation. I then calibrate the model's parameters according to stylized facts for China. In this framework, I investigate how a liberalization of banks' interest rates, coupled or not with a tighter regulation of alternative finance, impacts firms' investment opportunities and the aggregate economy.

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 of funding, including family and friends, non-listed equity, and informal sources in the model. In my set-up, firms have 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);

[1] As will be detailed in section 1.1, 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.

however they tend not to study alleviation mechanisms carefully. Second, for the case of China, I evaluate quantitatively the impact of reforming the credit sector on the aggregate economy and enterprises development, accounting for this alternative funding source. Such an evaluation has not been done before, as studies on investment financing in China have either been only qualitative, or have focused on financial constraints faced by firms rather than on how to bypass those constraints and potential reforms.

I compare four scenarios of reforms where the bank interest rates are fully liberalized and set competitively: (i) while alternative funding is never allowed; (ii) while alternative funding is always allowed; (iii) while access to alternative funding is shut down; and (iv) while access to alternative funding is more tightly regulated (partially shut down). The results show that the presence of alternative financing sources increase aggregate production and consumption by 6.6% and 6.2% respectively, and that a liberalization of the banking sector increases aggregate production and consumption by 5.5% and 3.1% respectively. In terms of development of small young firms over the first 6 years of their activity, the liberalization implies an average production growth from 2 percentage points slower to 7 percentage points faster (depending on their initial productivity), and an average capital growth from 1 percentage points slower to 13 percentage points higher. It also improves resource allocation, as more productive new-born firms grow faster in terms of production and capital after the liberalization, whereas their less productive peers grow slower. By alleviating financial constraints before the reforms, the presence of alternative financing sources dampens the reforms impact on the Chinese aggregate consumption. Furthermore, I show that liberalizing the banking sector can compensate for a tighter regulation of the alternative finance sector, but only partially. On the one hand, liberalizing the banking sector while shutting down all alternative funding increases aggregate production and consumption by respectively 5.61% and 3.05%; on the other hand, such a combined reform lowers the average growth of small young firms by up to 14 percentage points in terms of production, and up to 23 percentage point in terms of capital.

As highlighted by the above results, 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, liberalizing the banking sector has a clear positive impact, although possibly not as high as expected due to the presence of alternative financing. Tightening the regulation standards of non-bank lending institutions could be detrimental to this economic dynamism, and should go hand in hand with a liberalization of the banking sector and a more efficiently allocated bank credit, in order to prevent regulation from having a biased impact on young private firms.

The remainder of this section reviews related literature. Section 1 presents the data and some important stylized facts. Section 2 describes the program of the heterogeneous enterprises at the core of the theoretical model. Section 3 closes the model by inserting the firms' program into a general equilibrium framework. Section 4 turns to the calibration of the model and section 5 presents the results.

Related literature

This study is connected to three strands of literature. The first relates to theoretical and structural papers that tackle resource allocation, development of firms and economic growth. Second, many qualitative studies examine the link between institutions' general quality and development. Third, numerous papers focusing on China 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 heterogeneous tax rates on output, capital and labor in a macroeconomic set-up. Greenwood et al. (2013) further provide a microfounded framework based on incomplete information and costly monitoring technology. In their set-up, all funding for capital investment is obtained through financial intermediaries, within a single competitive sector for financial intermediation. The allocation of financial resources is also tackled by Song et al. (2011), who 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. Song et al. (2014) further take into account the government's action through capital controls, government bond rate, deposit rate and exchange rate policies. They conclude among others that liberalizing the deposit rate relaxes firms' credit constraints and fastens the economic transition. The model I present here emphasizes a different aspect of capital misallocation and fund-raising decision: it includes alternative funding sources accessible by credit constrained firms, and studies firms' constrained choice of funding source. My objective is to quantify not the impact of capital misallocation, but to what extent a bank liberalization in terms of lending rate could alleviate this misallocation, accounting for the presence of alternative sources of funding. 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 on top of self-financing to bypass financial constraints. I focus here on investment financing sources and credit sector reforms in the pre-crisis context, until 2007. More recently, Cong and Ponticelli (2016) study the impact of the "Chinese Economic Stimulus Plan" on credit distribution across firms after the start of the global financial crisis. They show evidence that the stimulus favors state-owned firms against private ones, thus partially counteracting the effects of previous financial reforms shown in this paper.

Other theoretical papers provide abundant literature related to heterogeneous agent models. The theoretical framework used here is relatively close to Arellano et al. (2012), who set up a model where heterogeneous firms choose between debt and equity to finance investment. Financial development, represented by a cost of access to credit, is at the center of their work, while mine focuses on the presence of alternative financing sources alleviating credit constraints. Further papers investigate firms' 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. While related to these studies in terms of firms' modelling and credit constraints, my paper includes additional financing mechanisms and focuses on reforms' impact rather than on the general age and size distribution of firms.

Second, from a more qualitative viewpoint, 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. (2012) 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 a decade. Drawing on the qualitative evidence provided by these studies, I suggest a theoretical model to quantify more precisely the impact of alternative financing sources on firms' development.

The third strand of literature regards empirical estimations of the extent of financial constraints in China. For instance, Ayyagari et al. (2010) analyze the performance difference between Chinese firms financed by banks and through informal sources. They show that the collateral required by formal banks is an important obstacle for private firms to obtain loans and that firms 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. More recently, Degryse et al. (2013) empirically show that informal finance has a positive impact on sales growth of small Chinese firms, and no impact for large ones. 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. My model, calibrated on the Chinese situation, builds on this empirical evidence.

1 Data and stylized facts

1.1 Chinese context

With the coming to power of Deng Xiaoping in 1978, China has gradually opened up and 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.[2]

Still, the current characteristics of the Chinese credit market go hand in hand with resource misallocations that may impact output production and efficiency. This situation is deeply rooted in Chinese post-World War II history. 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.

[2]The number of State-owned and State-holding industrial enterprises in China Mainland has decreased by 72% within 15 years, from 64737 in 1998 to 34280 in 2003 and 18197 in 2013. Over the same period, the number of private industrial enterprises has been multiplied by 18, increasing from 10667 in 1998 to 67607 in 2003 and 194945 in 2013. However, with average total assets per enterprise amounting to 276 million yuan in 2003 (up from 116 millions yuan in 1998), state-owned enterprises remain much larger than private enterprises, that reach an average level of total assets per enterprise equal to 21 million yuan (up from 14 million yuan in 1998). Source: Chinese Statistical Yearbook 2014.

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 are mainly set by the monetary authorities until 2004.[3] Hence, banks are not able to match their interest rates with the risk profile of the borrower and are instead forced to modify their credit supply by adjusting quantity or selecting their borrowers. Since large enterprises, and even more SOE, often beneficiate from an implicit government guaranty, banks tend to favor them when distributing loans.

To bypass these credit constraints, SME may want to turn to financial markets. Indeed, SME are often viewed as more productive than large ones – which are often SOE – and should therefore attract more investment, and be able to raise more funds through bank credit and financial markets. However, access to financial markets remains insufficiently developed to offer enough capital to Chinese enterprises, and those that cannot obtain bank loans either resort to retained earnings to finance themselves, or need to find funding through alternative non-market sources.

Besides retained earnings, SME use more informal funding sources to finance their investment: family and friends, non-listed outside equity, or informal banking institutions, from trust companies to pawnshops, via clan organizations (e.g. entrepreneurs from the coastal city Wenzhou[4]). These alternative sources are key for the growth of enterprises in China, and are at the center of this paper. Obtaining funding from family or friends has the advantage that it generally 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.

1.2 Data presentation

Firm-level data come from the Enterprise Surveys conducted by the World Bank[5] in many countries in the 2000s. These surveys mainly focus on SME, although they include some large enterprises too. In China, surveys were conducted over 1548 enterprises in 2002 and 2400 enterprises in 2003. Since the liberalization of retail banks interest rates was initiated in 2004, it is relevant to use data obtained just before the start of the reforms and I decided to focus on the situation of firms at the start of the 21^{st} century.[6] The samples used by the World Bank in 2002 and 2003 correspond

[3] Until 2004, the People's Bank of China imposed to domestic banks a ceiling and a floor rates for loans (and deposits): lending rates were allowed to move between 0.9 and 1.1 times the benchmark rate for loans to large enterprises, and between 0.9 and 1.3 times the benchmark rate for loans to SME. In 2004, the ceiling rate for loans (and the floor rate for deposits) were suppressed, allowing banks to better price the riskiness of the borrowers by adjusting lending rates upwards. Furthermore, Chinese monetary policy is also implemented through "window guidance", guiding credit allocation in terms of credit volumes and sectoral distribution. For more details, see, for instance, Laurens and Maino (2007).

[4] See for instance Liu (1992) and more recently Wei et al. (2007) for more details.

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

[6] A new survey (data from 2012) has been released recently; however the variables included in it are not easily comparable with previous surveys.

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 regarding their composition (see Table 11 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 in Table 1. 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 ones above 1000 employees. Since SOE and collective enterprises may have objectives that differ from the usual dividend maximization, I focus here on private firms only, in order to keep consistency between my theoretical model and the stylized facts observed in the data.[7,8] Similar statistics are presented in Appendix A in Table 13, using total sales to determine the size of a firm.

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

		All	Small	Medium	Large	Very large
Internal/retained earnings		24.21	20.37	26.01	26.98	21.41
Bank	Local banks	28.83	17.65	25.86	39.53	45.11
	Foreign-owned banks	0.23	0.06	0.47	0.13	0.00
	Special development financing	0.51	1.02	0.36	0.40	0.00
Alternative	Family, friends	11.69	18.16	13.55	5.30	1.64
	Equity, sale of stock to employees	5.65	6.87	6.19	4.31	3.39
	Equity, sale of stock to legal-persons	13.41	20.69	12.98	10.48	2.02
	Informal sources	3.02	3.27	3.18	2.99	1.77
	Trade credit	1.66	2.08	1.17	1.21	3.61
Equity, public issue of marketable share to outside investors		2.12	0.76	1.42	2.18	8.74
Others		8.66	9.07	8.82	6.48	12.31
Observations		630	172	247	149	61

In the raw data, the highest contribution to investment funding is attributed to "others", which accounts for about 40%. This high share 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[9]. Table 1 presents statistics including only the enterprises getting less than 100% of their financing from "other" sources. The highest source of funds is bank loans, with 29% of investment funds coming from local banks. The share of investment financed through bank loans is clearly increasing with size. Smaller firms compensate this fact by a more

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

[8]Very similar patterns are obtained when keeping all firms in the sample. Table 12 in Appendix A shows financing patterns across ownership status.

[9]I loose 314 observations from this manipulation. The firms dropped have similar characteristics to the firms kept in the data in terms of size, total sales and age. In this regards, the statistics shown here can be considered as a lower bound for the use of retained earnings and alternative finance.

intensive use of retained earnings and alternative sources of funding, notably funds provided by family and friends, and non-listed outside equity. Retained earnings are relatively low compared to other developed countries where similar surveys have been conducted.[10] However, this pattern is consistent across developing countries, where enterprises are younger, were not able to accumulate wealth yet and hence cannot use retained earnings intensively.[11] 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.

To define some stylized facts able to drive the model set-up, I regroup these various sources of funding into 3 categories as summarized in Table 2:

- retained earnings: this corresponds to the retained earnings defined in the data;
- bank loans: it contains loans from local banks, foreign banks and investment funds;
- alternative sources: this regroups family and friends, non-listed outside equity, trade credit and informal sources.

In the remainder of the paper, I will use these three categories to study more in detail investment financing across firms.

Table 2: Sources of funding for new investment, by firm size (% of total new investment), across private firms

	All	Small	Medium	Large	Very large
Internal/retained earnings	26.64	22.23	28.63	28.72	26.43
Bank	34.34	21.50	30.80	45.06	57.59
Alternative	39.03	56.27	40.58	26.22	15.98
Observations	624	171	244	147	61

1.3 Distribution of firms across uses of finance sources

The average shares of financing sources presented in Table 1 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. Table 3 reports, by size 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. Similar results are presented in Tables 17 and 18 in Appendix A, using total sales to define firms' size and separating firms across ownership status.

More than half of the firms do not use all the financing sources available. This share is the highest for funds coming from retained earnings, which 60% of the enterprises do not use, followed

[10] See Table 14 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 (nonexistent in China in 2003) is also used. On the opposite, family and friends are almost nonexistent as source of funding in Germany and informal sources disappear. Note that equity in the German case mostly corresponds to listed equity and is therefore only used by very large firms.

[11] Tables 15 and 16 show similar statistics for India in 2005 and Colombia in 2006, where retained earnings finance respectively 52% and 33% of investment. Vietnam also has a similar share of retained earnings in 2005 (results available upon request).

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

		All	Small	Medium	Large	Very large
not using (0%)	internal/retained earnings	60.19	69.59	59.02	53.06	55.74
	bank loans	56.02	71.35	60.25	41.50	31.15
	alternative	51.36	34.50	51.64	61.22	73.77
using only (100%)	internal/retained earnings	19.26	18.13	22.54	16.33	16.39
	bank loans	22.63	14.04	21.72	28.57	36.07
	alternative	29.21	45.61	29.92	15.65	13.11
	observations	623	171	244	147	61

by bank loans and alternative financing, which are not used by respectively 56% and 51% of the firms. Combining this with the fact that 29% of the firms use only alternative funding to finance their investment, only 20% of firms partially use alternative sources to finance their investment.

In section 2, I will set up a theoretical model that is flexible enough to reproduce for the various financing patterns observed in the data. The model's flexbility should both allow for variety of potential financing sources for investment, and for a limited mix across these sources for some of the firms.

1.4 Bank loans and collateral

Bank loan applications and accessibility are addressed in the Enterprise Survey through many questions. Table 4 provides the average answers to a subset of these questions, focusing on the collateral requirements. Clearly, providing collateral seems to be a bigger obstacle for smaller firms. 80% of the loan applications of small firms were turned down because of lack of collateral, whereas this was the case for only 40% of very large firms. Furthermore, 29% 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 19 in Appendix A) is slightly weaker than that of size. Similar results, separating firms by total sales, are provided in Table 20 in Appendix A.

Table 4: Bank loans requirements and applications, by size (% of private firms)

		Small	Medium	Large	Very large
if having a loan, was collateral needed?	Yes	39.62	60.40	68.83	68.18
if did not apply for a loan, is it because of collateral requirements?	Yes	28.54	27.84	23.68	23.08
if application rejected, was it because of lack of collateral?	Yes	80.00	68.83	70.00	40.00

The mean of the interest rate charged on bank loans, as well as the average collateral pledged as a share of granted loan, are presented in Table 5. The interest rate charged varies only slightly across firm size. This confirms 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, sales and amount invested (see Tables 21 to 23 in Appendix A).

Table 5: Average interest rate and collateral required for bank loans, by firm's size

	All mean	Small mean	Medium mean	Large mean	Very large mean
interest rate	5.29	5.35	5.37	5.06	5.53
collateral (% of loan)	84.58	90.28	85.62	82.38	79.00
Observations	456	65	201	136	53

Smaller firms tend to provide more collateral as a share of their loan (see Table 5). This is related to the size of the loan provided: if the amount lent is smaller, it is more easily covered 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 23 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 77% of their loan with collateral.

The information gathered in this section comfirms that collateral availability is crucial in China to obtain a loan from the formal banking sector, and that smaller firms are more credit constrained due to their lack of collateral. For these reasons, as will be detailed in the next section, I will model the credit constraint faced by enterprises as a collateral constraint.

2 The firm side: investment decision and financing choice

I set up here the program of the heterogeneous firms, focused on their investment decision and its financing at the firm level. The objective of each firm is to maximize its discounted stream of dividends. At each period, each firm produces using capital and labor, pays wages and reimburses its debt. It also decides how much to invest to build up tomorrow's capital, and how to finance it. To achieve this goal, it plans its investment and has three different ways of financing it: it can (i) use retained earnings (which are thus subtracted from its dividends), (ii) borrow from the formal banking sector at a fixed interest rate, or (iii) obtain funding from an alternative source (this regroups all external financing means that are not included in the official banking sector: non-listed outside equity, family and friends, trade credit, informal moneylenders...) at a variable cost. The firms may be credit constrained in the formal sector: banks require collateral and are only willing to grant a loan equal to some share of this collateral. If a 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. The main features of the model are described in more details in subsections 2.1 to 2.4.

2.1 Firm's current production and profit

The firms are heterogeneous with respect to their stock of capital and debt in the current period, their ease of access to alternative funding and their current productivity shock, which are the four state variables of the firm's program. The firm's production function is a usual 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 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. w is the wage that prevails on the labor market, and is taken as given by the firm. The current capital stock of the firm has been decided at the previous period through investment, while the firm chooses today how much labor to employ to maximize its profit, given its capital and technology shock. The current profits of the firm are therefore:

$$\Pi_E(A, k, d) = \max_l Ak^\alpha l^\gamma - wl - d \tag{1}$$

Since the labor demand decision is intratemporal, I can solve for it separately and obtain an analytical solution function of the firm's productivity, capital, and the wage prevailing on the labor market.

$$l^D(A, k) = \left(\frac{\gamma}{w} Ak^\alpha\right)^{\frac{1}{1-\gamma}} \tag{2}$$

$$\Pi_E(A, k, d) = Ak^\alpha (l^D(A, k))^\gamma - wl^D(A, k) - d \tag{3}$$

$$= (Ak^\alpha)^{\frac{1}{1-\gamma}} \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} (1 - \gamma) - d \tag{4}$$

Profits can be either positive or negative: if the firm faces a bad productivity shock, it may not be able to produce enough to cover its labor costs and its debt liabilities. In that case, to be able to distribute non-negative dividends, the firm has to roll over part of its debt through new borrowing. If it cannot borrow enough to cover its losses (negative profits), it defaults and exits the market.

2.2 Sources of finance for investment

The firm can finance its investment using three different sources: retained earnings from its own profit, bank loans, and loans from alternative sources. Investment allows the firm to accumulate capital that depreciates at a rate δ.

Retained earnings

When the firm makes positive profits, it can use these profits to distribute positive dividends or reinvest them to finance investment and increase its capital stock tomorrow. Reinvested profits are called retained earnings and denoted e'. If the firm is patient enough, using retained earnings is the cheapest way to invest, since it does not bear any interest rate. However, the amount of retained earnings the firm can use for investment cannot be larger than its current profits. Hence, the use of retained earnings to finance investment is constrained as follows:

$$0 \leq e' \leq \max(\Pi_E(A, k, d), 0) \tag{5}$$

Obviously, if the firm makes negative profits, it cannot reinvest nor distributed any of them, and both dividends and retained earnings are forced to be zero.[12]

[12] A firm cannot use loans from the bank or from alternative sources to increase its reinvested retained earnings or its dividends. Imposing this constraint avoids indeterminacy when solving for optimal investment and financing sources, and prevents Ponzi schemes.

Bank loans

A second possibility to finance investment is to borrow an amount b from the formal banking sector. As seen in section 1.4, the interest rate charged by banks varies 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. All firms also need to pledge some collateral to be able to borrow, and face a collateral constraint written as[13]:

$$qb' \leq \theta k$$

where b' is the amount to be reimbursed tomorrow, $q = \frac{1}{1+r}$ the price of the loan, k the firm's capital today and θ an exogenous parameter determining the tightness of the collateral constraint.

Where does this collateral constraint come from? Since smaller firms are expected to be more risky and the interest rate charged cannot be adjusted, banks tend to impose collateral requirements. As seen in table 4, this collateral constraint is often binding, especially for smaller enterprises. Hence, setting up a collateral requirement in this model reflects quite well the banks' behavior.

Alternative funding

The last possibility for financing investment is to resort to alternative sources of funding. To be able to access alternative funding, a firm has to pay up front a variable cost of access. It then pays an interest rate on the loan obtained.

As seen in section 1.3, the use of alternative financing is quite heterogeneous across firms, not only across firm's size, but also within size categories. While some enterprises use only alternative sources to finance investment, others never use them. To be able to reproduce this heterogeneity, I consider different types of firms $j \in J$, where J is the set of all possible types. To borrow an amount a, a firm of type j has to pay up front a quadratic access cost $x^j(a) = \eta^j a^2$, and then obtains a loan at the price $q_a^j = \frac{1}{1+r_a^j}$, where η^j and r_a^j are positive constants.

Firms' types

Each type of firms is characterized by its easiness to access the alternative financing market. This easiness of access can also be thought of as the degree of anonymity in the relationship between the lender and the borrower. Indeed, access to alternative funding sources depends on family, friends, networks that help firms in finding potential lenders. A "lucky" entrepreneur (say of type j_1) has investors in his close social circle – for instance a rich uncle, accesses alternative financing for a lower cost and obtains a loan at a lower interest rate. On the opposite, an "unlucky" entrepreneur (of type j_2) has to go beyond his social circle, maybe through costly intermediaries, to find a lender, and therefore faces both a higher access cost to alternative financing and a higher interest rate, such that: $\eta^{j_1} < \eta^{j_2}$ and $r_a^{j_1} < r_a^{j_2}$ implying $q_a^{j_1} > q_a^{j_2}$.

[13]There are many ways to define 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. Since capital is mainly constituted of seizable assets, it seems well suited to be pledged as collateral by the firms. Furthermore, as seen in section 1, banks tend to favor loans granted to larger firms, even when profit opportunities of SME are higher, so that a collateral constraint related to expected profit would not correspond well to this situation.

This easiness to find a lender outside the formal banking system can be considered as some stable random ability of the entrepreneur: it is related to the social and wealth background of the entrepreneur's family, his relationships, and is not directly linked to his productivity as an entrepreneur. Since the social network of an entrepreneur is mostly related to stable external conditions, I model the firms' types as follows. At its birth, each firm draws a type realization $j \in J$ from the (exogenous) types distribution. The type j of the firm remains fixed for its entire activity period, until it exits the market. As already mentioned, these different types also help the model reproducing the fact that some enterprises do not use alternative financing, while others use only alternative finance.

Access cost

The quadratic access 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 outside equity, a firm can only reach a limited number of potential lenders, because it does not beneficiate from the easy accessibility and guaranties provided by public financial markets, and the issue cost increases with the amount to be issued.

While the interest rate has to be paid by the firm at the time the loan is reimbursed, the access cost $x^j(a)$ is an upfront cost, paid at the time the firm is obtaining the loan. To pay this cost, the firm can use part of its profits (if positive), or part of the bank loan it currently borrows. This implies the following constraint:

$$x^j(a') \leq qb' + \max[\Pi_E(A, k, d) - e', 0] \tag{6}$$

2.3 Default

This model can allow for two types of default. First, the firm may default if it makes negative profit and cannot borrow enough to roll-over its debt. The firm is constrained on the total amount of debt it can roll-over for the following reasons: (i) investment is irreversible, so that previous period's capital cannot be sold to reimburse debt; (ii) the loan from the bank is limited by the collateral constraint (at most $qb' = \theta k$); and (iii) the amount borrowed from the alternative sources is constrained by the cost of access: at most $x^j(a') = qb' = \theta k$ so that the highest possible loan from alternative sources amounts to $a' = \sqrt{\frac{\theta k}{\eta^j}}$. If the losses to be rolled over are larger than $\theta k + q_a^j \sqrt{\frac{\theta k}{\eta^j}} - x^j(a') = q_a^j \sqrt{\frac{\theta k}{\eta^j}}$, the firm cannot roll over (its feasible decision set is empty) and has to default and exit the market. This corresponds to involuntary default, since it does not result from an arbitrage decision but comes from the firm's borrowing constraints.

Second, the firm may also want to default if repaying or rolling over its debt is possible, but implies capital and debt tomorrow such that its value is lower than some reservation value u. Then the enterprise prefers to default and obtains his outside option equal to $u \geq 0$.

In both cases, when the firm defaults, it exits the market forever and obtains 0. Its creditors' debts are reimbursed up to a share $\kappa \geq 0$ of the firm's capital. To keep the set-up simple, I set $u = 0$: given that the value of the firm is always non-negative, there is no voluntary default, only involuntary default occurs.

2.4 The program of firm

Given the set-up described above, we can now write the optimization program of the firm. The value of a firm at each period depends on its productivity shock A, its current capital k, its outstanding debt d, and its easiness of access to alternative financing j. It can be written as the following value function, where V^D and V^{ND} are respectively the values of defaulting and not defaulting:

$$V(A,k,d;j) = \begin{cases} V^D(A,k,d;j) & \text{if the firm defaults} \\ V^{ND}(A,k,d;j) & \text{otherwise.} \end{cases} \tag{7}$$

The corresponding definitions of default and non-default values are specified below in equations (8) to (19). 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 and all successive periods. Its creditors are partially reimbursed similarly to the case of default detailed above. As mentioned earlier, since capital and debt tomorrow are decided today and the type j is stable across time, the only uncertainty faced by the firm today regarding its value tomorrow comes from its productivity tomorrow and the eventuality of death. The firm may roll-over part of its debt, which implies to get new loans to repay old debt. New loans can be used partly to repay old debt, and partly to invest more. To have a coherent decision set-up and avoid any Ponzi-like behavior, some additional assumptions are needed, that may differ if the firm is making positive or negative profit today and are reflected in the constraints of the firm's maximization. Given these assumptions, the program of the firm can be written as follows ($\mathbb{E}$ stands for the expectation operator):

$$\begin{aligned} V^{ND}(A,k,d;j) = \max_{e',b',a'} \big\{ & \max\left[\Pi_E(A,k,d) - x^j(a') - e', 0\right] \\ & + \beta(1-\xi)\mathbb{E}V(A',k',d';j)\big\} \end{aligned} \tag{8}$$

such that

$$\Pi_E(A,k,d) = \max_l Ak^\alpha l^\gamma - wl - d = (Ak^\alpha)^{\frac{1}{1-\gamma}} \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} (1-\gamma) - d \tag{9}$$

$$k' = (1-\delta)k + e' + qb' + q_a^j a' + \min[\Pi_E(A,k,d) - e' - x^j(a'), 0] \tag{10}$$

$$d' = b' + a' \tag{11}$$

$$qb' \leq \theta k \tag{12}$$

$$e' \leq \max[\Pi_E(A,k,d), 0] \tag{13}$$

$$x^j(a') \leq qb' + \max[\Pi_E(A,k,d) - e', 0] \tag{14}$$

$$-(qb' + q_a^j a') \leq \Pi_E(A,k,d) - x^j(a') \tag{15}$$

$$e' \geq 0 \tag{16}$$

$$b' \geq 0 \tag{17}$$

$$a' \geq 0 \tag{18}$$

$$V^D(A,k,d;j) = 0 \tag{19}$$

Depending on its profit today and its investment financing decision, the firm distributes positive

or null dividends. As mentioned earlier, conditional on productivity A, capital k and the wage w, the labor demand is an intratemporal decision, so that the optimal labor demand can be determined analytically and plugged in the profit equation as done in equation (9). Equations (10) and (11) respectively specify the laws of motion of future capital and debt. Equation (12) defines the collateral constraint, imposing that the firm cannot borrow from the formal banking sector more than a share θ of its current capital. The additional assumptions and corresponding constraints are detailed below.

Assumption 1. *The firm cannot use newly obtained loans to distribute higher dividends.*

If the firm is making negative profits, today's dividends should be exactly zero (otherwise that would be close to running a Ponzi scheme). This implies that losses rolled over through debt are exactly equal to $\Pi_E(A, k, d) - x^j(a')$, and explains the presence of max and min operators in the current returns function in (8) and in the law of motion of capital in equation (10).

Assumption 2. *Retained earnings e' cannot exceed current profit, and additional debt cannot be used to increase retained earnings beyond a firm's positive profits. This corresponds to constraint* (13).

Indeed, it is equivalent for the firm to invest using retained earnings financed themselves through additional debt, and to directly use debt b' or a' to finance investment. Imposing retained earnings capped by current profit solves this indeterminacy. Consequently, a firm making negative profits cannot use retained earnings, and e' has to be equal to zero in that case.

Assumption 3. *Firms can use part of their new bank loans qb' to pay the cost of access to alternative funding $x^j(a')$, as is specified in constraint* (14).

This implies that the cost of access to alternative funding sources can be covered either by today's (positive) profit, or by the bank loans. Without this assumption, loss making firms would not be able borrow from alternative sources ($a' = 0$) and would only use loans from the bank to roll-over debt. With this assumption, firms can also use alternative funding to roll-over debt. Similarly, a firm making positive profit can use its newly obtained bank loan to pay the cost of access to alternative financing $x^j(a')$ if its current profit is not high enough.[14] Note that firms cannot use the loan obtained from the alternative sources $q_a^j a'$ to pay the cost of access to alternative funding $x^j(a')$, since this access cost has to be paid beforehand.

Assumption 4. *Investment is irreversible. Only the new loans $qb' + q_a^j a'$ can be used to roll over previous debt, as stated in inequality constraint* (15).

Note that the firm can borrow more than the debt to be rolled-over and use the remainder for investment.

2.5 Some intuition

As explained above, in case of default, the firm does not produce and obtains a value equal to zero forever. Here, I focus on the case where the firm is able to reimburse or roll-over its debt. To get a better overview of the input and funding choices we can expect from the firm, I provide some further

[14] Extending this assumption to firms making positive profits ensures the continuity of the feasible set of investment policies.

elements regarding its optimal decision. Separating the firm's state in two parts, between positive and zero dividends, the firm's program verifies the assumptions of theorem 9.10 from Stockey and Lucas Jr (1989) in both parts. Hence, the value function is continuously differentiable with respect to capital and debt in both cases, except at the kink point between these two parts. I set up the Lagrangian of the problem below, denoting λ, μ, ν and ζ the multipliers respectively associated with constraints (12), (13), (14) and (15). For better readability, I describe the Lagrangian separately for three cases: positive profits and dividends, positive profits and zero dividends, negative profits.

Positive dividends

$$\mathcal{L} = \Pi_E - x^j(a') - e' + \beta(1-\xi)\mathbb{E}V + \lambda(\theta k - qb') + \mu(\Pi_E - e' - x^j(a')) \tag{20}$$

Positive profit, zero dividends

$$\mathcal{L} = \beta(1-\xi)\mathbb{E}V + \lambda(\theta k - qb') + \nu(qb' + \Pi_E - x^j(a')) \tag{21}$$

Negative profits

$$\mathcal{L} = \beta(1-\xi)\mathbb{E}V + \lambda(\theta k - qb') + \nu(qb' - x^j(a')) + \zeta(\Pi_E - x^j(a') + qb' + q_a^j a') \tag{22}$$

From the first order conditions of the problem and the envelop theorem, I obtain equations (23) to (29) defining the optimal levels of retained earnings, bank loan and alternative funding. To simplify the notations, state variables of the value functions are dropped, so that $\mathbb{E}V^{ND}$ corresponds to $\mathbb{E}V^{ND}(A', k', d'; j)$, $\mathbb{E}V^D$ corresponds to $\mathbb{E}V^D(A', k', d'; j)$, and so on (note that all these value functions concern the future period, hence the expectation operator $\mathbb{E}$).

Positive dividends

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{1+\mu}{\beta(1-\xi)} \tag{23}$$

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{\lambda}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial \mathbb{E}V}{\partial d'} \tag{24}$$

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{x^{j\prime}(a')(1+\mu)}{\beta(1-\xi)q_a^j} - \frac{1}{q_a^j}\frac{\partial \mathbb{E}V}{\partial d'} \tag{25}$$

Positive profits, zero dividends

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{\lambda - \nu}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial \mathbb{E}V}{\partial d'} \tag{26}$$

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{\nu x^{j\prime}(a')}{\beta(1-\xi)(q_a^j - x^{j\prime}(a'))} - \frac{1}{q_a^j - x^{j\prime}(a')}\frac{\partial \mathbb{E}V}{\partial d'} \tag{27}$$

Negative profits

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{\lambda - \nu - \zeta}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial \mathbb{E}V}{\partial d'} \tag{28}$$

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{\nu x^{j\prime}(a')}{\beta(1-\xi)(q_a^j - x^{j\prime}(a'))} - \frac{\zeta}{\beta(1-\xi)} - \frac{1}{q_a^j - x^{j\prime}(a')}\frac{\partial \mathbb{E}V}{\partial d'} \tag{29}$$

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 to 2 give us a better understanding of the firm's funding decisions. Proposition 1 considers the case of a firm, distributing positive dividends, and specifies conditions under which we can analytically determine wich financing source s marginally preferred by the firm to finance investment and roll-over debt. Proposition 2 explores similar properties int he case where the firms' dividends are zero.

Proposition 1. *Provided that the firm distributes positive dividends, it marginally prefers to finance investment:*

(i) through retained earnings rather than through alternative sources, if alternative sources are already used intensively enough (i.e., if $a' \geq \bar{a}$, where the threshold $\bar{a}$ is defined by $x^{j\prime}(\bar{a}') = q_a^j$), provided that it does not hit the non-negative dividends constraint (13)*. It is ambiguous if $a' \leq \bar{a}$;*

(ii) through bank loans rather than alternative sources, if the interest rate charged on bank loans is lower than the one of alternative financing (i.e. $r \leq r_a^j$), provided that it does not hit the collateral constraint (12)*. It is ambiguous if $r \geq r_a^j$.*

Comparing analytically marginal costs and benefits of investing through retained earnings versus bank loans is inconclusive.

See proof in Appendix B.1. The intuition is the following.

(i) On one hand, the marginal cost of increasing retained earnings is a one for one reduction of the firms current dividends, and its benefit is a one for one increase in tomorrow's capital. On the other hand, increasing alternative funding marginally reduces current dividend by $x^{j\prime}(a')$ and marginally increases capital by less than one, because it bears some interest rate ($r_a^j > 0$). Increasing alternative funding also increases the level of debt tomorrow, while retained earnings do not. When the access cost $x^{j\prime}(a')$ or the interest rate r_a^j are high enough, the total marginal net benefit of increasing retained earnings becomes unambiguously higher than the one of alternative financing, and the firm marginally prefers to finance investment through retained earnings.

(ii) When the interest rate paid on bank loans is lower than the one paid on alternative financing ($r \leq r_a^j$) and the collateral constraint on bank loans does not bind, increasing bank loans rather than alternative sources to finance investment is relatively cheaper in terms of cost. On the one hand, the increase in debt tomorrow due to both bank loans and alternative sources is the same. On the other hand, an increase in bank loans raises capital tomorrow more than a similar increase in alternative funding that also necessitates to pay the access cost $x^j(a')$. Since the expected value of the firm is increasing with future capital and decreasing with future debt, the firm marginally prefers to finance investment with bank loans rather than with alternative sources.

Note that when $r > r_a^j$ and the firm is distributing positive dividends, then its preference between bank loans and alternative sources is ambiguous and depends on the parameters values. Similarly, when $q_a^j - x^{j\prime}(a') \geq 0$, we cannot conclude analytically whether alternative funding or retained earnings are preferred.

Proposition 2. *For both positive and negative profit values, provided that the firm distributes zero dividends, it marginally prefers to finance investment:*

(i) through bank loans rather than through alternative sources, if the interest rate on bank loans is low enough or alternative sources are already used intensively enough (i.e., if $a' \geq \underline{a}$, where $\underline{a}$ is defined by $x^{j\prime}(\underline{a}) = q_a^j - q$), provided that it does not hit the collateral constraint (12)*;*

(ii) through alternative sources rather than through bank loans, if the interest rates on bank loans is high enough or alternative sources are little used (i.e., if $a' \leq \underline{a}$), provided that it does not hit the access cost constraint (14)*.*

See proof in Appendix B.2. The mechanism is similar to the proof of Proposition 1.

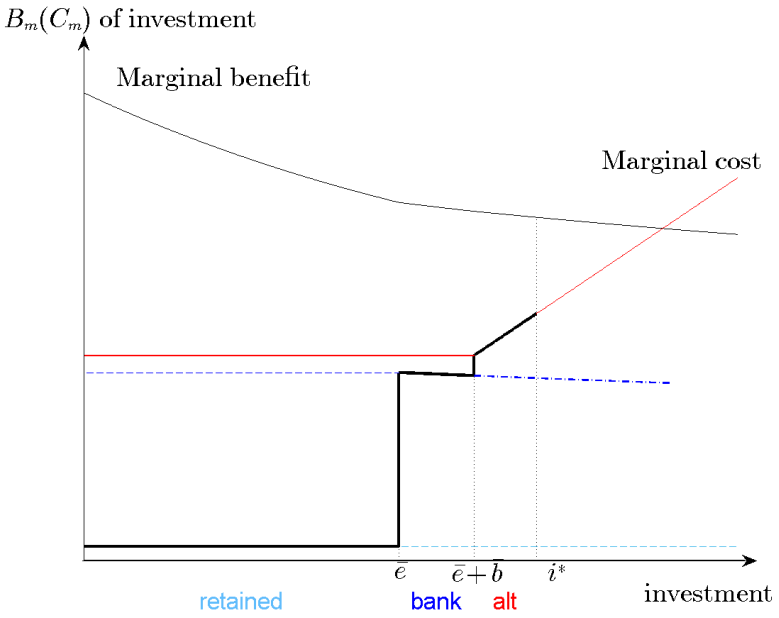
(i) Considering the situation of a firm distributing zero dividends, if $q \geq q_a^j - x^{j\prime}(a')$, an increase in bank loans marginally increases capital tomorrow more than alternative sources would do. On the debt side, both bank loans and alternative funding marginally increase debt by the same amount. Hence, if the marginal access cost to alternative sources $x^{j\prime}(a')$ is high enough, the firm marginally prefers to use bank loans to finance investment, even when bank loans bear a higher interest rate than alternative funding ($q < q_a^j$).

(ii) Similarly, if $q \leq q_a^j - x^{j\prime}(a')$, the marginal benefit of increasing alternative financing is higher than the marginal benefit of increasing bank loans, and their marginal costs are equal. Therefore, firms marginally prefer to use alternative sources, if the access cost constraint does not bind.

Figures 1 to 3 illustrate the various financing choices that can be generated by the model, by presenting three different cases. In all figures, the decreasing black curve shows the marginal benefit of investment, while the increasing thick black line is its marginal cost. The firm finances investment until it either hits a constraint, or the marginal benefit of investment is lower than its marginal cost. Figure 1 gives a representation of the funding choice when dividends are positive, $r < r_a^j$ and $\eta^j > 0$. In this case, Proposition 1 tells us that the firm marginally prefers to finance investment through bank loans rather than through alternative sources, provided that the collateral constraint does not bind. Therefore, the marginal cost for bank loans (dark blue dashed-dotted line) is always smaller than the marginal cost for alternative funding (red solid line). In the specific calibration shown on this graph, we consider a large firm[15] with a very high productivity shock. The decision sequence is as follows: retained earnings are initially marginally preferred to both other sources, until the non-negative dividends constraint (13) binds (at investment level $\bar{e}$). The firm then switches to the second cheapest source of financing, namely bank loans (light blue dashed line). Finally, when it hits the collateral constraint (12), at investment level $\bar{e} + \bar{b}$, the firm uses alternative sources to finance the residual investment until it cannot finance its cost of access

[15] In the model, as in the data, the size of a firm is determined by its labor demand.

Figure 1: Case of positive dividends, $r < r_a^j$

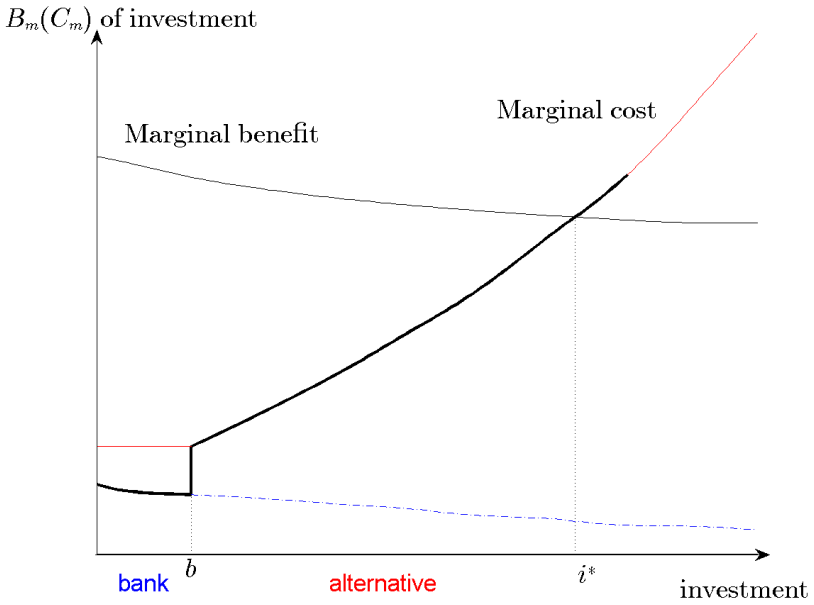


Note: The parameter and price values for this graph are as follows: $\beta = 0.9923$ $\xi = 0.082$, $\omega = 0.1$, $A = 2.7$, $\alpha = 0.51$, $\gamma = 0.30$, $\delta = 0.1$, $k = 11$, $d = 6$, $\eta^j = 0.142$, $r = 0.0309$, $r_a^j = 0.095$, $w = 0.80$.

any more, reaching a total investment equal to i^*. This firm finances 69% of its investment with retained earnings, 17% with bank loans and 14% with alternative sources. Comparing to the data seen in section 1, this enterprise uses more retained earnings, and less bank loans and alternative sources than the average large firm. This difference can be explained by the fact that the enterprise considered here has a very high productivity shock,and a fairly high capital level, and therefore has a large amount of profits to be reinvested. Given its high level of capital, it does not need to invest massively and can finance most of its investment through retained earnings.

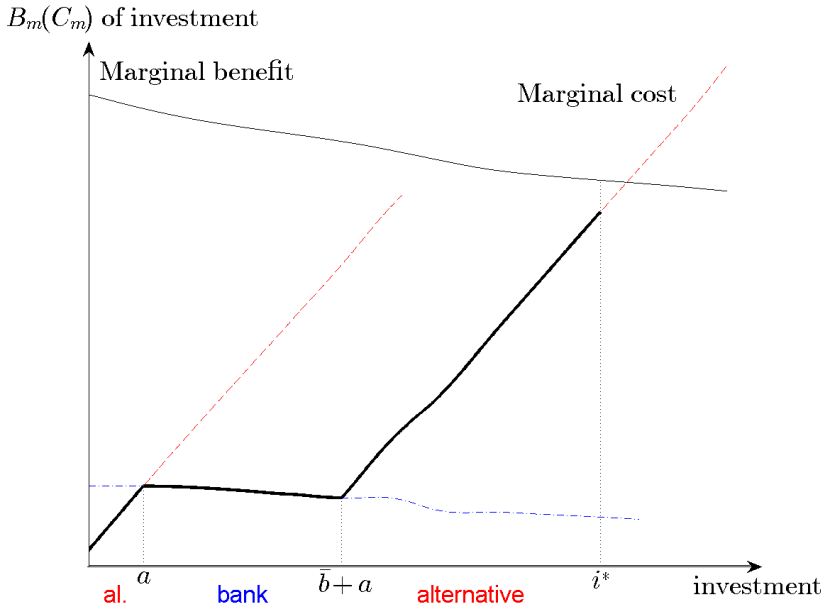
The example shown in Figure 1 is useful to understand the pecking order of enterprises facing various financing possibilities, by showing a case where the enterprise uses the three possible funding sources. However, as seen in the data, many enterprises do not use all financing sources. Clearly, on Figure 1, if the firm had a lower productivity shock, the marginal benefit curve would shift down, and the enterprise would probably not use alternative financing, maybe even use only retained earnings. Figure 2 shows another possible case where the enterprise uses only bank loans and alternative sources, and does not reinvest profits through retained earnings. Here again, $r < r_a^j$, $\eta^j > 0$ and we examine a medium-sized enterprise with a medium-high shock currently making losses. Because of its negative profit, this firm needs to roll-over part of its debt and cannot use retained earnings. From Proposition 2, we can conclude that this firm always marginally prefers to use bank loans rather than alternative funding to invest. The firm first uses bank loans until it hits the collateral constraint, financing 26% of its total investment. It then turns to alternative sources to finance the remaining 74% of its total investment i^*. This firm is one of the 59% of medium-sized firms that do not use retained earnings in the data.

Figure 2: Case of zero dividends, $r < r_a^j$



Note: The parameter and price values for this graph are as follows: $\beta = 0.9923$, $\xi = 0.082$, $\omega = 0.1$, $A = 1.6$, $\alpha = 0.51$, $\gamma = 0.30$, $\delta = 0.1$, $k = 2.50$, $d = 1.8276$, $\eta^j = 0.142$, $r = 0.0309$, $r_a^j = 0.095$, $w = 0.80$.

Figure 3: Case of positive dividends, $r > r_a^j$



Note: The parameter and price values for this graph are as follows: $\beta = 0.9923$, $\xi = 0.082$, $\omega = 0.1$, $A = 1.6$, $\alpha = 0.51$, $\gamma = 0.30$, $\delta = 0.1$, $k = 35$, $d = 14$, $\eta^j = 0.01$, $r = 0.0309$, $r_a^j = 0.01$, $w = 0.80$.

Finally, Figure 3 shows the case where $r > r_a^j$. For small amounts of alternative funding, alternative finance may be cheaper than bank loans, so that the marginal cost of alternative sources is below the marginal cost of bank loans (dark blue dashed-dotted line). In the case represented, the firm is large-sized and has a medium-high productivity shock. It first finances investment through alternative sources, until it becomes more expensive than bank loans due to the quadratic cost of access (the two curves cross at the investment level a). The firm then uses bank loans until it hits the collateral constraint (12) at investment level $\bar{b} + a$, and switches back to alternative sources to reach the total amount invested i^*. 38% of the firm's investment is financed through bank loans, while 61% is financed through alternative finance. Compared to large-sized firms in the data, this firm uses no retained earnings because it currently makes negative profits. It also uses more alternative sources than the average large firm in the data, because it benefits from a cheap access to alternative sources.

3 General equilibrium

To insert the firm's program described above within a general equilibrium framework, I need to add a household and a financial intermediary. Their respective programs are detailed in sections 3.1 and 3.2. Throughout this section, for consistency, I keep the price notations used above for the firm's program, so that the household generally saves some amount qs and obtains s the next period, and the bank takes deposits qD and repays D at the next period. To keep the general equilibrium as simple as possible, the household side is represented by a single representative household, which implies some shortcuts. The interested reader can find a general equilibrium version with full-fledged heterogeneous households in Appendix C.

3.1 Program of the household

There is one infinitely-lived representative household who supplies labor inelastically for a wage w, and decides how much of his income to consume and save. Importantly, the household does not face any uncertainty in terms of labor income. He is willing to save if the interest rate he obtains from saving is higher than his discount factor, and willing to borrow otherwise. For a steady state to exist in terms of wealth, consumption and savings levels, I need to assume that the interest rate is exactly equal to the discount factor, which makes the household indifferent between saving and consuming.[16] On top of his labor income, the household owns all firms' shares and earns the dividends of the firms. The shares of the firms are non-transferable and the dividends are a per period lump-sum transfer.

The household can save using different assets:

- *bank deposits*: he can deposit his savings at the bank, and earn a risk-free rate r_d. For notations consistency with the firm's program, I denote the price of this asset $q_d = \frac{1}{1+r_d}$.
- N_J *types of direct firms financing*: he can lend his savings directly to enterprises, which corresponds to the alternative finance obtained by the firms. To match the different types of firm (having a more or less costly access to alternative financing), I distinguish between

[16] For simplicity, I assume that the households cannot borrow. Since I assume that the interest rate is equal the discount factor, this borrowing constraint is never binding.

$N_J = \dim(J)$ types $j \in J$ of direct firms financing that differ in their rate of return and their intermediation cost: to find a firm willing to invest, the household may have to search, and pay some intermediation cost χ^j (accounted for in terms of goods). This cost is higher when households go beyond their close social circle, since more intermediaries are involved to reach a firm needing investment. At the same time, the household can require a higher interest rate when lending to a firm less tightly related to his social circle. For consistency with the notations of the firms' program, I denote $q_a^j = \frac{1}{1+r_a^j}$ the price of type j asset bought by the household. This saving instrument is risky, since firms may default on their loan and not fully reimburse. However, the household knows the average probability of default of a firm, and he holds a fully diversified portfolio of loans to firms, so that from the law of large numbers, he can perfectly anticipate the share of firms that will default and what ex-post return he will obtain. Hence, he does not face any uncertainty on his returns. Denoting $\bar{p}$ the average default probability, a unit portfolio of direct loans to firms bought at price q_a^j yields a return 1 with probability $1 - \bar{p}$ and reimburses $\underline{r} < 1$ with probability $\bar{p}$. The household's total return is therefore $1 - \bar{p} + \bar{p}\underline{r}$ per amount q_a^j lent.

The program of the household is shown in equations (30) to (33). As mentioned before, since the household holds a fully diversified portfolio of firms loans and bank deposits are risk-free, he does not face any uncertainty.

$$V(W) = \max_{c, s_b, \{s_a^j\}_{j \in J}} u(c) + \beta V(W') \tag{30}$$

s.t.

$$W = c + q_d s_b + \sum_{j \in J} q_a^j s_a^j + \sum_{j \in J} \chi^j s_a^j \tag{31}$$

$$W' = D_e + w + s_b + \sum_{j \in J} s_a^j (1 - \bar{p} + \bar{p}\underline{r}) \tag{32}$$

$$s_a^j, s_b, c \geq 0 \tag{33}$$

where W is the current total wealth of the household, c is consumption today, s_b is the amount deposited to the bank, s_a^j is the capital directly supplied to the firm of type j through alternative financing, w is the household's wage, D_e is the dividends obtained from the firms' profit, $\bar{p}$ is the aggregate default probability determined by the firms' program, and $\underline{r}$ the average reimbursement rate in case of default.

The first order conditions of this program imply:

$$q_d u'(c) = \beta V'(W') \tag{34}$$

$$\frac{q_a^j + \chi^j}{1 - \bar{p} + \bar{p}\underline{r}} u'(c) = \beta V'(W') \qquad \forall j \in J \tag{35}$$

All three saving instruments (bank deposits and the N_J types of direct loans to firms) are risk-free for the household. Hence, if one of them has a higher return, the household will invest all

his savings in that asset and will not use the others. To avoid such corner equilibria, I will further assume that all assets have equal returns and that the household is indifferent between investing in one or the other:

$$q_d = \frac{q_a^j + \chi^j}{1 - \bar{p} + \bar{p}\underline{r}} \qquad \forall j \in J \tag{36}$$

This property can be easily obtained by adjusting the intermediation costs χ^j or the price q_a^j, as detailed in section 4. Given that the household is indifferent between the three types of saving instruments, his decision at each period simplifies to choosing his total consumption c and his total amount used for savings and intermediation costs $\bar{q}\bar{s} = q_d s_b + \sum_{j \in J} q_a^j s_a^j + \sum_{j \in J} \chi^j$, where $\bar{q} = q_d = \frac{q_a^j + \chi^j}{1 - \bar{p} + \bar{p}\underline{r}}$. Rewriting the household's program after this simplification, and assuming a log utility function, there are analytical solutions for the household's value function and optimal policy functions. Using a "guess and verify" procedure, it is easy to show that:

$$V(W) = \frac{1}{1-\beta}\log(1-\beta) + \frac{\beta}{(1-\beta)^2}\log\left(\frac{\beta}{\bar{q}}\right) + \frac{1}{1-\beta}\log\left(W + \frac{\bar{q}}{1-\bar{q}}(D_e + w)\right) \tag{37}$$

$$\bar{s}^* = \frac{\beta}{\bar{q}}W - \frac{1-\beta}{1-\bar{q}}(D_e + w) \tag{38}$$

$$c^* = (1-\beta)W + \frac{\bar{q}(1-\beta)}{1-\bar{q}}(D_e + w) \tag{39}$$

$$W'^* = \frac{\beta - \bar{q}}{1-\bar{q}}(D_e + w) + \frac{\beta}{\bar{q}}W \tag{40}$$

Clearly, the only values of β and $\bar{q}$ that allow for a steady state with a non-negative constant wealth W are such that $\beta = \bar{q}$. If this is the case, then any amount $W \geq D_e + w$ is a possible steady state with non-negative savings, and the value of total wealth W pins down the optimal steady state levels of savings and consumption. To close the model, I finally need to add a financial intermediary, namely one representative bank, whose program is described in the next section.

3.2 Program of the bank

There is a representative bank in the economy. At each period, the bank takes deposits $q_d D$ (at price $q_d = \frac{1}{1+r_d}$) and grants loans qB (at price $q = \frac{1}{1+r}$) to meet firms' demand given the collateral constraint. Like the household, the bank holds a fully diversified portfolio of loans to firms, and knows the average default and reimbursment rates, so that it does not face any aggregate uncertainty on the outcome of its loans. On average, a fraction $\bar{p}$ of the firms default on their loan and reimburse only $\underline{r}$ on average instead of 1, so that the bank obtains an aggregate return equal to $(1 - \bar{p} + \bar{p}\underline{r})B$ on its loans.

The bank faces operating costs in proportion ζ to the total amount of deposits and loans handled $q_d D + qB$. To be solvent, the bank needs to receive more deposits than it grants loans, i.e. $q_d D \geq qB$. The bank's total profit to maximise is then:

$$\max_{D,B} \Pi_b = q_d D - qB - D + (1 - \bar{p} + \bar{p}\underline{r})B - \zeta(qB + q_d D) \tag{41}$$

$$\text{s.t.} \qquad q_d D \geq qB \tag{42}$$

As mentioned earlier, in the early 2000's in China, interest rates offered by banks are heavily guided by the People's Bank of China. Notably, the deposit and lending rates r_d and r are respectively subject to a ceiling and a floor such that $r_d < r$, which corresponds to $q_d > q$. To account for this situation in the baseline specification of the model, I force the bank to act like a "machine", meaning that it has no free adjustment variable and hence no proper optimisation program to solve. The amount of deposits taken by the bank is hence equal to the aggregate deposits of the households, while the amount of loans granted by the bank is equal to the enterprises' aggregate loan demand. The intermediation margin of the bank is used to cover the operating costs of the bank (accounted for in terms of consumption good). In the baseline calibration, ζ is set to ensure the bank makes zero profits.

Policy experiments liberalizing the interest rates setting are conducted in section 5.

3.3 Market clearing conditions

There are $4 + N_J$ markets to be cleared: good, labor, deposits and the $1 + N_J$ types of loans (obtained from the bank and alternative sources).[17] There is one single type of good used for consumption, investment and capital for production; it is the numeraire. The wage adjusts to reach the equilibrium on the labor market, while the interest rates adjust to balance the demand and supply of alternative financing. The case of bank loans and deposits is slightly different: usually, the equilibrium is reached by adjusting the deposit and lending rates. However, this project focuses on the case of China during the early 2000's, where both deposit and lending rates are fixed by the People's Bank of China and cannot freely adjust. I detail below how the equilibrium on these markets is dealt with.

Labor market

The inelastic labor supply of the household is fixed, equal to L^S. The demand side on the labor market consists in the aggregate labor demand $L^D(w)$, computed by solving the firms' program, and depends on the wage w. To avoid heavy notations, I summarize the firms' state variables by $m = \{A, k, d; j\}$ and denote the probability distribution of firms across states by $\mu(m)$. The wage has to adjust such that at each period:

$$L^S = L^D(w) = \int l_m^D(w)\mu(m)dm \tag{43}$$

Alternative capital market

The alternative capital market is pooled within each type $j \in J$: there is a single separated alternative capital market for each type j, where firms of type j meet the household. The direct loan $s_a^j(q_a^j)$ from the household has to be equal to the aggregate demand for alternative funding $a'(q_a^j; j)$ by each type of firms.

$$s_a^j(q_a^j) = \int a'_m(q_a^j)\mu(m)dm = a'(q_a^j; j) \qquad \forall j \in J \tag{44}$$

[17] As mentioned earlier, the firms' shares are entirely held by the household and are not transferable.

For each $j \in J$, the interest rate q_a^j adjusts to clear the market.

Bank capital markets

In the baseline scenario, the bank cannot refuse the deposits supplied by the household ($q_d s_b$) and the loan demand (qb') it faces, and has basically no room for action. The bank accepts all deposits supplied by the household, and grants all loans demanded by the firms up to the collateral constraint. This implies the following equalities:

$$q_d D = q_d s_b(q_d) \tag{45}$$

$$qB = \int qb'_m(q)\mu(m)dm = qb'(q) \tag{46}$$

The loan supply from the bank qB should be equal to the aggregate bank loan demand from the firms $qb'(q)$. The aggregate deposits from the household $q_d s_b(q_d)$ should be equal to the deposits in the bank $q_d D$. In section 5, I conduct policy experiments where constraints on interest rates setting are relaxed and the bank maximizes its profit as is common in the literature.

Good market

The same good is used for consumption, investment, operating costs of the bank, access costs to alternative financing from the firms' side, and intermediation costs from the household's side. It is the numeraire. On the supply side, we have the aggregate production Y obtained from the firms. On the demand side, there is the consumption of the household C, the aggregate total investment of the firms I (retained earnings, bank loans and alternative loans net of rolled-over debt and of access cost to alternative funding), the aggregate cost of access to alternative financing X paid by the firms, the intermediation costs INT paid by the household, the bank's operating costs and the bank's and household's losses LO due to firms' default. The good is the numeraire, and from Walras' low, if all other markets are in equilibrium, the demand and supply of the good market should also be balanced. The equilibrium on the goods market is reached when:

$$Y = C + I + X + INT + \zeta(qL + q_d D) + LO \tag{47}$$

which corresponds to:

$$\int Y_m \mu(m)dm = C + \int inv_m \mu(m)dm + \sum_{j\in J} \int x^j(a'_m)\mu(m)dm + \sum_{j\in J} \chi^j s_a^j \tag{48}$$
$$+ \zeta(q_d D + qB) + \int losses_m \mu(m)dm$$

We now have all the elements needed to define an equilibrium in this economy.

3.4 Equilibrium definition

In the remainder of this paper, I will solve for and study only stationary equilibria. To define a stationary equilibrium in this environment, I first need to specify the stationary distribution of

firms. Equation (49) defines the law of motion of the firms' distribution.

$$\mu'(A', k', d'; j) = \int Prob(k' = k'(A, k, d; j), d' = d'(A, k, d; j)|A, k, d; j) T_{AA'} d\mu(A, k, d; j) \quad (49)$$

where $T_{AA'}$ is the transition probability from productivity shock A to productivity shock A'.

Given the above law of motion, I can now turn to the definition of the stationary equilibrium in this set-up.

Definition 1. *A stationary equilibrium consists in policy functions* $a'(A, k, d; j)$, $b'(A, k, d; j)$, $e'(A, k, d; j)$, $c(W)$, $\{s_a^j(W)\}_{j \in J}$, $s_b(W)$, B *and* D; *a probability distribution* $\mu(A, k, d; j)$ *for firms; and prices* $\{w, \{q_a^j\}_{j \in J}, q, q_d\} \in \mathbb{R}_+^{3+N_J}$ *such that:*

1. *The policy functions* $a'(A, k, d; j)$, $b'(A, k, d; j)$ *and* $e'(A, k, d; j)$ *solve the firms' program as defined in equations* (8) *to* (19), *given prices* w, $\{q_a^j\}_{j \in J}$ *and* q;
2. *The policy functions* $c(W)$, $\{s_a^j(W)\}_{j \in J}$, *and* $s_b(W)$ *solve the household's program as defined in equations* (30) *to* (33), *given prices* w, $\{q_a^j\}_{j \in J}$, *and* q_d;
3. *The policy functions* B *and* L *solve the bank's program as defined in equations* (41) *and* (42) *given* q *and* q_d;
4. *Markets clear, so that equations* (43) *to* (48) *are satisfied;*
5. *The stationary distribution* $\mu(A, k, d; j)$ *is the fixed point of equation* (49).

4 Calibration

The model is calibrated according to the Enterprise Survey data presented in section 1, and aggregate moments obtained from the China Statistical Yearbook and World Development Indicators database from the World Bank. The discount rate and the depreciation rate of capital are set in line with the literature, while the interest rates for bank loans and bank deposits are directly obtained from the data. The parameters defining the production function and the technology shock are estimated using the data. The remaining parameters are defined to match aggregate moments from the data.

4.1 Parameters derived from the literature and data

As presented in section 1.4, the data provide the interest rate charged by the formal banking sector, denoted r. From Table 5, the average nominal interest rate for bank loans is equal to 5.29%. After subtracting the inflation rate for investment in fixed assets for the year 2003, the real interest rate in the model is calibrated at $r = 3.09\%$, corresponding to $q = 0.97$. The nominal interest rate on one-year deposits set by the People's Bank of China from February 2002 to October 2004 is equal to 1.98%. Taking into account the rate of inflation for consumer prices in 2003, the real interest rate paid by the bank on deposits is set at $r_d = 0.78\%$, corresponding to an asset price $q_d = 0.9923$. To ensure that the household is indifferent between consuming and saving, I set the value of the discount factor β to 0.9923. The share κ of capital that can be used used by enterprises

to reimburse loans in case of default or death is set to 0.25. Regarding the depreciation rate δ, only a few of the studies using depreciation rates for China or other developing countries actually estimate it. According to the results summarized in Table 24 in Appendix A, it seems reasonable to set δ to 10% for the calibration.

4.2 Calibrating the production function

To calibrate the elasticity of output with respect to capital and labor (parameters α and γ respectively), I estimate the production function using data from 2002.[18] There is abundant literature on the estimation of Cobb-Douglas type production functions. 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. I follow here the approach suggested by Olley and Pakes (1996) (hereafter OP), that takes this simultaneity into account by using investment as a proxy for the productivity shock. 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.[19]

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 the data from the Enterprise 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.

Table 6: Estimation of the production function coefficients with OP's method

	Olley & Pakes		
	(1)	(2)	(3)
	All	Manufacturing	Services
labor	0.30**	0.28***	0.52***
	(0.0356)	(0.0397)	(0.0925)
capital	0.51***	0.59***	0.43**
	(0.127)	(0.144)	(0.208)
N (first step)	1383	1050	333
N (second step)	778	596	182

Standard errors in parentheses, specification controlling for age

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

Table 6 presents the results of the estimation of the production function for OP's method. Results obtained with OLS and fixed effects are shown in Table 25 in Appendix A for the whole sample, as a reference to compare with more robust approaches. The variable used for output

[18] Missing values for capital in 2003 do not allow me to use that year for the estimation.

[19] Another approach, developed by Levinsohn and Petrin (2003) (hereafter LP), uses intermediate inputs such as energy or materials to proxy the productivity shock. One of the general advantages of this 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. Hence, I favor investment as proxy variable, and OP's method. Results from LP's approach are available upon request.

here corresponds to value added (materials have been subtracted). OP's method yields plausible and stable coefficients estimates, with a capital coefficient ranging from 0.43 to 0.59 and a labor coefficient between 0.28 and 0.51. I use these results to calibrate the production function, with calibrated values of parameters α and γ respectively equal to 0.51 and 0.30, 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 $\rho = 0.91$. To define the productivity shock process of my model, I use a discrete Markov-Chain process with a transition matrix T such that the theoretical autoregressive coefficient associated to it equal to 0.91. The levels of the productivity shocks, as well as the level of newborn firms' initial capital, are calibrated to match the firms' size distribution (in terms of number of employees) obtained from the data with the size distribution obtained from the model's stationary state. There are 5 shocks and one level of initial capital, hence 6 parameters, that match 8 percentiles of the firm size distribution.[20] I obtain the following values for the shocks matrix A and for the transition matrix T.

$$A = \begin{pmatrix} 0.35 & 0.75 & 1 & 1.6 & 2.7 \end{pmatrix} \tag{50}$$

$$T = \begin{pmatrix} 0.8765 & 0.1235 & 0 & 0 & 0 \\ 0.0164 & 0.9146 & 0.0690 & 0 & 0 \\ 0 & 0.0352 & 0.9295 & 0.0352 & 0 \\ 0 & 0 & 0.0690 & 0.9146 & 0.0164 \\ 0 & 0 & 0 & 0.1235 & 0.8765 \end{pmatrix} \tag{51}$$

4.3 Further Parameters: Matching moments

The remaining parameters are calibrated in order to match the moments highlighted in section 1. I allow for two possible types $j \in \{L, H\}$ of firms, which helps matching the patterns of firms' investment financing while keeping low enough the number of parameters to calibrate. Firms of type L have an easy access to lenders in their social circles and do not need to go through intermediaries. They face therefore a low cost of borrowing through alternative finance systems. On the opposite, firms of type H need to go through some intermediaries to get in touch with lenders and hence face a higher cost of borrowing through non-bank systems. This implies that $\eta^H > \eta^L$ and $r_a^H > r_a^L$. Similarly, the household faces a higher intermediation cost when lending to type H firms than when lending to type L firms, so that $\chi^H > \chi^L$. The parameters to be calibrated are then:

- χ^j for $j \in \{L, H\}$: cost of accessing alternative funding for type j households;
- θ: tightness of the collateral constraint to obtain bank loans;
- η^j for $j \in \{L, H\}$: quadratic cost of accessing alternative funding for type j firms;
- ξ: exogenous death probability for all firms;

[20] These percentiles are the 1^{st}, 5^{th}, 10^{th}, 25^{th}, 75^{th}, 90^{th}, 95^{th} and 99^{th}, normalized by the median.

- p_0: probability for a firm to be of type L.

To achieve this, I first solve for the policy functions of the firms with value function iterations, and for the firms' stationary distribution. I then compute the prices (wage and interest rate for both types of alternative funding) to reach the equilibrium on the labor and alternative funding markets. As mentioned before, the baseline case used to calibrate the model corresponds to the situation of China in 2002, when the bank deposit and loan interest rates are exogenously set by the government, so that the bank does not maximize its profit.

Given that the household has to be indifferent between the three possible saving instruments (bank deposits and both types of direct loans to firm), the intermediation costs χ^L and χ^H are tightly related to the prices q_a^L and q_a^H according to the following formula:

$$q_a^j = q_d(1 - \bar{p} + \bar{p}\underline{r}) - \chi^j \qquad \forall j \in \{L, H\} \tag{52}$$

Calibrating χ^L and χ^H is therefore quasi equivalent (taking into account the endogenous changes in $\bar{p}$ and $\underline{r}$) to setting the prices q_a^L and q_a^H at values that allow for an equilibrium on the bank capital and alternative financing markets. By determining the prices q_a^L and q_a^H faced by each type of firms on the alternative financing markets, the household's intermediation costs parameters have a crucial impact on the investment financing decisions of enterprises.

The 7 remaining parameters are adjusted to match the firms' investment financing pattern, from which I need at least 7 moments from the data. Table 7 presents the moments from the data to be matched. Note that these moments are interdependent, since the shares of financing sources for each firm size have to sum up to 100%[21], so that there are actually 8 independent moments to be matched. I include all three sources in the targeted moments to not underweight deviations from target of one specific source.

Table 7: Moments from the data: firms' investment financing

	Small firms	Medium firms	Large firms	Very large
share of retained earnings in investment funding	22%	29%	29%	26%
share of bank loans in investment funding	22%	31%	45%	58%
share of alternative sources in investment funding	56%	41%	26%	16%

The model's moments in terms of financing sources are computed using the firms' stationary distribution and optimal policy functions. Similarly to the data presented in section 1, I build four size categories according to the quantity of labor employed by the firms. 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. Namely, 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. Optimal investment decisions and their financing are computed for each firm, and averaged within size categories. Finally, the operating cost parameter ζ is set so that the bank makes zero profit in this baseline calibration. Given that the bank's surplus is very small, ζ's value is also very small, equal to 0.0030.

[21] It might not exactly sum up to 100% in Table 7 due to rounding.

The calibrated values of the parameters and the corresponding equilibrium prices are presented in Tables 8 and 9 respectively. These values imply that, depending on firms' type, $q_a^L = 0.9901$ and $q_a^H = 0.9132$, so that $q_a^H < q < q_a^L$. As a consequence, the results highlighted in point (ii) of Proposition 1 and point (i) of Proposition 2 always apply for type H firms, meaning that they always marginally prefer to finance investment through bank loans rather than alternative sources. From point (i) of Proposition 1, type H firms also marginally prefer to use retained earnings when their use of alternative financing is already relatively high, while it would apply for type L firms only in extreme cases (which are not observed at the stationary equilibrium). Last, if type L firms are using little alternative financing, they marginally prefer to increase it rather than increasing bank loans (case (ii) of Proposition 2), whereas the opposite is true if alternative financing is more heavily used (case (i) of Proposition 1).

Table 8: Calibrated parameter values

q	β	δ	α	γ	χ^L	χ^H
0.97	0.9923	0.10	0.51	0.30	-0.0143	0.0625
θ	η^L	η^H	ξ	κ	p_0	ζ
0.10	0.01	0.142	0.082	0.25	0.52	0.0030

Table 9: Equilibrium prices

q_a^L	q_a^H	w
0.9901	0.9132	0.80

4.4 Baseline fit

Figure 4 shows the targeted moments from the data (dashed lines) and their match from the model (solid lines) for the share of investment financed by each of the three sources of funding. The calibration manages to reproduce the data's patterns for small to very large firms: small firms use indeed more alternative sources and less bank loans, while large firms use predominantly bank loans to finance their investment.

To assess the fit of the model, I compare further non-targeted moments to the data. The share of firms *not* using one source of funding and the share of firms *using only* one source of funding, are shown in Figure 5. The model is relatively close to some stylized facts from the data, further from some others. For instance, the share of firms not using retained earnings and the share of firms using only bank loans are at levels similar to the data. The share of firms using only alternative sources is decreasing with size as in the data. None of the firms use only retained earnings to finance their investment in the model, due to their high death probability that makes them relatively impatient. Very few enterprises do not use any bank loans to finance their investment. This is related to the debt roll-over mechanism in the model: if a firm is making negative profits, it can roll-over its debt and needs to use some bank loans to finance further access to alternative sources. Hence, every firm rolling over its debt needs to use some bank loans, at least to finance the access cost to alternative sources.

Figure 4: Calibrated moments (data in dashed lines, model in solid lines)

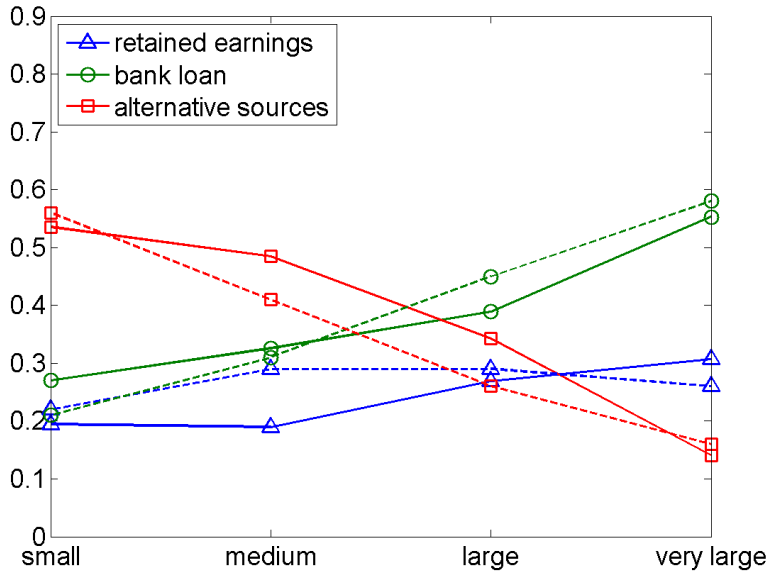
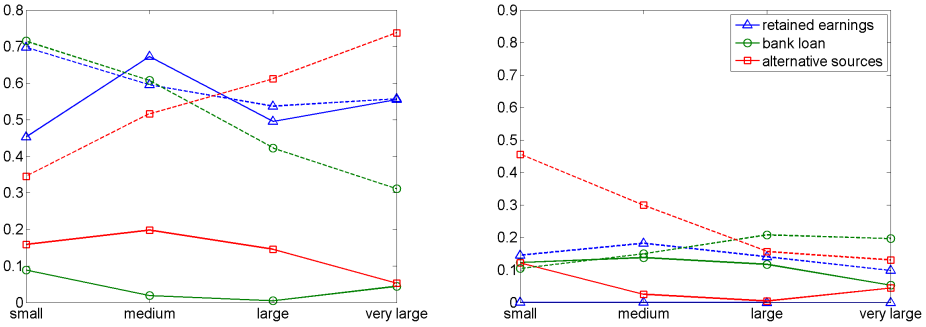


Figure 5: Non-targeted moments (data in dashed lines, model in solid lines)

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



In terms of aggregate characteristics of the economy, I obtain a consumption over GDP ratio equal to 57%, which fits quite well the actual consumption rate in China (60% in 2002, 57% in 2003). Similarly, the investment over GDP ratio generated by the model is 44%, while the investment rate in China was equal to 38% in 2002 and 41% in 2003.[22] The share of firms actually investing is equal to 82%, hence slightly higher than the data where respectively 68% and 70% of the firms invested in 2001 and 2002.[23] Finally, the average leverage of enterprises, defined as the ratio of total assets over equity, is equal to 2.10 at the stationary state, which corresponds quite well to the data (average leverage of 2.00, from the Enterprise Survey).

5 Reforming the credit distribution

5.1 On-going reforms in China

The regulation of the credit distribution sector is a heated topic in China, and reforms are an on-going process since the mid-2000s. They include liberalizing banks' interest rates by modifying their floors and ceilings, inciting state-owned banks to redirect loans from large state-owned firms towards smaller private enterprises, but also tightening the regulation of the non-bank financial institutions and informal lenders. More details on the regulatory evolution of these three aspects are provided below.

First, while interbank and bond rates were liberalized in 1996, the first significant step towards a liberalization of retail interest rates took place in 2004. From September 1999 until October 2004, lending rates were allowed to move between 0.9 and 1.1 times the benchmark rate for loans to large enterprises, and between 0.9 and 1.3 times the benchmark rate for small and medium enterprises. For deposit rates, banks had to strictly comply with the ceiling and floor rates. On its way towards a credit market liberalization, the Chinese government first suppressed the ceiling rates for bank loans and the floor rates for bank deposits in 2004, allowing banks to increase their intermediation margin by increasing lending rates or decreasing deposit rates. By maintaining the floor and ceiling for loans and deposit rates respectively, the Chinese authorities limit competition across banks to attract borrowers and depositors, and ensure that banks keep a sufficient profit margin. More recently, banks have also been allowed to set deposit rates 10% higher than the benchmark rate in June 2012, and this limit was progressively increased to 50% higher between November 2014 and May 2015. The full liberalization of interest rates is still an open process.

Second, "window guidance" is still an important tool for monetary policy in China. The People's Bank of China (PBC) meets every month with commercial banks and gives written or oral directives in terms of amount of credit distributed as well as loans beneficiaries, depending on their characteristics in terms of industrial sector, size, or even polluting emissions. The PBC started mentioning SME in its quarterly reports (*China Monetary Policy Report*) in 2004, stating its intention to "[promote] financial institutions to increase their support for SMEs and [curb] usury"[24] along with the loosening of the retail interest rates fluctuation bands. However, we have to wait until the spread of the financial crisis and the fourth quarter of 2008 to see some important

[22] Source: World Bank WDI Database.
[23] Source: Enterprise Survey.
[24] *China Monetary Policy Report*, Quarter Three, 2004.

evolution, with the publication of the *Notice on Perfecting the Management of the Rediscount Business and Increasing Agro-linked Loans and Financing to SMEs*. From 2009 on, the PBC monitors specifically the evolution of the amount lent by commercial banks to SME. Defined by the PBC as an objective for Chinese banks, loans to SME start increasing significantly, and their share across total loans raises despite the general increase in credit in China due to the stimulus package launched in November 2008.[25] From 2012 on, the focus of the PBC narrows towards small and micro-enterprises, to which bank loans are strongly encouraged.

Third, the regulation of financial intermediation has been debated and tightened over the last few years. As mentioned before, the monetary authorities state their intention to "curb usury" in the *China Monetary Policy Report* from 2004. Furthermore, the opportunities for non-bank financial institutions to attract funds from Chinese households are more supervised, as well as the sale to households of more remunerating trust assets through the intermediation of banks. The links between banks and trust companies, for instance, have been clarified either through the repatriation of off-balance-sheet assets into the banks' balance sheets, or through a clearer separation between banks and trust entities. These regulatory changes render access to credit more difficult for enterprises that do not manage to obtain bank loans.

5.2 Reforms' counterpart in the model

In this context, my model allows to conduct policy experiments by modifying the functioning of the credit distribution sector. To investigate the impact of various possible policies, I compare the stationary equilibrium of the baseline model calibration to the stationary equilibria reached after various reforms. The following changes can be implemented, simultaneously or separated:

(i) *Interest rates*: I assume perfect competition, meaning that the representative bank can maximize its profit by choosing the amount of deposits it demands and the amount of loans it supplies, taking the deposit and lending rates as given. Bank's interest rates are then fully liberalized. Instead of being exogenously set by the government, they adjust to reach the equilibrium on the bank deposits and loans markets, given the household's deposit supply and the firms' loan demand. This reflects the on-going liberalization of interest rates in the banking sector.

(ii) *Window guidance*: to take into account the change in incentives given to commercial banks, I relax the collateral constraint faced by enterprises. Thus, banks are able to channel more funds to small enterprises. The extent to which this constraint is relaxed is determined to match the change in the bank lending rate between 2004 and the end of 2007.

(iii) *Non-bank financial intermediation*: I consider experiments where the alternative financing sector is shut down, which is an extreme case of tighter regulation. Since the alternative sources of funds in my model correspond both to family and friends ("cheap" alternative financing, accessible to type L firms) and to external investors ("expensive" alternative financing, accessible to type H firms), I also consider shutting down only "expensive" alternative finance. Indeed, the regulator may not wish to ban contributions to investment financing

[25] Loans granted to small enterprises increased by 41% in 2009, 29% in 2010, 26% in 2011 and 17% in 2012 according to the PBC monetary reports. Their growth was respectively 16, 14 and 8 percentage points faster than loans to large enterprises in 2010, 2011 and 2012.

from family and friends, but only to prevent moneylenders and further intermediaries to take advantage of cash-starved enterprises.

Reforms scenarios

Given these reforms possibilities, four different scenarios are considered, as detailed below. Since the bank's operating cost parameter ζ is set to ensure that bank's profits are zero, the baseline scenario is already at equilibrium and simply liberalizing the interest rates would not induce any change. I therefore always consider a global liberalization of the banking sector, that includes both a loosening of the collateral constraint[26] and a liberalization of the interest rates.

a. For comparison, I study the impact of interest rate liberalization and collateral constraint loosening in the case where alternative financing does not exist neither before nor after the reform;

b. Starting from the baseline case where alternative finance is fully accessible, the banking sector is liberalized, while the regulation of alternative sector remains stable, so that the alternative financing sector remains fully accessible;

c. The third scenario examines the effect of a liberalization the banking sector, when the entire alternative sector is simultaneously shut down, so that enterprises can use alternative financing before the reform but not any more after the reform.

d. In this last scenario, the banking sector is liberalized, while only the expensive alternative sector is shut down. This means that type L firms maintain their access to alternative financing sources throughout the policy experiment, while type H firms loose the possibility to use alternative financing after the reform. This scenario corresponds most closely to the aim of the Chinese government to curb usury.

Bank's profit maximization

As presented in section 3.2, the program of the bank is linear in the amount of deposits $q_d D$ taken and loans qB granted, and the bank faces the solvency constraint $qB \leq q_d D$. Hence, maximizing this program yields some equality relationships between interest rates and further parameters, equalities that need to be verified in order to avoid a corner solutions (in terms of loans supply or deposits demand). There are two possible solutions to the bank's program:

(i) If both deposits and loans are costless for the bank, meaning that $q_d = \frac{1}{1-\zeta}$ and $q = \frac{1-\bar{p}+\bar{p}\underline{r}}{1+\zeta}$. In this case, the bank is indifferent regarding the amount of deposits and loans it has, and the solvency constraint is not binding. Since $q_d \in (0,1)$, this can never be the case unless $\zeta = 0$ and $q_d = 1$. The calibrated value of ζ being 0.0030, this case does not occur here.

(ii) Since $\zeta > 0$, holding deposits is always costly for the bank, and the solvency constraint will always bind, so that $qB = q_d D$. In this case, profit maximization brings the following relationship between q and q_d:

$$q = \frac{(1 - \bar{p} + \bar{p}\underline{r})q_d}{1 + 2\zeta q_d} \tag{53}$$

[26] Given the calibration obtained in section 4, the parameter θ is increased from 0.1 to 0.292. This increase is designed to reproduce the change in bank lending real rates in China between 2003 and the end of 2007, up from 3.09% to 3.58%.

This equality is necessary to rule out corner solutions and implies that the bank makes zero profit at each period.

The solution that is relevant here is case (ii). Given that the bank's profits are zero, any amount of deposits and loans such that $q_d D = qB$ is a solution to the bank's program, and loans and deposits are determined by the firms' and household's programs respectively. From the household's program, the deposits price q_d has to be equal to the discount rate β to ensure the existence of a non-zero steady state wealth level. This means that the loan price q has to adjust according to equation (53), given the average default rate and reimbursement of enterprises, to ensure that the bank's profit is zero.

5.3 Results

After solving for the stationary equilibrium in scenarios *a.* to *d.*, I analyze the impact of the reforms in each case by comparing the aggregate economy, equilibrium prices and the average development path of an individual newborn firm before and after the reform. I also examine the development of newborn firms by simulating the path of a newborn firm with little capital and various initial productivity levels for a very large number of firms[27]. The average path for production, capital and investment is then obtained by averaging across firms.

Presence of alternative finance

Before studying in details the impact of the reforms, it is useful to have in mind the impact of the presence of alternative finance. Comparing the baseline case (where interest rates are not liberalized and the collateral constraint for bank loans is tight) to a similar situation without alternative finance yields the following results. The presence of alternative finance, by relaxing the credit constraints faced by the enterprises, increases the aggregate production, consumption and capital by 6.6%, 6.2% and 8.0% respectively. At the level of individual enterprises, alternative financing opportunities fasten the growth of small newborn enterprises' capital by respectively 11 to 129 percentage points. Similarly, the growth of newborn enterprises' production is 10 to 41 percentage points faster, depending on their initial productivity. Alternative finance has therefore a non-negligible impact on both aggregate variables and enterprise dynamics, and strongly contributes to alleviate credit constraints.

Impact on the aggregate economy

Turning to the impact of credit sector reforms, results for the various scenarios considered are presented in Table 10. At the bottom of Table 10, the numbers presented correspond to the difference in terms of the average growth paths of newborn firms for production and capital, during the first 6 periods of their life.

Except when alternative finance is fully or partially shut down (scenarios *c.* and *d.*), the banking sector liberalization has a clear positive effect. Overall, the impact of liberalization is influenced

[27] The simulations presented here are done for 20000 firms for each possible initial productivity level. A sequence of productivity shocks is drawn for each simulated firm; the optimal investment decisions and resulting production and capital accumulation are then computed given these shocks, for each firm.

Table 10: Impact of banking sector liberalization, for different scenarios

	Initial level	Change, with Alternative Financing Sector: Never allowed *scenario a.*	Always allowed *scenario b.*	Shut down *scenario c.*	Partially shut down *scenario d.*
Aggregates					
Production	8.58	5.34 %	5.47 %	-0.75 %	5.61 %
Capital	20.37	9.54 %	9.91 %	2.43 %	11.11%
Consumption	4.90	4.02 %	3.10 %	-1.08 %	3.05 %
Prices					
Bank lending rate	3.09	+0.19	+0.49	-1.54	+0.06
Low alternative rate	1.00	-	+0.50	-	+0.06
High alternative rate	9.50	-	+0.57	-	-
Wage	0.80	5.48 %	5.41 %	-0.6 %	5.62 %
Firms' path					
New-born average production growth	-	0.5 to 4.6 % pts	-1.6 to 6.9 % pts	-36.8 to -9.8 % pts	-13.6 to 1.3 % pts
New-born average capital growth	-	0.7 to 8.6 % pts	-0.7 to 13.3 % pts	-120.1 to -10.1 % pts	-22.9 to 2.4 % pts

by (i) the presence of alternative finance; (ii) general equilibrium effects: prices increase in most scenarios.

Importance of alternative finance. Aggregate production, consumption, and capital increase in all scenarios except scenario *c.*. As shown in scenario *a.*, a naive view of the Chinese economy, not taking into account the presence of alternative financing sources, would overstate the positive impact of the liberalization in terms of consumption. When estimating the potential impact of liberalization reforms, it is therefore useful, as in scenario *b.*, to account for alternative financing sources, which allow firms to bypass credit constraints and make the impact of liberalization less stringent. A liberalization of the banking sector increases aggregate production by 5.34% in the absence of alternative finance, which is similar to the production increase of 5.47% when alternative finance is taken into account. The aggregate capital increase resulting from the liberalization is also similar whether alternative finance is included or not in the model. However, and most importantly for a policy maker, the change in consumption decreases from 4.02% to 3.10%, strongly reducing the welfare implications for households. Furthermore, the development implications for small young firms are more heterogeneous when alternative finance is available.

Scenario *c.*'s results may seem surprising: while aggregate capital increases, production decreases slightly. This is due to two effects: first, the strong drop in the bank loan rate and the relaxation of the collateral constraint favors a higher level of capital – though far from the increase seen n scenario *b.*. However, financial constraints are still present in this scenario, and alternative financial sources cannot be used any more to alleviate them. Hence, aggregate capital is higher, but its allocation is worse, as is shown by the increase in the dispersion of the marginal productivity of capital across firms, from 0.142 to 0.157. As a consequence, the aggregate production decreases, and so does aggregate consumption. This scenario confirms the importance of alternative finance in alleviating resource misallocations and improving aggregate welfare.

General equilibrium effects. The impact of banking sector reforms is about half smaller than in a partial equilibrium situation where all prices were fixed. In scenario *b.*, aggregate production increases by 5.5% instead of 14.8%, while aggregate capital increases by 9.9% instead of 20.7%. This is due to a general increase in all prices following the reforms, for which I explain the intuition below. There are two mechanisms impacting directly the bank lending rate. First, due to the relaxed collateral constraint, firms' demand for bank loans increases, driving up the prices. Second,

in terms of loan riskiness, the liberalization slightly decreases the average default probability of enterprises since firms may more easily roll-over small amounts of debt. However, since they may also borrow higher amounts, the share of debt they are able to reimburse in case of default decreases, so that the expected loan return slightly decreases. To compensate for these two changes, the interest rate of bank loans increases. This second mechanism is also valid for alternative sources, and drives up both alternative interest rates too. Last, given their higher capital level, enterprises also demand more labor, causing a rise in the wage since the labor supply is fixed. This results in an increase in all prices, in particular the type H alternative financing (when available), that raises by 0.57 percentage points.

Impact on the demand for bank loans

Having a closer look at the change in firm borrowing behavior in terms of bank loans helps us understand the mechanisms behind reforms' impact. Focusing on scenario *b.*, the liberalization, through the loosening of the collateral constraint, causes a strong increase in the total amount of bank loans distributed (multiplied by 2.2). In terms of extensive margin, the quantitative impact on bank borrowing is relatively small and, if anything, tends to decrease the total amount borrowed from banks. Only 5.5% of the firms that were not using bank loans before start using it after the reforms – most of them being small and medium-sized firms – and they account for only a negligible part of total bank borrowing. A similarly low impact is due to enterprises that would have defaulted without the liberalization, and are now able to roll over their debt: they account for less than 1% of total bank borrowing after the reform, most of it coming from medium or larger enterprises. Finally, due to the increase in the bank lending rate, some firms actually stop borrowing from banks, relying only on retained earnings and alternative finance. These firms were responsible for more than 2% of borrowing before the liberalization. The large majority of the increase in bank borrowing is at the intensive margin. Indeed, firms that were already borrowing before and keep on borrowing account for 99% of total borrowing after the reform. Many of them were constrained by the collateral requirement and increase the size of their bank loan despite the interest rate rise. This intensive margin effect strongly overcomes the extensive margin slight decrease.

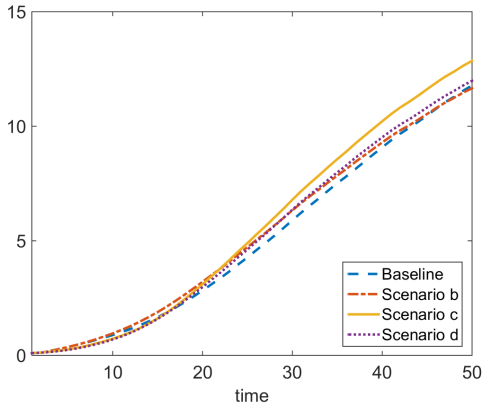
Impact on small, new-born enterprises

In scenarios *a.* and *b.*, newborn firms with a low level of capital and a high enough productivity are strongly benefitting from liberalization. Indeed, it increases their average production growth over the first 6 years by up to 7 percentage points in scenario *b.*. By alleviating the credit constraints before the liberalization, alternative financing reduces the reforms' impact on production for less productive firms. For more productive firms, the availability of alternative finance combines with the liberalization to produce a stronger impact.

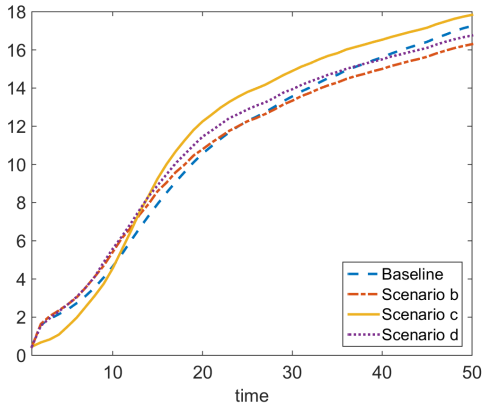
The importance of alternative finance for small firms is also emphasized in scenarios *c.* and *d.*: liberalizing the banking sector cannot compensate for a tight regulation of the alternative financing sector, and newborn enterprises grow much slower, both in terms of production and capital, when their access to alternative finance is shut down. The speed of development of newborn firms decreases by up to 37% and 120% for production and capital respectively in scenario *c.*. This is also true for aggregate production and consumption. This result implies that the regulation of the

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

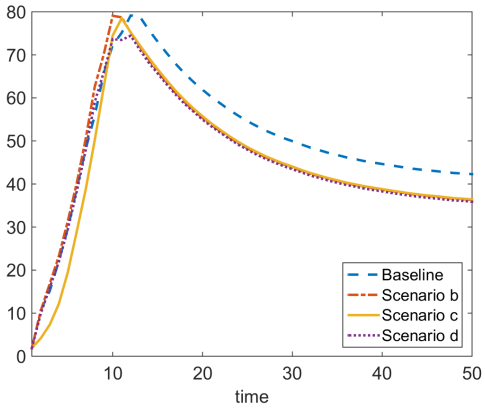
(a) Low initial productivity



(b) Medium initial productivity



(c) High initial productivity



non-bank financial sector should be accompanied by making the banking sector function on a more competitive basis, but should also be mild enough not to penalize small firms too strongly.

In scenario *d.*, only type H enterprises do not have access to alternative finance. Depending on their initial productivity, newborn firms are differently affected by the reform: enterprises with a high initial productivity level are more penalized by the tighter regulation of alternative finance, because they optimally would want to invest more. On the opposite, enterprises with a low initial productivity gain from the reform of scenario *d.*, since they are able to invest enough using bank loans.

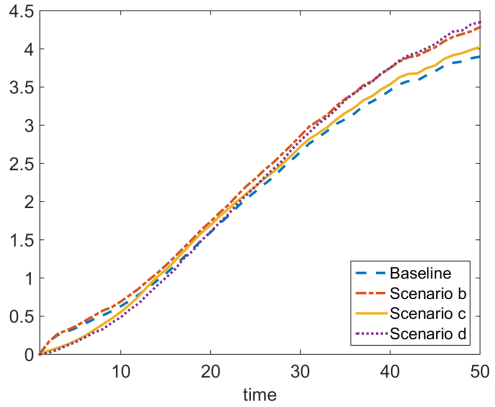
This analysis is further illustrated by Figures 6 and 7. The blue dashed lines in both figures show, in the baseline calibration, the average production and investment of newborn firms starting with various initial levels of productivity. The red dashed-dotted line corresponds to scenario *b.* (liberalization of the banking sector, no change in alternative finance), while the yellow solid line represents scenario *c.* (liberalization of the banking sector and closing of the alternative sector) and the purple dotted line shows scenario *d.* (liberalization of the banking sector and closing on the expensive alternative sector only). The overshooting of production observed in Figure 6c is

related to the very high initial productivity level of enterprises: their initially high production decreases after about 10 years, when their productivity shock goes back to its steady state average level. In scenarios *b.* and *d.*, the liberalization allows newborn firms' production to grow somewhat faster towards their steady state level, especially for firms starting with a medium productivity. Similarly, firms starting with a high productivity reach both their peak of production and their long-term average production level earlier in scenario *b.*.

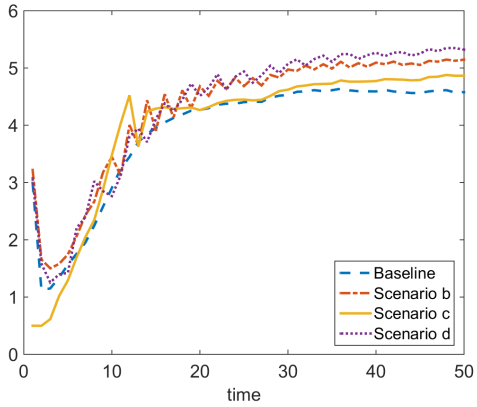
A ban of the alternative financing sector is more detrimental to firms with a high initial productivity, since their suboptimal level of investment implies a larger loss in terms of production during the first 10 periods. (see Figure 6c). In scenario *c.*, firms clearly have a lower level of production for the first periods. We can notice that allowing access to L type alternative finance (scenario *d.*) almost restaures the production curve to the level of scenario *b.* (with all alternative sources allowed), meaning that most of the impact of alternative financing is coming from the "cheap" alternative.

Figure 7: Average investment path of a new-born firm starting with low capital

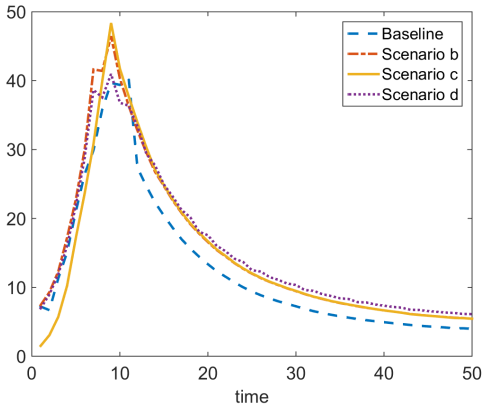
(a) Low initial productivity



(b) Medium initial productivity



(c) High initial productivity



As shown in Figure 7, for firms with a low or medium initial productivity, investment is lower in the baseline calibration and in scenario *c.* compared to scenario *b.*. This is the case both in the very

first years, and later on, when the steady state is reached. Similarly to production, investment in scenario *d.* is almost equal to scenario *b.*, confirming the importance of cheap alternative financing options, even if only half of enterprises have access to it given the calibration.[28] We can also observe that high productivity firms delay their investment in scenario *c.* because of financial constraints, thus having a lower level of investment over the first 10 periods. After around 15 to 20 periods periods, all liberalization scenarios show a higher level of investment, which is consistent with their higher level of aggregate capital. We can also observe on Figure 7c that the peak of investment is delayed by about one year in the baseline scenario: the firms have to comply with the bank's collateral constraint and to pay alternative finance's access cost, which forces them to delay investment. However, given that the productivity progressively decreases back to its steady state level, delayed investment does not fully take place later on. Therefore the level of the investment peak in the baseline case is lower, as firms' investment plans adjust to their new productivity shock.

Impact on capital allocation

Despite the increase in capital, production and consumption, the average value of firms slightly decreases in scenario *b.*. Indeed, the discounted stream of dividends is lowered by the increase in all prices. It is less so for type H enterprises and smaller-sized enterprises as they benefit more from the reform in terms of access to finance, and see a smaller decrease in their value. The changes in marginal productivity of capital (MPK) can help evaluating the evolution of capital misallocations. All enterprises see their MPK decrease, which is logical since they invest more. The changes in MPK are fairly similar across firm size, whereas H type firms tend to see their MPK decrease relatively more than L type firms. This confirms that type H enterprises benefit more from banking sector reforms. In terms of dispersion, the standard error of MPK slightly decreases with the reforms, from 0.1420 to 0.1369, which shows once again that capital is better allocated after the reforms.

Conclusion

This paper studies the access to investment funding for Small and Medium Enterprises and the importance of alternative financing sources – namely non-bank, non-retained earnings sources – in a context of banking sector liberalization. These alternative sources include family and friends, non-listed equity and various types of informal lending institutions. The model set-up focuses on the choice of investment financing by heterogeneous enterprises facing a collateral constraint, idiosyncratic productivity shocks and different costs of access to alternative sources of funding. Embedding the firm's side into a general equilibrium model, I quantify the impact of a reform of the credit distribution sector in China, including the liberalization of bank interest rates, the modification of banks' incentives to lend and the regulation of alternative finance.

The model is more specifically tailored to the situation in China at the start of the 21^{st} century where, as shown by firm-level surveys, smaller firms are facing tighter credit constraints than large ones and resort to retained earnings or further alternative sources to finance their investment. I solve for the stationary equilibrium and calibrate the parameters so as to reproduce stylized facts

[28] The share of L type firms is 0.52, see Table 8.

from Chinese data. Using this calibrated model as a benchmark, I show that a liberalization of the banking sector towards more competition among banks for loans and deposits is beneficial to the economy. It indeed increases both the aggregate production and consumption, and improves the development speed of newborn enterprises. By alleviating the credit constraints faced by enterprises, alternative finance also reduces the impact of the liberalizing reforms compared to a "naive" view where alternative finance would not be accounted for. A liberalization of the banking sector increases aggregate production and consumption respectively by 5.5% and 3.1%. It also speeds up the growth of newborn enterprises by up to 7 percentage points in terms of production and 13 percentage points in terms of capital accumulation.

Simultaneously tightening the regulation of alternative finance, on the opposite, would diminish —but not cancel —the benefits of the liberalization in terms of aggregate consumption. It would however be strongly detrimental to younger, smaller firms, reducing their access to credit and their investment, and slowing down their growth by up to 14 and 23 percentage points in terms of production and capital respectively.

From this exercise, we can conclude that the availability of alternative funding allowed Chinese firms to partially bypass credit constraints, and to develop faster in terms of capital size and production, hence favoring a higher long-run aggregate level of capital and production. A liberalization of the banking sector, by easing access to credit and favoring investment, would beneficiate to all enterprises, especially small, high productive ones. Results also show that non-banking credit institutions should be regulated carefully. If not conducted in parallel to a reform of the Chinese banking system, tightening the regulation of alternative funding institutions could undermine the dynamism of younger firms unable to obtain formal bank loans. China has been progressively liberalizing retail bank interest rates since 2004, and the final steps of this liberalization process are still an open debate. This paper shows that such a liberalization is beneficial and necessary before regulating too tightly the alternative financing sector.

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Appendix

A Tables

Table 11: Descriptive statistics comparing the composition of 2002 and 2003's samples of the Enterprise Survey - China

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

		foreign	private	collective	soe
Internal/retained earnings		31.52	24.21	33.67	19.83
Banks	Local banks	22.64	28.83	41.85	52.89
	Foreign-owned banks	0.34	0.23	0.00	0.00
	Special development financing	2.41	0.51	0.00	2.19
Alternative	Family, friends	3.62	11.69	6.67	1.19
	Equity, sale of stock to employees	5.17	5.65	0.00	1.27
	Equity, sale of stock to legal-persons	17.98	13.41	15.70	8.17
	Informal sources	2.59	3.02	0.00	3.41
	Trade credit	5.74	1.66	0.00	0.04
Equity, public issue of marketable share to outside investors		1.72	2.12	0.00	1.91
Others		6.26	8.66	2.11	9.11
Observations		58	630	27	124

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

Table 13: Sources of funding for new investment (% of total new investment), by firm sales , across private firms

		Very Small	Small	Medium	Large
Internal/retained earnings		19.23	21.31	28.77	26.34
Bank	Local banks	19.38	25.35	30.15	39.25
	Foreign-owned banks	0.06	0.00	0.76	0.00
	Special development financing	0.79	0.62	0.56	0.11
Alternative	Family, friends	22.43	15.34	9.01	1.34
	Equity, sale of stock to employees	6.88	8.66	4.43	3.57
	Equity, sale of stock to legal-persons	17.49	12.88	12.95	10.29
	Informal sources	4.26	2.20	3.98	1.38
	Trade credit	1.33	2.23	0.39	2.92
Equity, public issue of marketable share to outside investors		0.18	0.83	1.40	5.74
Others		7.96	10.59	7.60	9.08
Observations		164	121	178	167

Table 14: Sources of funding for new investment for Germany in 2005, by firm size (in terms of employment)

		All	Small	Medium	Large	Very large
Internal/retained earnings		50.73	53.81	43.52	35.01	24.55
Banks	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
	Investment funds	0.50	0.43	0.33	1.38	0.00
Alternative	Family, friends	0.83	0.99	0.16	0.32	0.00
	Informal sources	0.00	0.00	0.00	0.00	0.00
	Trade credit	4.17	4.25	5.53	2.39	0.00
	Credit card	0.89	0.96	0.90	0.37	0.00
Equity, sale of stock		9.33	9.01	8.98	11.29	20.91
Leasing		10.85	10.49	12.62	12.50	5.45
Others		0.05	0.06	0.00	0.00	0.00
Observations		1177	935	122	109	11

Table 15: Sources of funding for new investment for India in 2005, by firm size (in terms of employment)

		All	Small	Medium	Large	Very large
Internal/retained earnings		52.30	51.73	56.89	48.89	38.87
Bank	Local banks	31.46	27.49	36.86	39.46	55.04
	Foreign-owned banks	0.87	0.75	0.92	1.69	3.75
Alternative	Family, friends	6.97	9.17	2.33	2.89	0.00
	Informal sources	0.60	0.75	0.09	0.28	0.00
	Trade credit	4.53	6.35	1.16	2.57	1.67
	Credit card	0.87	1.30	0.11	0.32	0.00
Equity, sale of stock		1.10	1.00	1.13	2.36	0.67
Leasing		0.93	1.19	0.48	0.18	0.00
Others		0.36	0.26	0.03	1.38	0.00
Observations		1468	918	320	109	24

Table 16: Sources of funding for new investment for Colombia in 2006, by firm size (in terms of employment)

		All	Small	Medium	Large	Very large
Internal/retained earnings		33.01	31.52	39.96	74.85	52.67
Bank	Private banks	35.93	35.87	40.32	11.14	47.33
	State-owned banks	7.15	7.77	2.41	0.42	0.00
Alternative	Family, friends	9.88	11.09	0.11	0.00	0.00
	Debt	0.19	0.13	0.48	1.76	0.00
	Informal sources	0.63	0.64	0.49	0.84	0.00
	Trade credit	9.78	10.67	3.10	0.08	0.00
	Non-bank financial institutions	1.38	0.72	6.16	10.92	0.00
Equity, sale of stock		0.36	0.03	3.58	0.00	0.00
Others		1.70	1.56	3.37	0.00	0.00
Observations		559	404	122	25	8

Table 17: Sources of financing: share (%) of enterprises declaring not using one financing source, or using only one finance source, by ownership status

		All	Foreign	Private	Collective	SOE
not using (0%)	internal/retained earnings	61.61	56.14	60.26	59.26	71.54
	bank loans	52.47	63.16	55.93	48.15	30.89
	alternative	56.80	57.89	51.44	70.37	80.49
using only (100%)	internal/retained earnings	20.10	33.33	19.23	25.93	17.07
	bank loans	27.56	19.30	22.76	37.04	53.66
	alternative	26.35	28.07	29.17	18.52	13.01
	observations 831	57	624	27	123	

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

		Very Small	Small	Medium	Large
not using (0%)	internal/retained earnings	73.17	64.17	51.70	53.66
	bank loans	71.95	62.50	52.27	39.02
	alternative	34.15	43.33	56.82	68.90
using only (100%)	internal/retained earnings	16.46	19.17	21.02	20.12
	bank loans	15.24	21.67	23.30	30.49
	alternative	48.17	32.50	21.59	15.85
	observations	164	120	176	164

Table 19: Bank loans requirements and applications, by ownership status (% of firms)

		Foreign	Private	Collective	SOE
if having a loan, was collateral needed?	Yes	53.10	58.55	64.41	61.89
if did not apply for a loan, is it because of collateral requirements?	Yes	23.91	27.57	15.09	22.42
if application rejected, was it because of lack of collateral?	Yes	66.67	71.71	56.25	66.67

Table 20: Bank loans requirements and applications, by sales (% of private firms)

		Very Small	Small	Medium	Large
if having a loan, was collateral needed?	Yes	43.72	49.28	63.84	74.27
if did not apply for a loan, is it because of collateral requirements?	Yes	25.86	32.43	26.80	24.72
if application rejected, was it because of lack of collateral?	Yes	71.15	71.70	77.42	62.50

Table 21: Average interest rate and collateral required for bank loans, by firm's status

	Foreign mean	Private mean	Collective mean	SOE mean
interest rate	5.01	5.29	5.65	5.58
collateral (% of loan)	80.03	84.58	71.30	85.38
Observations	49	456	30	129

Table 22: Average interest rate charged on bank loans, by sales

	Very Small mean	Small mean	Medium mean	Large mean
interest rate	5.74	5.42	5.14	5.17
collateral (% of loan)	96.30	79.20	84.85	82.04
Observations	70	86	144	156

Table 23: Average interest rate and collateral required for bank loans, by amount invested (in thousand yuan)

	0-100 mean	100-1000 mean	1000-10000 mean	>10000 mean
interest rate	5.35	5.50	5.13	5.18
collateral (% of loan)	90.72	88.18	83.65	77.61
Observations	59	122	115	60

Table 24: Depreciation rates estimated or assumed by various studies

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%	India, industry
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

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 (see Table 24 in Appendix A). 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.

B Proofs

B.1 Proof of Proposition 1

Proof. First, I demonstrate the Lemma 1 below, as it will be useful for the proof.

Lemma 1. *The value function $V(A, k, d; j)$ is increasing with capital k and decreasing with debt d: $\frac{\partial V(A,k,d;j)}{\partial k} \geq 0$ and $\frac{\partial V(A,k,d;j)}{\partial d} \leq 0$.*

Proof of the Lemma. Using the envelop theorem, tt is easy to derive the partial derivatives of the value function is the following three cases:

Table 25: Estimation of the production function coefficients with OLS and fixed effects

	Least squares		Fixed effects	
	(1)	(2)	(3)	(4)
	All	All	All	All
labor	0.33***	0.36***	0.33***	0.35***
	(0.0323)	(0.0320)	(0.0563)	(0.0567)
capital	0.52***	0.53***	0.39***	0.37***
	(0.0183)	(0.0181)	(0.0406)	(0.0424)
age		-0.019***		0.031**
		(0.00221)		(0.0151)
Constant	5.99***	5.83***	7.90***	7.80***
	(0.199)	(0.197)	(0.662)	(0.664)
N	1888	1885	1888	1885

Standard errors in parentheses

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

- Positive dividends:

$$\frac{\partial V^{ND}}{\partial k} = (1+\mu)\alpha A k^{\alpha-1} l^{\gamma} + \lambda\theta > 0 \tag{54}$$

$$\frac{\partial V^{ND}}{\partial d} = -1 - \mu < 0 \tag{55}$$

- Positive profits, zero dividends:

$$\frac{\partial V^{ND}}{\partial k} = \nu\alpha A k^{\alpha-1} l^{\gamma} + \lambda\theta \geq 0 \tag{56}$$

$$\frac{\partial V^{ND}}{\partial d} = -\nu \leq 0 \tag{57}$$

- Negative profits:

$$\frac{\partial V^{ND}}{\partial k} = \zeta\alpha A k^{\alpha-1} l^{\gamma} + \lambda\theta \geq 0 \tag{58}$$

$$\frac{\partial V^{ND}}{\partial d} = -\zeta \leq 0 \tag{59}$$

Given that the value function in case of default is always equal to zero, this implies the result of Lemma 1.

Let us now turn to the proof of Proposition 1. From equations (24) and (25), I define the marginal benefit of investing (the same for all sources of funding) as:

$$B_m(b') = B_m(a') = B_m(e') = \frac{\partial EV}{\partial k'} \tag{60}$$

Focusing on the case where the firm distributes positive dividends, I then examine the marginal

cost of investment depending on the financing source:

$$C_m(e') = \frac{1+\mu}{\beta(1-\xi)} \tag{61}$$

$$C_m(b') = \frac{\lambda}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial EV}{\partial d'} \tag{62}$$

$$C_m(a') = \frac{x^{j\prime}(a')(1+\mu)}{q_a^j \beta(1-\xi)} - \frac{1}{q_a^j}\frac{\partial EV}{\partial d'} \tag{63}$$

(i) *Comparing retained earnings and alternative financing.*

$$C_m(a') - C_m(e') = \underbrace{\frac{1+\mu}{\beta(1-\xi)}}_{\geq 0}\left(\frac{x^{j\prime}(a')}{q_a^j} - 1\right) - \frac{1}{q_a^j}\underbrace{\frac{\partial EV}{\partial d'}}_{\leq 0} \tag{64}$$

$q_a^j - x^{j\prime}(a') < 0$ implies that $C_m(a') \geq C_m(b')$, which gives us the result that retained earnings are marginally preferred to alternative financing.

(ii) *Comparing bank loans and alternative financing.*

$$C_m(a') - C_m(b') = \underbrace{\frac{x^{j\prime}(a')(1+\mu)}{q_a^j \beta(1-\xi)}}_{\geq 0} - \frac{\lambda}{\beta(1-\xi)} + \left(\frac{1}{q} - \frac{1}{q_a^j}\right)\underbrace{\frac{\partial EV}{\partial d'}}_{\leq 0} \tag{65}$$

When the collateral constraint does not bind ($\lambda = 0$) and $q \geq q_a^j$, we clearly have $C_m(a') \geq C_m(b')$.

These results shows both points (i) and (ii) of Proposition 1. □

B.2 Proof of Proposition 2

Proof. Similarly to the proof of Proposition 1, I define the respective marginal cost and benefits of investment financed by various sources. Note that when the firm distributes zero dividends, it does not want to marginally increase its retained earnings, since it has already used all its profits (if any) to invest through retained earnings or alternative sources. Hence I only compare the marginal costs and benefits of bank loans and alternative financing. The marginal benefit of investing is the same for both sources:

$$B_m(b') = B_m(a') = \frac{\partial EV}{\partial k'} \tag{66}$$

To study the marginal costs, I separate across two cases depending on the sign of the firm's profits.

(i) *Case of positive profit and zero dividends.* The marginal costs of bank loans and alternative financing are respectively:

$$C_m(b') = \frac{\lambda - \nu}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial EV}{\partial d'} \tag{67}$$

$$C_m(a') = \frac{x^{j\prime}(a')}{\beta(1-\xi)(q_a^j - x^{j\prime}(a'))} - \frac{1}{q_a^j - x^{j\prime}(a')}\frac{\partial EV}{\partial d'} \tag{68}$$

$$C_m(a') - C_m(b') = \underbrace{\frac{x^{j\prime}(a')}{\beta(1-\xi)(q_a^j - x^{j\prime}(a'))}}_{\geq 0} + \frac{\nu - \lambda}{\beta(1-\xi)} + \left(\frac{1}{q} - \frac{1}{q_a^j - x^{j\prime}(a')}\right) \underbrace{\frac{\partial EV}{\partial d'}}_{\leq 0} \quad (69)$$

Here I consider only the case where $q_a^j - x^{j\prime}(a') > 0$. Indeed, remember that tomorrow's capital is given by: $k' = (1-\delta)k + qb' + q_a^j a' + profit - x^j(a')$. If $q_a^j - x^{j\prime}(a') \leq 0$, tomorrow's capital is decreasing with alternative sources, and the firm will never find it optimal to use alternative sources to finance investment. When the collateral constraint does not bind ($\lambda = 0$), having $q \geq q_a^j - x^{j\prime}(a')$ implies that $C_m(a') \geq C_m(b')$. Since the cost function $x^j(.)$ is convex, assuming that $q \geq q_a^j - x^{j\prime}(a')$ is equivalent to assuming that $a' \geq \underline{a}$, where $\underline{a}$ is defined by $x^{j\prime}(\underline{a}) = q_a^j - q$.

(ii) *Case of negative profits.* Here again, we can compute the marginal costs of bank loans and alternative sources.

$$C_m(b') = \frac{\lambda - \nu - \zeta}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial EV}{\partial d'} \quad (70)$$

$$C_m(a') = \frac{x^{j\prime}(a')}{\beta(1-\xi)(q_a^j - x^{j\prime}(a'))} - \frac{\zeta}{\beta(1-\xi)} - \frac{1}{q_a^j - x^{j\prime}(a')}\frac{\partial EV}{\partial d'} \quad (71)$$

$$C_m(a') - C_m(b') = \underbrace{\frac{x^{j\prime}(a')}{\beta(1-\xi)(q_a^j - x^{j\prime}(a'))}}_{\geq 0} + \frac{\nu - \lambda}{\beta(1-\xi)} + \left(\frac{1}{q} - \frac{1}{q_a^j - x^{j\prime}(a')}\right) \underbrace{\frac{\partial EV}{\partial d'}}_{\leq 0} \quad (72)$$

This gives us the same result as for positive profit and zero dividends, and Proposition 2 is obtained by combining the two cases.

□

C General equilibrium with heterogeneous households

I detail below a version of the general equilibrium model with heterogeneous households instead of a representative one. Using heterogeneous households with a wealth distribution allows to avoid some shortcuts that are necessary in the representative household version, namely:

- Households do not have to be indifferent between saving and consuming, which frees the bank deposit rate for the liberalization experiment;
- Households can hold risky assets, and bear to cost of firms' default if lending directly to them;
- Households do not have to be indifferent between the saving instruments to avoid corner solutions, since the bank loans are risk-free while the direct loan to the firms is risky.

The subsequent changes in the general equilibrium set-up are described in sections C.1 to C.3 of this appendix.

C.1 Program of the heterogeneous households

The households are heterogeneous and go through the life cycle as young workers and old pensioners. The young households supply labor inelastically for a gross wage w, and decide how much of their income to consume and save. Their wage is taxed at a rate t to finance the old households' pension scheme by repartition. Old households are retired and earn some pension benefit equal to $\underline{w} < w$. They also optimize their consumption and savings. A young household has a probability ρ to retire, while an old household dies with probability τ^O. Importantly, the households do not face any uncertainty in terms of labor or pension income. They have an incentive to save to smooth consumption because they earn less as pensioners than as workers. To keep the size of the total population constant, every time a household dies, a young household is born and inherits the wealth of the old household. For simplicity, I assume that the households cannot borrow. Given the set-up outlined above, this borrowing constraint is mostly not binding, except for poor, young (working) households. On top of their labor or pension income, the households earn the dividends of the firms. The shares of the firms are equally distributed and the dividends are a per period per household lump-sum transfer (to keep the households' program simple enough, I assume that firms' shares are non-transferable).

Differently from the representative household case, each household can choose between only two (instead of three) saving instruments: bank deposits, and one of the two types of direct loans to firms (corresponding to the two types of alternative financing received by the firms). Indeed, beyond wealth and age differences, I further distinguish between N_J types of households $j \in J$ that pay a different intermediation cost χ^j to find a firm willing to invest. This cost is higher when households search beyond their close social circle, since the search involves more intermediaries to reach a firm needing investment, and this is reflected in the variations in χ^j depending on the household's type j. Granting a direct loan to enterprises is risky, since the firm may default on the loan and not fully reimburse. The households do not have precise enough information on the firm they are lending to to know its specific probability of default, but they know the average probability of default of a firm, and the average reimbursement rate in case of default. Denoting $\bar{p}$ the default probability and $\underline{r}$ the reimbursement rate, an asset priced q_a^j gives a return 1 with probability $1 - \bar{p}$ and an return $\underline{r} < 1$ with probability $\bar{p}$.

The households are hence heterogeneous with respect to their total wealth W, their age (young Y or old O), and their type in terms of connection to enterprises. The program of the young and old households is respectively shown in equations (73) to (80).

when young:

$$V(W;Y,j) = \max_{c,s_b,s_a^j} u(c) + \beta\left((1-\rho)EV(W';Y,j) + \rho EV(W';O,j)\right) \tag{73}$$

s.t.

$$W = c + q_d s_b + q_a^j s_a^j + \chi^j s_a^j \tag{74}$$

$$W' = \begin{cases} D_e + w(1-t) + s_b + s_a^j & \text{with probability } 1-\bar{p} \text{ if no default} \\ D_e + w(1-t) + s_b + \underline{r} s_a^j & \text{with probability } \bar{p} \text{ if default} \end{cases} \tag{75}$$

$$s_a^j, s_b, c \geq 0 \tag{76}$$

when old:

$$V(W; O, j) = \max_{c, s_b, s_a^j} u(c) + \beta(1-\tau^O) EV(W'; O, j) \tag{77}$$

s.t.

$$W = c + q_d s_b + q_a^j s_a^j + \chi^j s_a^j \tag{78}$$

$$W' = \begin{cases} D_e + \underline{w} + s_b + s_a^j & \text{with probability } 1-\bar{p} \text{ if no default} \\ D_e + \underline{w} + s_b + \underline{r} s_a^j & \text{with probability } \bar{p} \text{ if default} \end{cases} \tag{79}$$

$$s_a^j, s_b, c \geq 0 \tag{80}$$

where W is the current total wealth of the household, c is consumption today, s_b is the amount deposited to the bank, s_a^j is the capital directly supplied to the firm through alternative financing, w is the young households'wage, $\underline{w}$ is the old households'pension income, D_e is the dividends obtained from the firm's profit, j is the type of household, p is the aggregate default probability determined by the firm's program. The resource constraint for the pension scheme further implies that

$$\int_O \underline{w} = \int_Y tw \tag{81}$$

The trade-off between the two saving instruments is the following: the bank deposits are risk-free, while the alternative financing is risky and has a higher return (i.e. $q_d > q_a^j \quad \forall j \in J$). Since there is uncertainty on the return of the alternative financing, W' is a random variable. New-born households inherit firms' shares and the left-over wealth of their predecessors (but there is no altruistic motive for bequest).

C.2 Program of the bank

The program of the representative bank is similar to the one described in section 3.

C.3 Market clearing conditions

The new market clearing conditions are similar to the previous ones. The good market clearing condition is modified to take into account the foreign asset returns. To avoid heavy notations, I summarize the firms' state variables by $m = \{A, k, d; j\}$ and the households' state variables by $n = \{W; o, j\}$. The probability distributions of firms and households are respectively denoted by $\mu(m)$ and $\nu(n)$.

Labor market

The inelastic labor supply of each young household is equal to 1, while old households do not work and therefore supply zero labor. The total aggregate labor supply L^S is therefore equal to the share of young households at steady state (exogenously determined by the retirement and death probabilities ρ and τ^O). The wage has to adjust such that at each period:

$$L^S = \int l_n^S \nu(n) dn = \int l_m^D(w) \mu(m) dm = L^D(w) \tag{82}$$

Alternative capital market

There is an alternative capital market for each type j, where households and firms of the same type meet. The aggregate alternative savings $S_a(q_a^j; j)$ from each type of household have to be equal to the aggregate demand for alternative funding $a'(q_a^j; j)$ by each type of firms.

$$S_a(q_a^j; j) = \int_{n \in j} s_{a,n}(q_a^j) \nu(n) dn = \int_{m \in j} a'_m(q_a^j) \mu(m) dm = a'(q_a^j; j) \qquad \forall j \in J \tag{83}$$

For each j, the interest rate q_a^j adjusts to clear the market.

Bank capital markets

As before, in the baseline specification, the bank has basically no room for action. The bank accepts the totality of the deposits supplied by the households, and grants all loans demanded by the firms up to the collateral constraint. This implies the following equalities:

$$q_d D = \int q_d s_{b,n}(q_d) \nu(n) dn = q_d S_b(q_d) \tag{84}$$

$$qB = \int q b'_m(q) \mu(m) dm = q b'(q) \tag{85}$$

The loan supply from the bank qB should be equal to the aggregate bank loan demand from the firms $qb'(q)$. The aggregate deposits from the households $q_d S_b(q_d)$ should be equal to the deposits in the bank $q_d D$.

Good market

The equilibrium condition is similar to the representation household case.

C.4 Equilibrium definition

To the law of motion of the firms' distribution, I now add the low of motion of the households' distribution:

$$\nu'(W'; o, j) = \int Prob(W' = W'(W; o, j) | W; o, j) \pi_{oo'} d\nu(W; o, j) \tag{86}$$

where $\pi_{oo'}$ is the transition probability from age o to age o', with $o, o' \in \{Y, O\}$.

The definition of the stationary equilibrium in this set-up is modified into:

Definition 2. *A stationary equilibrium consists in policy functions $a'(A,k,d;j)$, $b'(A,k,d;j)$, $e'(A,k,d;j)$, $s_a(W;o,j)$, $s_b(W;o,j)$, B and D; probability distributions $\mu(A,k,d;j)$ for firms and $\nu(W;o,j)$ for households; and prices $\{w, \{q_a^j\}_{j\in J}, q, q_d\} \in \mathbb{R}_+^{3+N_J}$ such that:*

1. *The policy functions $a'(A,k,d;j)$, $b'(A,k,d;j)$ and $e'(A,k,d;j)$ solve the firm's program as defined in equations (8) to (19), given w, $\{q_a^j\}_{j\in J}$ and q;*
2. *The policy functions $s_a(W;o,j)$, and $s_b(W;o,j)$ solve the household's program as defined in equations (73) to (80), given w, $\{q_a^j\}_{j\in J}$ and q_d;*
3. *The policy functions B and L solve the bank's program as defined in equation (41) given q and q_d;*
4. *Markets clear*
5. *The stationary distribution $\mu(A,k,d;j)$ is the fixed point of equation (49);*
6. *The stationary distribution $\nu(W;o,j)$ is the fixed point of equation (86).*

C.5 Calibration and results

The calibration approach is the same as the one presented in section 4; there are a few additional parameters to be defined. The young and old households' death probabilities and the retirement probability are directly obtained from the data.

The probability of a young household to retire ρ is set to 0.025, which corresponds to an average duration of working life of 40 years. The death probability for old households is set to match the life expectancy of 60-year old persons in China between the years 2005 and 2010, based on the World Population Prospects database published by the United Nations. Hence, the probability of dying when old τ^O is equal to 0.05156, matching the life expectancy of 19.43 years at age 60. The pension income of the households is calibrated to match the quantity of deposits required by banks to be solvent in the baseline specification. I set the ratio $\frac{\overline{w}}{w} = 0.48$.

Finally, the intermediation cost paid by type L households is normalized to $\chi^L = 0.0089$. For H type households, I set $\chi^H = 0.08444$, and both types of households are present in the economy in equal proportions, implying $p_1 = 0.5$.

Results from a previous calibration are qualitatively very similar to the ones obtained in the framework with a representative household.