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Alternative finance and credit sector reforms: the case of China

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Abstract

This paper studies the impact of credit sector reforms in a general equilibrium framework where heterogeneous firms choose their optimal investment and how to finance it. 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 can account for the financing patterns observed in Chinese data. Despite an increase in non-performing loans by 11%, liberalizing the banking sector increases the steady-state aggregate level of capital by 10% and the steady-state aggregate production by 5%, inducing efficiency gains and a welfare increase of 1.8%. Selectively tightening the regulation of the alternative finance sector, if simultaneous to bank liberalization, may prevent the rise in non-performing loans while preserving most welfare improvements. This remains however detrimental to the development of small, young enterprises and limits efficiency gains.

Key words: Informal finance, banking reform, heterogeneous agents, credit constraints, China.

JEL classification: E22, O16, O17.

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1 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 organization 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 modeling alternative funding sources and quantifying the impact of a banking liberalization for firms' investment, with a specific focus on the Chinese case and on credit markets as one cause for capital misallocation. Over the past century, financial resources have indeed often been allocated across Chinese enterprises according to motives that differ from pure profit maximization. This 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. 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. 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, on the theoretical side, the current corporate finance literature only considers equity, bonds and retained earnings. Arellano et al. (2012), for instance, develop a heterogeneous firms set-up focusing on the arbitrage between debt and equity, and on its link to financial markets' development in Europe. They represent the level of financial development by a fixed cost of credit paid by the creditor, and do not provide firms with alternative ways of sidestepping formal credit constraints. While also examining firms' arbitrage decisions

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

between various financing sources, the framework I suggest is tailored for emerging countries, where an important part of external finance is still informally channeled from the lenders to the borrowers and cannot be simply assimilated to bank loans or equity issuance. I add the possibility for firms to access alternative sources of funding, which includes family and friends, non-listed equity, and informal sources. The microfoundation of alternative finance also reflects the randomness of contacts and social networks, with firms having unequal and costly access to this additional funding source.

Second, I evaluate quantitatively the impact of reforming the credit sector on the aggregate economy and enterprises development in China, accounting for the presence of alternative finance. Such an evaluation has not been done before, as studies on investment financing in China have either been only qualitative, or have focused on access to formal finance rather than on potential reforms and ways to bypass financial constraints. Cong and Ponticelli (2016), for instance, show that formal credit distribution was still biased towards state-owned firms during the Chinese post-crisis stimulus plan. This study complements their statement by underlining the impact of a full interest rate liberalisation and the importance of alternative finance to compensate for low access to formal credit. Many papers have dealt with the impact of resource allocation on the aggregate economy (see, for instance, Restuccia and Rogerson, 2008 and Hsieh and Klenow, 2009); however they tend not to focus on mechanisms to improve this allocation. Since it helps by-passing credit constraints, alternative finance offers a way of reducing resource misallocation and its consequences. By examining the importance and implications of alternative finance in the context of Chinese credit sector reforms, this paper casts some additional light on this key financing mechanism in emerging countries.

I compare four scenarios of reforms where the bank interest rates are fully liberalized and set competitively: (i) while alternative funding is never available; (ii) while alternative funding is always available; (iii) while access to alternative funding is shut down; and (iv) while access to alternative funding is more tightly regulated (partially shut down). By alleviating financial constraints before the reforms, the presence of alternative financing sources dampens the reforms impact in terms of consumption and welfare. The results show that alternative finance increases aggregate production and welfare by 6.6% and 4.0% respectively, and that a liberalization of the banking sector increases aggregate production and welfare by 5.5% and 1.8% respectively. The liberalization improves resource allocation, as more productive firms are able to grow faster in terms of production and capital, implying a 3.6% decrease in the dispersion of the marginal productivity of capital (MPK). By facilitating access to finance, the liberalization also increases amounts borrowed and default probabilities, with the share of non-performing loans rising by 11%, potentially calling for a tighter regulation of alternative finance. I show that liberalizing the banking sector can compensate for such a tighter regulation, but only partially. Liberalizing the banking sector while shutting down all alternative funding decreases both production and welfare by -0.8%; such a combined reform increases MPK dispersion by 10.3% and decreases aggregate total factor productivity by 1.9%. Selectively shutting down alternative finance, however, preserves most of liberalization's welfare gains, while decreasing non-performing loans. Still, its impact remains detrimental to small firms.

The following theoretical mechanism lies behind these results. Depending on its discount factor

and its characteristics, each firm sequentially picks the cheapest financing source available to cover its investment costs, switching to the second and third bests when it has exhausted the first one. The presence of alternative finance and the implementation of credit sector reforms, by changing the availability and cost of the three possible financing sources (reinvested profits, bank loans and alternative finance), modify the shape of the marginal cost of investment curve each firm faces. This impacts differently each firm's optimal investment decisions depending on the firm's characteristics, by affecting its pecking order across financing sources and its total amount invested. In this respect, the model allows us to study firms' investment and financing decisions both at the intensive and extensive margins. Consequently, the reforms impact both the level of aggregate variables (investment, capital, production) and, through their distribution across firms, the efficiency of resource allocation, the default probabilities and the aggregate welfare.

As highlighted by the above results, alternative funding renders small young firms more dynamic in terms of production and capital growth, contributing to a more efficient resource allocation and a higher long-run level of aggregate production and welfare. This partly explains the surprising coexistence of a tremendous economic growth and less market-based 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. While necessary to prevent a rise in non-performing loans, tightening the regulation standards of non-bank lending institutions could disproportionately affect smaller, younger firms and be detrimental to this economic dynamism. Chinese policy makers should therefore ensure that regulatory changes go hand in hand with a liberalization of the banking sector and a more efficiently allocated bank credit. The path of interest rates liberalization followed since 2004 seems to go in the right direction.

The remainder of this section reviews related literature. Section 2 presents the data and some important stylized facts. Section 3 describes the program of the heterogeneous enterprises at the core of the theoretical model. Section 4 closes the model by inserting the firms' program into a general equilibrium framework. Section 5 turns to the calibration of the model, section 6 presents the results and section 7 concludes.

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 resource distributions that can be triggered by political preferences, regulation or credit constraints, thus differing from pure profit maximization. To do so, they impose 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 allocation and fund-raising decisions: 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.

2 Data and stylized facts

2.1 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 allocation decisions 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.

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.

[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.

[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).

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. They further require higher interest rates, close to 100% per year in some extreme cases, which limits the amount and loan duration the borrower can get. The data presented in the next section give us more details regarding these alternative ways to finance investment.

2.2 Data presentation

Firm-level data come from the Enterprise Surveys conducted by the World Bank[5] in the 2000s. These surveys mainly focus on SME, although they include large enterprises too. In China, surveys were conducted over 1548 enterprises in 2002 and 2400 enterprises in 2003. This allows me to focus on the situation of Chinese firms just before the start of the reforms of retail bank interest rates, in 2004. The samples used by the World Bank in 2002 and 2003 correspond broadly to the overall distribution of Chinese enterprises. They provide firm-level data on many aspects of the firms' situation, including the ownership structure, production, labor, investment and financing. [6]

Detailed data on sources of financing are available only in the 2003 survey, and are presented across firm size in Table 1. 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 my theoretical model consistent with the stylized facts observed in the data.[7].

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[8]. Table 1 presents statistics including only the enterprises

[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]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 13 in Appendix A for a comparison), so I can use both of them without inconsistency.

[7]All results shown in this section remain very similar when keeping all firms in the sample and separating across ownership status, when using total sales to determine the size of a firm. See tables 14 to 21 in Appendix A

[8]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.

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
Total		100	100	100	100	100
Observations		630	172	247	149	61

Source: Enterprise survey, 2003. Results for privately owned firms only. Small firms: below 50 employees, medium firms: between 50 and 250, large firms: between 250 and 1000, very large firms: above 1000 employees.

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 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.[9] 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.[10] 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.

The varying importance of alternative financing sources across countries is shown in Figure 1. Using data from the World Bank Enterprise Survey, I study the cross-country distribution of the share of investment financed by alternative sources for low and middle income economies, between 2002 and 2006.[11] While alternative finance is relatively common, China is among the countries that have the most intensive use. As mentioned earlier, potential explanations for this phenomenon are the numerous constraints faced by enterprises to obtain official bank loans, and the traditional importance of social connexions and clan organizations to obtain financing in China.

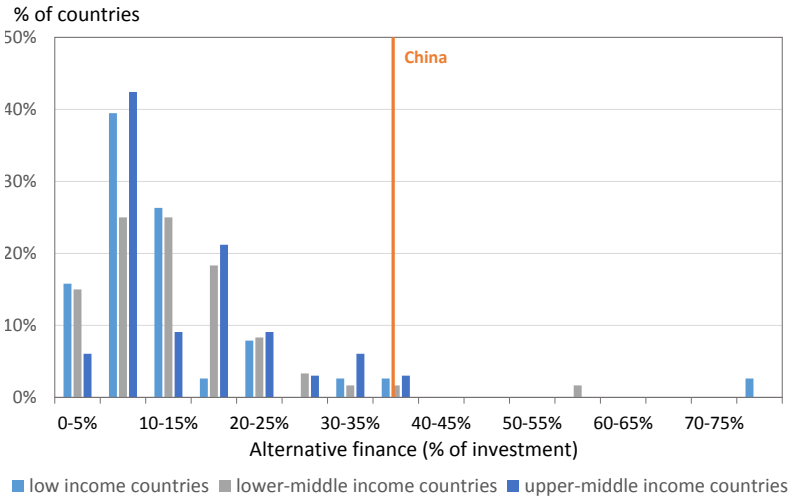
To define some stylized facts able to drive the model set-up, I regroup these various sources of funding into 3 categories as summarized in Table 2:

[9] See Table 22 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. Conversely, 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.

[10] Tables 23 and 24 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).

[11] The various financing categories included in alternative finance may not reflect the same reality across countries. Figure 1 gives us a general overview of the importance of alternative finance, but should be interpreted with caution. See Appendix Tables 23 and 24 for the more precise examples of India and Colombia.

Figure 1: Distribution of countries according to the share of investment financed by alternative sources



Note: The sample includes 131 low, lower-middle and upper-middle income countries surveyed by the World Bank's Enterprise Survey between 2002 and 2006.

- retained earnings: this corresponds to the retained earnings defined in the data;
- bank loans: it contains loans from local banks, foreign banks and special development funds;
- alternative sources: this regroups family and friends, non-listed outside equity, trade credit and informal sources. Non-listed equity is included in this category as it remains a fairly informal financing source in China in 2003. While listed equity is issued through official procedures and contracts, non-listed equity is generally more related to social connexions and based on trust. In that sense, it belongs to what I define as alternative finance.[12]

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

	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
Total	100	100	100	100	100
Observations	624	171	244	147	61

Source: Enterprise survey, 2003. Private firms only. Small firms: below 50 employees, medium firms: between 50 and 250, large firms: between 250 and 1000, very large firms: above 1000 employees.

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

[12]With the recent development of Internet and notably online crowd-funding platforms, this may not be true any more fifteen years later.

2.3 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.

Table 3: Sources of financing: share (%) of 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

Source: Enterprise survey, 2003. Private firms only. Small firms: below 50 employees, medium firms: between 50 and 250, large firms: between 250 and 1000, very large firms: above 1000 employees.

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

2.4 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 interest rate charged varies only slightly across firm size (see Table 5). 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.

Table 4: Bank loans requirements and applications, by size

		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

Source: Enterprise survey, 2003. Private firms only. Small firms: below 50 employees, medium firms: between 50 and 250, large firms: between 250 and 1000, very large firms: above 1000 employees.

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

Source: Enterprise survey, 2003. Private firms only. Small firms: below 50 employees, medium firms: between 50 and 250, large firms: between 250 and 1000, very large firms: above 1000 employees.

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 average interest rate and collateral as a function of investment size yields similar results (see Appendix Table 25).

The information gathered in this section confirms 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 is detailed in the next section, I model the credit constraint faced by enterprises as a collateral constraint.

3 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, using three possible financing sources: (i) retained earnings (which are thus subtracted from its dividends), (ii) loans from the formal banking sector at a fixed interest rate, provided it meets the collateral requirements or (iii) loans 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 main features of the model are described in more details in subsections 3.1 to 3.4.

3.1 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. Each firm's production function is a standard Cobb-Douglas function using capital k and labor l as inputs: $f(A,k,l) = Ak^{\alpha}l^{\gamma}$. A is the idiosyncratic 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 $\alpha + \gamma \leq 1$, and are common to all firms. 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 firms. The current capital stock of each firm has been decided at the previous period through investment, while they choose today how much labor to employ to maximize its profit, given its capital and technology shock. The current profits of each 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, it is easy to obtain an analytical solution for the optimal labor demand, and to plug it in the profits expression.

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

$$\Pi_E(A,k,d) = (Ak^{\alpha})^{\frac{1}{1-\gamma}}\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}(1-\gamma) - d \tag{3}$$

Profits can be either positive or negative: if a firm faces a bad productivity shock, it may not be able to produce enough to cover its labor costs and its debt. In that case, to be able to distribute non-negative dividends, the firm has to roll over part of its debt through new borrowing. As highlighted in Assumption 1, investment is not reversible. Therefore if a firm cannot borrow enough to cover its losses (negative profits), it defaults and exits the market. Note that the firm can borrow more than the debt to be rolled-over and use the remainder for investment.

Assumption 1. *Investment is irreversible and cannot be sold to roll over previous debt.*

Assumption 2. *A firm cannot use newly obtained loans to distribute higher dividends.*

Assumption 2 ensures that a firm making negative profits distributes exactly zero dividends (otherwise that would be close to running a Ponzi scheme). This explains the presence of the max and min operators in the current returns function in (6) and in the law of motion of capital in equation (8).

3.2 Sources of finance for investment

Firms accumulate capital over time, that depreciates at rate δ. They can finance their investment using three different sources: retained earnings from their own profit, bank loans, and loans from alternative sources.

Retained earnings

When a 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 a firm can use for investment cannot be larger than its current profits, as stated in Assumption 3.

Assumption 3. *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* (11).

Obviously, if a firm makes negative profits, it cannot reinvest nor distribute any of them, and both dividends and retained earnings are forced to be zero. A firm cannot use loans from the bank or from alternative sources to increase its reinvested retained earnings or its dividends. [13]

Bank loans

A second possibility to finance investment is to borrow an amount b from the formal banking sector. As seen in section 2.4, the interest rate charged by banks varies very little across firm's characteristics, and banks generally ask for collateral. 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[14]:

$$qb' \leq \theta k$$

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.

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.

Firms' types

As seen in section 2.3, 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 characterized by their 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, *etc.*. These characteristics are independent from the entrepreneur's productivity, and are relatively stable across time.

[13] 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. Assumption 3 avoids indeterminacy when solving for optimal investment and financing sources, and prevents Ponzi schemes.

[14] 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 2, banks tend to favor loans granted to larger firms, even when profit opportunities of SME are higher. A collateral constraint related to expected profit would not be well-suited.

In modeling terms, each firm draws at birth a type realization $j \in J$ from the (exogenous) types distribution. The type j of the firm remains fixed for its entire life, until it exits the market. 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. 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. Conversely, 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 $q_a^{j_1} > q_a^{j_2}$.

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 firms at the time the loan is reimbursed, the access cost $x^j(a)$ is an upfront cost, paid at the time firm are obtaining the loan.[15] To pay this cost, I assume that firms can use part of their profits (if positive), or part of their current bank loan, as summarized in Assumption 4.

Assumption 4. *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* (4)*:*

$$x^j(a') \leq qb' + \max[\Pi_E(A, k, d) - e', 0] \tag{4}$$

This assumption is designed to allow firms making losses to use alternative funding to roll-over debt, instead of relying only on bank loans, and is extended to firms making positive profits.[16]

3.3 Default

This model can allow for two types of default. First, a firm may default if it makes negative profit and cannot borrow enough to roll-over its debt. Each 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; and (iii) the amount borrowed from the alternative sources is constrained by the cost of access. If the losses to be rolled over are too large, the firm cannot roll over (its feasible decision set is empty) and has to default and exit the market.[17] This corresponds to involuntary

[15] This implies that firms cannot use the loan obtained from the alternative sources $q_a^j a'$ to pay the cost of access to alternative funding $x^j(a')$.

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

[17] The maximum amount a firm making negative profits can borrow is equal to $qb' = \theta k$ for bank loans and $a' = \sqrt{\frac{\theta k}{\eta^j}}$ for alternative finance when the access cost is $x^j(a') = qb' = \theta k$. Hence if the losses to be covered 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 defaults.

default, since it does not result from a strategic decision but comes from the firm's borrowing constraints.

Second, a firm may also strategically prefer to default if repaying or rolling over its debt is possible, but implies levels of capital and debt tomorrow such that its value is lower than some reservation value $u \geq 0$. 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.

When the firm defaults, it exits the market forever and obtains u. Its creditors' debts are reimbursed up to a share $\kappa \geq 0$ of the firm's capital.

3.4 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:

$$V(A,k,d;j) = \begin{cases} V^D(A,k,d;j) & \text{if the firm defaults} \\ V^{ND}(A,k,d;j) & \text{otherwise.} \end{cases} \tag{5}$$

The corresponding definitions of default and non-default values are specified below in equations (6) to (17) ($\mathbb{E}$ stands for the expectation operator).

$$\begin{aligned} V^{ND}(A,k,d;j) = \max_{e',b',a'} \{ & \max\left[\Pi_E(A,k,d) - e' - x^j(a'), 0\right] \\ & + \beta(1-\xi)\mathbb{E}V(A',k',d';j)\} \end{aligned} \tag{6}$$

such that

$$\Pi_E(A,k,d) = (Ak^\alpha)^{\frac{1}{1-\gamma}} \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} (1-\gamma) - d \tag{7}$$

$$k' = (1-\delta)k + e' + qb' + q_a^j a' + \min[\Pi_E(A,k,d) - e' - x^j(a'), 0] \tag{8}$$

$$d' = b' + a' \tag{9}$$

$$qb' \leq \theta k \tag{10}$$

$$e' \leq \max[\Pi_E(A,k,d), 0] \tag{11}$$

$$x^j(a') \leq qb' + \max[\Pi_E(A,k,d) - e', 0] \tag{12}$$

$$-(qb' + q_a^j a') \leq \Pi_E(A,k,d) - x^j(a') \tag{13}$$

$$e' \geq 0 \tag{14}$$

$$b' \geq 0 \tag{15}$$

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

$$V^D(A,k,d;j) = 0 \tag{17}$$

The firm faces an exogenous death probability denoted ξ at every period. If it dies, it 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. Equations (8) and (9) respectively specify the laws of motion of future capital and debt. Equation (10) defines the collateral constraint. Constraints 11 to 13 implement assumptions 1 to 4, imposing a coherent decision set-up and avoiding any Ponzi-like behavior.

3.5 Some intuition

To gain some intuition regarding the firms' capital and funding choices, I focus here on cases where the firm is able to reimburse or roll-over its debt, and abstract from the situations where a firm has to default. Propositions 1 and 2 give us a deeper understanding of the firms' funding decisions, by specifying the analytical conditions under which a firm marginally prefers one financing source over the others to finance investment and roll-over debt. Proposition 1 considers the case of a firm distributing positive dividends, while Proposition 2 explores similar properties in the case where the firms' dividends are zero. Detailed derivations are provided in Appendix C.

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

(i) 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 (10)*. It is ambiguous if $r \geq r_a^j$.*

(ii) 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 (11)*. It is ambiguous if $a' \leq \bar{a}$;*

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

See proof in Appendix C.2. The intuition is the following.

(i) Let us assume that 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 cheaper or equivalent in terms of interest rate (and hence debt reimbursement in the next period), and does not involve the payment of any access cost in the current period. The same amount of investment is therefore marginally more beneficial to the firm if financed through bank loans than through alternative sources.

(ii) We can compare the merits of using retained earnings or alternative finance as follows. Increasing alternative funding marginally reduces current dividends proportionally to the access cost $x^{j\prime}(a')$, involves debt and interest rate payments and increases the firm's default probability next period. Increasing retained earnings also has the drawback of reducing the firm's current dividends, but does not imply any debt or interest rate reimbursement in the next period, and decreases the default probability, as the firm has similar debt and increased

capital. Hence, when the access cost $x^{j\prime}(a')$ is 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.

Note that when $q_a^j - x^{j\prime}(a') \geq 0$, then the firm's preference between bank loans and alternative sources is ambiguous and depends on the parameters values. Similarly, when $r > r_a^j$ and the firm is distributing positive dividends, 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 (10)*;*

(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 (12)*.*

See proof in Appendix C.3. The mechanism is similar to the proof of Proposition 1.

(i) Consider the situation of a firm distributing zero dividends. If $q \geq q_a^j - x^{j\prime}(a')$, the marginal cost of increasing bank loans is lower that the one of increasing alternative loans, which combines both interest rate and access cost payments. On the benefits side, both bank loans and alternative sources marginally increase capital by the same amount. Hence, if the marginal cost to access 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 ($q < q_a^j$).

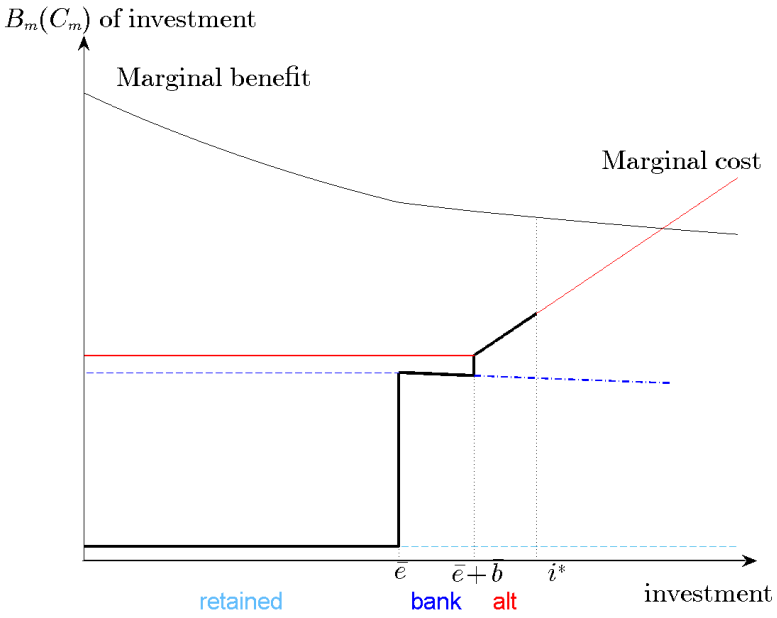
(ii) Similarly, if $q \leq q_a^j - x^{j\prime}(a')$, the marginal cost of increasing alternative financing is lower than the marginal cost of increasing bank loans, and their marginal benefits are equal. Therefore, firms marginally prefer to use alternative sources, if the access cost constraint does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

Figures 2 to 4 illustrate the various financing choices that can be generated by the model, by presenting three different cases. In all figures, the decreasing thin 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 equal to its marginal cost. Figure 2 illustrates the pecking order of enterprises facing various financing possibilities, by showing a case where the enterprise uses the three possible funding sources, while the firms on Figure 3 and Figure 4 use only bank loans and alternative sources.

Figure 2 represents the funding choice of a large[18], high productivity firm when dividends are positive, $r < r_a^j$ and $\eta^j > 0$. In this case, according to Proposition 1, the marginal cost for bank loans (dark blue dashed-dotted line) is always smaller than the marginal cost for alternative

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

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



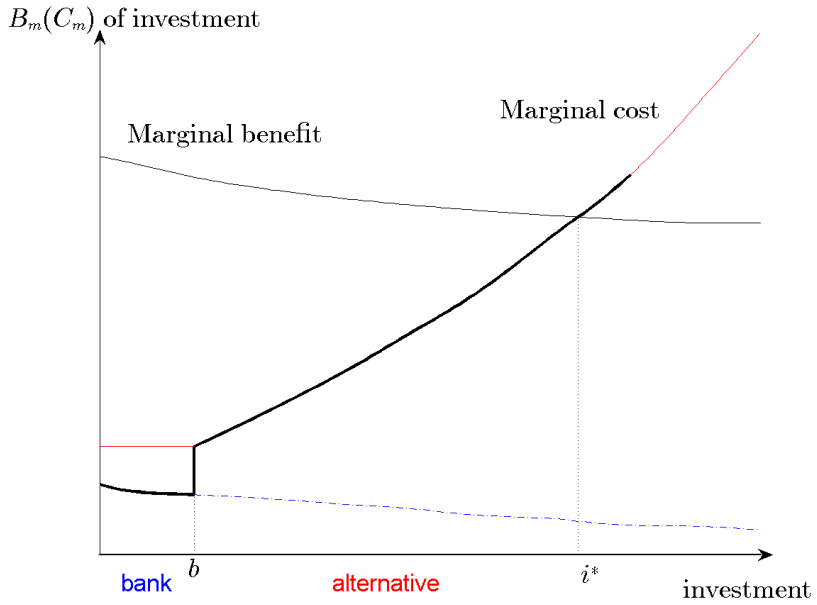
Note: The thin and thick black lines are respectively the marginal benefit and cost of investment. The marginal costs of retained earnings, bank loans and alternative finance are the dashed light blue, dashed-dotted dark blue and solid red lines respectively. The parameter and price values for this graph are as follows: $\beta = 0.9923$ $\xi = 0.082$, $\omega = 0.1$, $A = 2.7$, $\alpha = 0.51$, $\gamma = 0.30$, $\delta = 0.1$, $k = 11$, $d = 6$, $\eta^j = 0.142$, $r = 0.0309$, $r_a^j = 0.095$, $w = 0.80$.

funding (red solid line). The decision sequence is as follows: retained earnings (light blue dashed line) are initially marginally preferred to both other sources, until the non-negative dividends constraint (11) binds at investment level $\bar{e}$. The firm then switches to the second cheapest source of financing, namely bank loans. Finally, when it hits the collateral constraint (10), 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 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. This is more retained earnings, and less bank loans and alternative sources than the average large firm in the data (section 2). The enterprise considered here has indeed a very high productivity shock, a fairly high capital level, and therefore a large amount of profits to reinvest.

The medium-sized, medium-high productivity enterprise shown in Figure 3 currently makes losses and faces expensive alternative finance as in Figure 2 ($r < r_a^j$, $\eta^j > 0$). Because of its negative profit, this firm needs to roll-over part of its debt and cannot use retained earnings. From Proposition 2, it always marginally prefers to invest using bank loans rather than alternative funding. The firm finances 26% of its total investment i^* with bank loans until it hits the collateral constraint and turns to alternative sources. This firm belongs to the 59% of medium-sized firms that do not use retained earnings in the data.

Finally, the case of a large size, medium-high productivity firm with cheap access to alternative finance ($r > r_a^j$) is shown on Figure 4. The firm first finances investment through alternative

Figure 3: Case of zero dividends, $r < r_a^j$



Note: The thin and thick black lines are respectively the marginal benefit and cost of investment. The marginal costs of retained earnings, bank loans and alternative finance are the dashed light blue, dashed-dotted dark blue and solid red lines respectively. The parameter and price values for this graph are as follows: $\beta = 0.9923$, $\xi = 0.082$, $\omega = 0.1$, $A = 1.6$, $\alpha = 0.51$, $\gamma = 0.30$, $\delta = 0.1$, $k = 2.50$, $d = 1.8276$, $\eta^j = 0.142$, $r = 0.0309$, $r_a^j = 0.095$, $w = 0.80$.

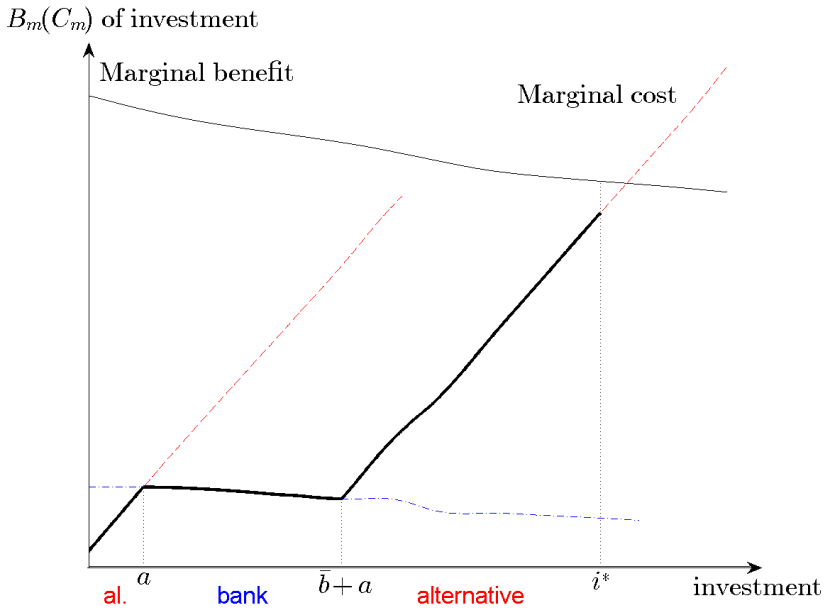
sources, which is cheaper than bank loans for small amounts. At the investment level a, alternative finance becomes more expensive than bank loans due to the quadratic access cost. The firm then uses bank loans to finance 38% of its total investment, until it hits the collateral constraint at investment level $\bar{b} + a$, and switches back to alternative sources to reach the total amount invested i^*. Compared to large-sized firms in the data, this firm is relatively impatient and uses no retained earnings . It also uses more alternative sources than the average large firm in the data, because it benefits from a cheap access to alternative sources.

4 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 4.1 and 4.2. To keep the general equilibrium as simple as possible, the household side is represented by a single representative household.[19] 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.

[19] A general equilibrium version with full-fledged heterogeneous households is available upon request.

Figure 4: Case of positive dividends, $r > r_a^j$



Note: The thin and thick black lines are respectively the marginal benefit and cost of investment. The marginal costs of retained earnings, bank loans and alternative finance are the dashed light blue, dashed-dotted dark blue and solid red lines respectively. The parameter and price values for this graph are as follows: $\beta = 0.9923$, $\xi = 0.082$, $\omega = 0.1$, $A = 1.6$, $\alpha = 0.51$, $\gamma = 0.30$, $\delta = 0.1$, $k = 35$, $d = 14$, $\eta^j = 0.01$, $r = 0.0309$, $r_a^j = 0.01$, $w = 0.80$.

4.1 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. 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*: they earn a risk-free rate r_d and are priced at $q_d = \frac{1}{1+r_d}$.
- N_J *types of direct firm financing*: This corresponds to the alternative finance obtained by the firms. To find a firm willing to invest, the household may have to search, and pays 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. To match the different types of firms (having a more or less costly access to alternative financing), I distinguish between different types $j \in J$ of direct firm financing that differ in their rate of return and their intermediation cost. A direct loan of type j is priced at $q_a^j = \frac{1}{1+r_a^j}$. This saving instrument is risky, since each individual firm may default on its loan and not fully reimburse.

The household holds a fully diversified portfolio of firms loans and knows the average probability

of default of a firm, so he can perfectly anticipate the share of firms that will default and what ex-post return he will obtain. Since bank deposits are risk-free, he does not face any uncertainty. The program of the household is shown in equations (18) to (21).

$$V(W) = \max_{c, s_b, \{s_a^j\}_{j \in J}} u(c) + \beta V(W') \tag{18}$$

s.t.

$$W = c + q_d s_b + \sum_{j \in J} q_a^j s_a^j + \sum_{j \in J} \chi^j s_a^j \tag{19}$$

$$W' = D_e + wL^S + s_b + \sum_{j \in J} s_a^j (1 - \bar{p} + \bar{p}\underline{r}) \tag{20}$$

$$\{s_a^j\}_{j \in J}, s_b, c \geq 0 \tag{21}$$

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, L^S is the labor supply, w is the 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.[20]

The first order conditions of this program imply:

$$q_d u'(c) = \beta V'(W') \tag{22}$$

$$\frac{q_a^j + \chi^j}{1 - \bar{p} + \bar{p}\underline{r}} u'(c) = \beta V'(W') \qquad \forall j \in J \tag{23}$$

All $N_j + 1$ saving instruments (bank deposits and the N_J types of direct loans to firms) are risk-free for the household. To avoid corner equilibria, I further assume that all assets have equal average returns and that the household is indifferent between investing in one or the other:

$$q_d = \frac{q_a^j + \chi^j}{1 - \bar{p} + \bar{p}\underline{r}} \qquad \forall j \in J \tag{24}$$

This property can be easily obtained by adjusting the price q_a^j, given the intermediation cost χ^j. Since the household is indifferent between all 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 $\bar{q}\bar{s} = q_d s_b + \sum_{j \in J} q_a^j s_a^j + \sum_{j \in J} \chi^j s_a^j$, 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:

[20] 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 unit lent.

$$V(W) = \frac{1}{1-\beta}\log(1-\beta) + \frac{\beta}{(1-\beta)^2}\log\left(\frac{\beta}{\bar{q}}\right) + \frac{1}{1-\beta}\log\left(W + \frac{\bar{q}}{1-\bar{q}}(D_e + wL^S)\right) \tag{25}$$

$$\bar{s}^* = \frac{\beta}{\bar{q}}W - \frac{1-\beta}{1-\bar{q}}(D_e + wL^S) \tag{26}$$

$$c^* = (1-\beta)W + \frac{\bar{q}(1-\beta)}{1-\bar{q}}(D_e + wL^S) \tag{27}$$

$$W'^* = \frac{\beta - \bar{q}}{1-\bar{q}}(D_e + wL^S) + \frac{\beta}{\bar{q}}W \tag{28}$$

For a steady state with positive levels of wealth, consumption and savings to exist, the interest rate has to be equal to the discount factor, which makes the household indifferent between saving and consuming.[21] If this is the case, then any amount $W \geq D_e + wL^S$ 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.

4.2 Program of the bank

There is one 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, knows the average default and reimbursment rates, and therefore does not face any aggregate uncertainty.

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:

$$\max_{D,B} \Pi_b = q_d D - qB - D + (1 - \bar{p} + \bar{p}\underline{r})B - \zeta(qB + q_d D) \tag{29}$$

$$\text{s.t.} \qquad q_d D \geq qB \tag{30}$$

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 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 6.

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

4.3 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).[22] 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: as mentioned earlier, 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. 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:

$$L^S = L^D(w) = \int l_m^D(w)\mu(m)dm \tag{31}$$

Alternative capital market

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

$$s_a^j(q_a^j) = \int a'_m(q_a^j)\mu(m)dm = a'(q_a^j; j) \qquad \forall j \in J \tag{32}$$

Bank capital markets

In the baseline scenario, the bank has no room for action. It accepts all deposits $q_d s_b(q_d)$ supplied by the household, and grants all loans $qb'(q)$ demanded by the firms up to the collateral constraint, thus equating demand and supply for deposits and loans.

$$q_d D = q_d s_b(q_d) \tag{33}$$

$$qB = \int qb'_m(q)\mu(m)dm = qb'(q) \tag{34}$$

In section 6, I conduct policy experiments where constraints on interest rates setting are relaxed and the bank maximizes its profit as is common in the literature.

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

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. 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 supply corresponds to the firms' aggregate production Y. The demand side consists of the household consumption C, the firms' aggregate investment I (retained earnings, bank loans and alternative loans net of rolled-over debt and of access cost to alternative funding), the aggregate access costs 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 equilibrium on the goods market is reached when:

$$Y = C + I + X + INT + \zeta(qL + q_d D) + LO \tag{35}$$

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

4.4 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 distribution of firms. Equation (36) defines the law of motion of the firms' distribution.

$$\mu'(A', k', d'; j) = \int Prob\Big(k' = k'(A, k, d; j), d' = d'(A, k, d; j) | A, k, d; j\Big) T_{AA'} d\mu(A, k, d; j) \tag{36}$$

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* (6) *to* (17)*, 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* (18) *to* (21)*, 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* (29) *and* (30) *given q and q_d;*
4. *Markets clear, so that equations* (31) *to* (35) *are satisfied;*
5. *The stationary distribution $\mu(A, k, d; j)$ is the fixed point of equation* (36)*.*

5 Calibration

The model is calibrated using the literature, the Enterprise Survey data presented in section 2 as well as aggregate data from the China Statistical Yearbook and World Development Indicators database from the World Bank. A first set of parameters is defined from the literature or direct evidence in the data. The production parameters are estimated using the data. The remaining parameters are defined to match aggregate moments from the data.

5.1 Parameters set from the literature and data

As presented in section 2.4, 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%, implying a real interest rate $r = 3.09\%$, corresponding to $q = 0.97$ in the model. 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%, yielding a real bank deposit rate $r_d = 0.78\%$, corresponding to an asset price $q_d = 0.9923$ in the model.[23] To ensure that the household is indifferent between consuming and saving, I set the discount factor β to 0.9923. The share κ of capital that can be used by enterprises to reimburse loans in case of default or death is set to 0.25. Only a few of the studies using depreciation rates for China or other developing countries actually estimate it. Given the results summarized in Table 26 in Appendix A, I set δ to 10%.

5.2 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[24], following the approach developed by Olley and Pakes (1996). The detailed procedure is explained in Appendix B. This 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.

Olley and Pakes (1996)'s procedure also provides an estimated series for the productivity of each firm at the available dates, with an estimated autoregressive coefficient $\rho = 0.91$. I discretize this process into a Markov-chain following Tauchen (1986) to obtain the transition matrix for the productivity shock in the model. 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) at the model's stationary equilibrium with the data. I obtain the following values for the shocks matrix A (see Appendix B for more details and the values of the transition matrix):

$$A = \begin{pmatrix} 0.35 & 0.75 & 1 & 1.6 & 2.7 \end{pmatrix} \tag{37}$$

[23] The real lending rate is obtained after subtracting from the nominal interest rate the inflation rate for investment in fixed assets for the year 2003. The inflation rate of consumer prices in 2003 is used to obtain the real deposit rate.

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

5.3 Further Parameters: Matching moments

The remaining parameters are calibrated in order to match the moments highlighted in section 2. I allow for two possible types of firms $j \in \{L, H\}$, with $\eta^H > \eta^L$ and $r_a^H > r_a^L$. Type L firms have good connections to potential lenders in their social circles and therefore face a low cost of borrowing through alternative finance. Conversely, type H firms need to go through some intermediaries to get in touch with lenders and pay a higher cost to obtain alternative finance. 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 $j \in \{L, H\}$: intermediation cost of granting direct loans to type j firms for the household;
- 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;
- p_0: probability for a firm to be of type L.

To do so, I solve for the model's stationary equilibrium corresponding to the situation of China in 2002. The 7 parameters to be calibrated are then adjusted to match the firms' investment financing patterns presented in Table 6. Note that these moments are interdependent, since the shares of financing sources for each firm size have to sum up to 100%[25], 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. The link between the parameter values and the aggregate moments to be matched is obvious for most parameters (θ, $\{\eta^j\}_{j\in\{L,H\}}$, p_0). The exogenous death probability of enterprises ξ affects the patience of the firms and their willingness to distribute dividends instead of reinvesting profits. It also impacts the stationary firms distribution and makes sure that smaller, more financially constrained firms are present in the model. Because 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. The household's intermediation cost parameters have therefore a crucial impact on the investment financing decisions of enterprises.

Table 6: Moments from the data: private 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%

Source: Enterprise survey, 2003. Results for privately owned firms only. Small firms: below 50 employees, medium firms: between 50 and 250, large firms: between 250 and 1000, very large firms: above 1000 employees.

The model's moments in terms of financing sources are computed using the firms' stationary distribution and optimal policy functions at equilibrium prices, conditionnal on parameters values.

[25] It might not exactly sum up to 100% in Table 6 due to rounding.

Similarly to the data presented in section 2, 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.

The calibrated values of the parameters and the corresponding equilibrium prices are presented in Tables 7 and 8 respectively. These values imply that, at the stationary equilibrium, $q_a^L = 0.9901$ and $q_a^H = 0.9132$, so that $q_a^H < q < q_a^L$. As a consequence, the results highlighted in point (i) 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 (ii) 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 (ii) of Proposition 1).

Table 7: 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 8: Equilibrium prices

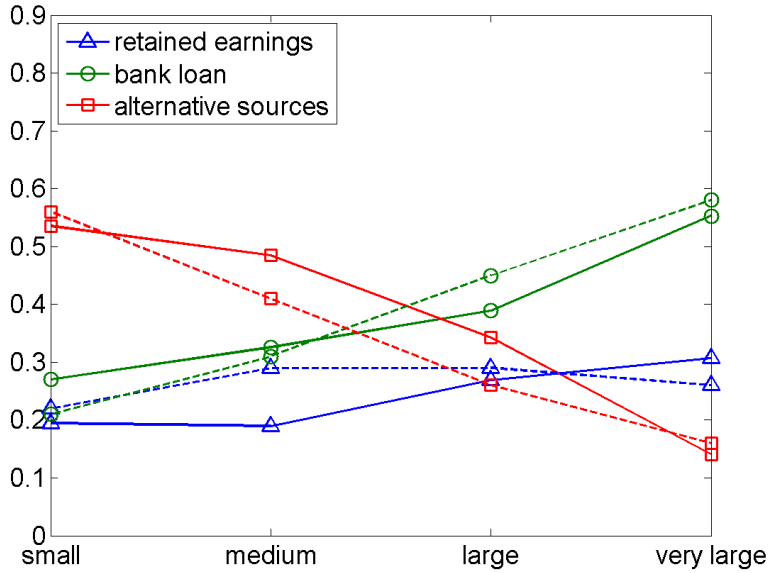
q_a^L	q_a^H	w
0.9901	0.9132	0.80

5.4 Baseline fit

Figure 5 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. I consider first the share of firms not using (financing less than 5% of investment via) one financing source, and well as the share of firms using only (financing more than 95% of their investment via) only

Figure 5: Calibrated moments: share of investment financed by each financing source (%)



The data are in dashed lines, the model in solid lines.

one financing source, as shown in Figure 6.[26] The model is relatively close to some stylized facts from the data, and further from some others. For instance, the share of firms not using retained earnings and the share of firms using mostly bank loans are at levels similar to the data. The slope across firm size is similar in the model and in the data, for firms using mostly alternative sources and firms not using financing bank loans and alternative sources. None of the firms use mostly retained earnings to finance their investment in the model, due to their high death probability that makes them relatively impatient.

Regarding the aggregate characteristics of the economy, Table 9 compares the model outcomes at the stationary equilibrium and the data for 2002 and 2003. The model turns out to fit quite well the data for all non-targeted variables.

6 Reforming the credit distribution

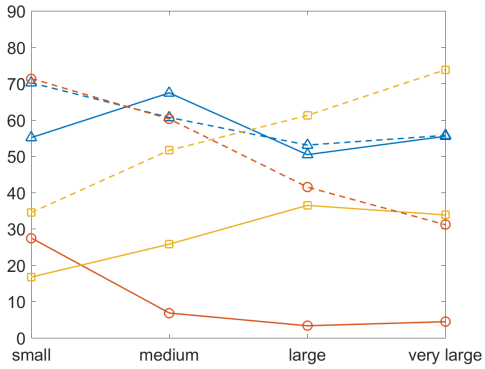
6.1 On-going reforms in China

Reforms of the credit distribution sector in China have been going on 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

[26]The reason for using these 5% and 95% thresholds instead of 0% and 100% is that the answers in the data are often rounded to multiples of 5 or even 10. Since this is not the case in the model results, it is more accurate to label a financial resource use as "almost inexistant" below 5% of their investment, and "almost unique" above 95%, both in the model and in the data.

Figure 6: Non-targeted moments (data in dashed lines, model in solid lines)

(a) Share of firms financing less than 5% of investment from one source of funding (%)



(b) Share of firms financing more than 95% of investment from only one source of funding (%)

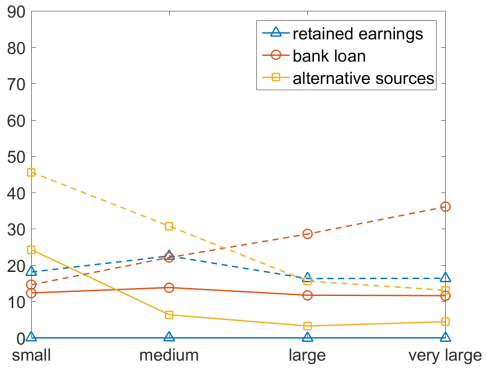


Table 9: Non-targeted moments

	Model	Data (2002)	Data (2003)	Data source
Consumption/GDP	57%	60%	57%	World bank WDI
Investment/GDP	44%	38%	41%	
Capital/GDP	2.37	2.80	2.86	Penn World tables
Share of firms investing	82%	70%	na	
Average firm leverage	1.97	2.00	na	Enterprise survey
Share of firms obtaining alternative funds[1]	62%	48%	na	

[1] As mentioned previously, since in the survey data practically no firm declares using less than 10% alternative funds to finance investment, firms having access to alternative funds in the data are matched with firms financing at least 10% of their investment through alternative finance in the model.

on the regulatory evolution of these three aspects are provided below.

While interbank and bond rates were liberalized in 1996, the first significant step towards a liberalization of retail interest rates took place in 2004. Table 10 recalls the time-line of the interest rates liberalization process in China. By maintaining the floor and ceiling for loans and deposit rates respectively after 2004, the Chinese authorities limit competition across banks to attract borrowers and depositors, and ensure that banks keep a sufficient profit margin, until 2013. Although the full interest rate liberalization has been achieved at the end of 2015, benchmark lending and deposit rates are still published. State-owned firms are still legally entitled to borrow at the benchmark lending rate, and both lending and deposit benchmark rates keep an influence on rates offered by Chinese banks.

Table 10: Interest rates liberalization time-line

	Lending rates	Deposit rates
1999	floor at 0.9 times benchmark rate ceiling at 1.1 times benchmark rate for large enterprises, 1.3 for small enterprises	at benchmark rate
Autumn 2004	ceiling suppressed floor at 0.9 times benchmark rate	floor suppressed ceiling at benchmark rate
Summer 2012	floor at 0.7 times benchmark rate	ceiling at 1.1 times benchmark rate
July 2013	floor suppressed	
November 2014		ceiling at 1.2 times benchmark rate
May 2015		ceiling at 1.5 times benchmark rate
October 2015		ceiling suppressed

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"[27] 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 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.[28] 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"

[27] *China Monetary Policy Report*, Quarter Three, 2004.

[28] 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.

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.

6.2 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, and adjust to reach the equilibrium on the bank deposits and loans markets, given the household's deposit supply and the firms' loan demand.

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

Bank's profit maximization

As presented in section 4.2, 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:

$$q = \frac{(1 - \bar{p} + \bar{p}\underline{r})q_d}{1 + 2\zeta q_d} \tag{38}$$

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 (38), given the average default rate and reimbursement of enterprises, to ensure that the bank's profit is zero.

Reforms scenarios

Given these reforms described earlier, 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[29] 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 banking sector is liberalized, while 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. 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.

6.3 Pre-reforms situation and presence of alternative finance

Before studying in details the impact of the reforms, it is useful to have in mind the characteristics of the baseline (pre-reforms) situation and the impact of the presence of alternative finance in

[29] Given the calibration obtained in section 5, 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%.

that context. Table 11 compares 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.

Table 11: Impact of alternative finance in 2003

	Levels		Change
	without alternative finance	with alternative finance	when including alternative finance
Aggregates			
Production	8.05	8.58	6.60%
Capital	18.86	20.37	7.98%
Consumption	4.62	4.91	6.32%
MPK dispersion	0.16	0.14	−12.90%
TFP	1.27	1.30	2.53%
Welfare	198.63	206.59	4.01%
Prices			
Bank lending rate	3.09	3.09	0
Low alternative rate	-	1.00	-
High alternative rate	-	9.50	-
Wage	0.75	0.80	6.67%
Firms' dynamics			
New-born average production growth	19.5 to 57.1 %	29.6 to 103.0 %	+8.68 to 46.0 % pts
New-born average capital growth	9.7 to 109.7 %	19.0 to 244.3 %	+9.25 to 134.6 % pts

Alternative finance, by relaxing the credit constraints faced by the enterprises, increases the aggregate production, investment and capital by up to 8%. As shown by the change in the dispersion of the marginal product of capital (-12.90%), the presence of alternative finance strongly contributes to reducing capital misallocation, and increases aggregate TFP by 2.53%. Last but not least, the presence of alternative finance, by allowing firms to partially bypass financial constraints, is clearly welfare improving: despite multiplying the firms' default probability by 10, it increases aggregate consumption and welfare by 6.3% and 4% respectively.

Besides aggregate variables, I also examine the young firms' development by simulating the average production and capital paths of a newborn firm with little capital and various initial productivity levels.[30] The last two lines of Table 11 correspond to the average growth of newborn firms for production and capital, during the first 6 periods of their life. At the level of individual enterprises, alternative financing opportunities fasten the growth of small newborn enterprises' capital by up to 135 percentage points. Similarly, the growth of newborn enterprises' production is up to 46 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.

The improvement brought by alternative finance is not equally shared. Since alternative finance helps more productive firms to grow faster, it diminishes the number of small firms, while increasing the number of medium and large firms in the economy. Following a similar logic, the average

[30]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. The average paths for production and capital are then obtained by averaging across firms.

productivity and stream of discounted future dividends of small and medium-sized firms decrease with the introduction of alternative finance, while they increase for large and very large firms. The easiness of access to alternative finance also matters, as average marginal productivity of capital and the aggregate productivity are respectively 18% higher and 2.8% lower among H type firms (that do not benefit from a cheap access to alternative finance). Although type H and L firms start with the same initial characteristics besides access to finance, an average L firm produces 30% more than an average H firm. This difference in access to finance also implies differences in default probabilities, with H firms 10 times more likely to default.

6.4 Liberalizing the credit sector

After solving for the stationary equilibrium in scenarios *a.* to *d.*, I analyze the impact of the reforms in each case by comparing the situation of the economy before and after the reforms. The results are summarized in Table 12. Except when alternative finance is fully shut down (scenario *c.*), banking sector liberalization has clear positive effects: production increases by up to 5.5% and welfare by 1.8% to 2.6%. Prices moderately increase too, by up to 5.6% for the wage and 57 basis points for interest rates. Conversely, scenario *c.*'s results show the negative impact an alternative finance ban could have, even after liberalization: all indicators worsen, except aggregate capital. In the following, I examine the results in terms of general mechanisms at play, enterprise dynamics, investment financing, efficiency and welfare.

Table 12: Impact of banking sector liberalization, for different scenarios

	Change, with Alternative Financing Sector:			
	Never allowed *scenario a.*	Always allowed *scenario b.*	Shut down *scenario c.*	Partially shut down *scenario d.*
Aggregates				
Production	5.34%	5.47%	−0.75%	5.61%
Capital	9.54%	9.91%	2.43%	11.11%
Consumption	4.02%	3.10%	−1.08%	3.05%
MPK dispersion	−3.69%	−3.59%	10.35%	−0.85%
TFP	0.59%	0.48%	−1.93%	0.08%
Welfare	2.58%	1.82%	−0.78%	1.79%
Prices				
Bank lending rate	0.19	0.49	−1.54	0.06
Low alternative rate	-	0.50	-	0.06
High alternative rate	-	0.57	-	-
Wage	5.48%	5.41%	−0.6 %	5.62%
Firms' dynamics				
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

Dampening mechanisms

Before studying the impact of the various reform scenarios, it is useful to note the importance of general equilibrium effects. The impact of banking sector reforms in general equilibrium is about half the one in a partial equilibrium situation where all prices are fixed. For instance, when alternative finance is always allowed (scenario *b.*), the 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. Two main mechanisms impact directly the bank lending rate. First, due to the relaxed collateral constraint, firms' demand for bank loans increases. Second, the liberalization increases the average default probability of enterprises: firms can borrow higher amounts that they may not be able to roll-over in case of a bad shock. These two changes drive up the interest rate on bank loans. This second mechanism is also valid for alternative sources, and raises both alternative interest rates too. Last, given their higher capital level, enterprises also demand more labor, raising 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 in scenario *b.*. Consequently, to obtain accurate results, it is crucial to take into account general equilibrium effects, as they considerably reduce the impact of the reforms.

The impact of the reforms is also dampened by the presence of alternative finance. As shown comparing scenarios *a.* and *b.*, 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. Liberalizing the banking sector increases the aggregate production by similar amounts whether or not alternative finance is included in the model, and the resulting aggregate capital increase is also similar. Most importantly for a policy maker, however, the change in consumption decreases from 4.02% to 3.10%. The impact on welfare is thus one third smaller when alternative finance is accounted for (scenario *b.*). The development implications for small young firms are also more heterogeneous when alternative finance is available. It is therefore crucial, when estimating the potential impact of liberalization reforms, to include alternative financing sources which allow firms to bypass credit constraints and reduce the impact of liberalization. The decrease in welfare in scenario *c.*, in which alternative finance is fully shut down after the reforms, is another example of the importance role of alternative finance in the Chinese economy.

Firm level impact

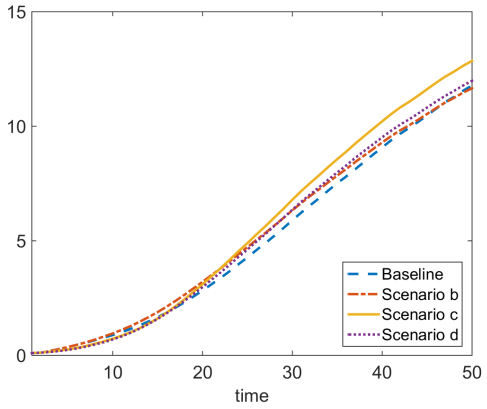
The average production and investment trajectories of newborn firms are shown in Figures 7 and 8, each panel starting with a different initial level of productivity. The blue dashed lines in both figures show the average production and investment of those firms in the baseline calibration. The red dashed-dotted lines correspond to scenario *b.* (liberalization of the banking sector, no change in alternative finance), while the yellow solid lines represent scenario *c.* (liberalization of the banking sector and closing of the alternative sector) and the purple dotted lines show scenario *d.* (liberalization of the banking sector and closing of the expensive alternative sector only).

Although liberalization in scenario b. allows firms to grow somewhat faster towards their steady state production level (see Figure 7[31]*), the present value of all firms decreases.* Firms have a higher investment level than in the baseline scenario, both in the early years and in steady state (cf. Figure 8), which is consistent with a higher level of accumulated capital. Conversely, the investment in the baseline scenario is delayed with no full catch-up later on, especially for firms with high initial productivity (Figure 8c) since their productivity gradually goes back to the average productivity

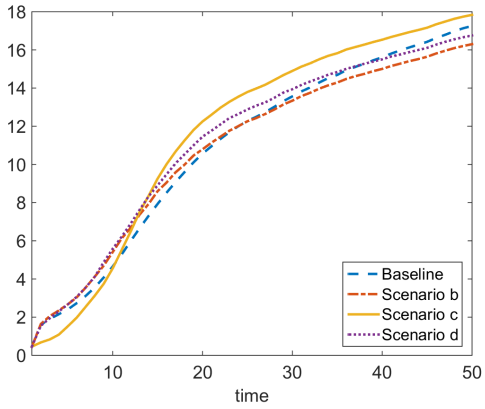
[31]The overshooting of production observed in Figure 7c is related to the very high initial productivity level of enterprises: their initially high production starts decreasing after about 10 years, when their productivity shock progressively returns to its steady state average level.

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

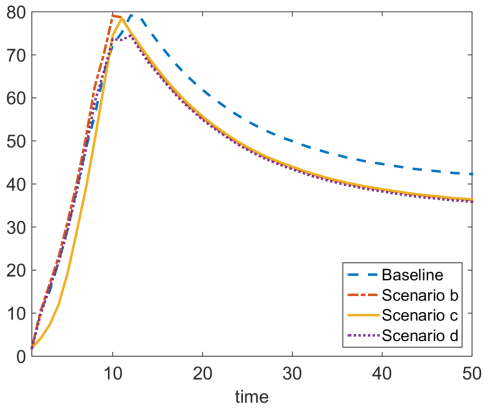
(a) Low initial productivity



(b) Medium initial productivity



(c) High initial productivity



level. Still, in scenarios *a.* and *b.*, the value of all firms (computed as their stream of discounted dividends) decreases, because of the higher input prices and the lower profit levels implied by the liberalization.

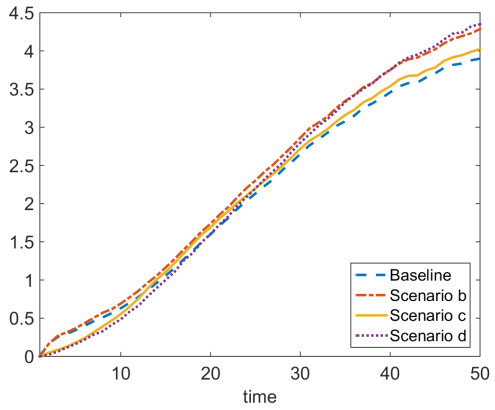
Liberalization benefits are not evenly shared across firms. Large firms tend to loose more than small firms in terms of value: they were less financially constrained before the reforms, and therefore benefit less from a better access to bank loans, and are hit more strongly by the increase in prices. High productivity firms gain more in scenarios *a.* and *b.*, and loose more in scenario *c.*. They reach their long term average production level faster, and see their average production increase by 7.65% in scenario *b.* (where alternative finance is alway allowed), against a negligible increase for low productivity firms.[32] Results are qualitatively similar for capital accumulation across firms. High productivity firms are able to finance more investment, hence accumulate more capital and produce more, thanks to an improved access to external finance. On the contrary, they are more affected by the tighter regulation imposed on alternative finance in scenarios *c.* and *d.*. While low productivity firms are still able to invest enough thanks to a better access to bank loans, this is not sufficient for high productivity firms to reach their (higher) optimal level of investment.

[32]The average production of low productivity firms even decreases in scenario *a.*.

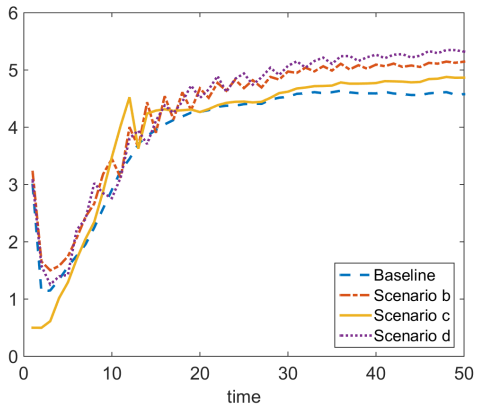
The impact of the reforms also varies depending on firms' easiness of access to alternative finance. H firms benefit more from liberalization, with their average capital increasing by 11.5% in scenario *b.*, against 8.6% for L firms, implying increases in average production of 6.5% and 4.5% respectively. This difference is even larger when alternative finance is fully shut down (scenario *c.*): H firms increase their production even more (by 14.6%), whereas L firms' average production is strongly hit by the absence of alternative finance and decreases by 12%.

Figure 8: Average investment path of a new-born firm starting with low capital

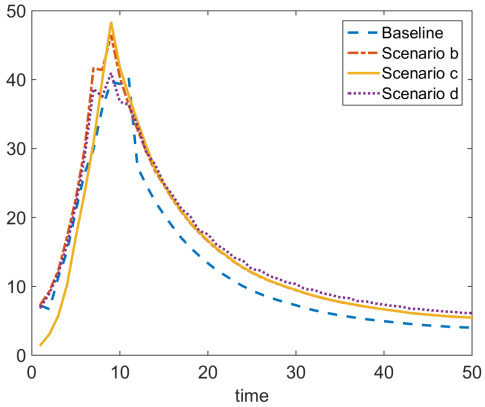
(a) Low initial productivity



(b) Medium initial productivity



(c) High initial productivity



The importance of alternative finance for firm dynamics, even after the liberalization of the banking sector, is striking in scenario c.. The growth in capital and production of newborn firms is much slower. Tighter regulation is initially more detrimental to young, high productivity firms, who have to delay their investment during the first 10 periods of their activity (see Figure 8). While medium and low productivity firms tend to remain smaller in the post-reforms steady state, high productivity firms are the only ones whose steady state average level of capital and production does not decrease: their high productivity allows them to progressively accumulate retained earnings and capital, and gain a better access to bank loans. As smaller firms face more hurdles to invest, they remain smaller for longer, and their share in the aggregate economy increases to 40% (up from 34%). Hence the aggregate production decreases. Banning alternative finance proves thus to

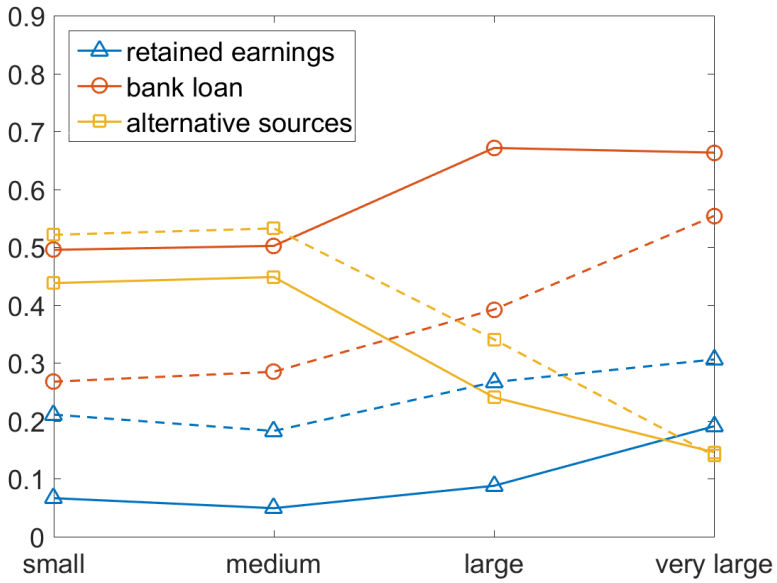
be detrimental to most firms, and to delay useful investment.

Finally, scenario d. shows that easily accessible ("cheap") alternative finance is the most important element of alternative financing. Even though H firms cannot access "expensive" alternative finance any more, the availability of "cheap" alternative finance for L firms is enough to reach liberalization benefits equivalent to scenario *b.*. In this case, both medium and high productivity firms manage to increase their capital and production by up to 14% and 7% respectively after liberalization. As can be seen in Figure 8, scenario *d.* allows for a higher investment level for young, medium and high productivity firms. Both types L and H see their average capital and production increase substantially, at levels equivalent to scenario *b.*. Tighter regulation is still detrimental only to low productivity firms, whose investment level is below the baseline one for the first 15 periods of their activity and whose average production decreases.

Use of financial resources

Having a closer look at the change in firm investment financing behavior helps understand the mechanisms behind the impact of the reforms. Focusing on scenario *b.* (where alternative finance is always allowed), *the liberalization causes a strong increase in the share of investment financed by bank loans* (up by 74%) while shares of investment financed by retained earnings and alternative finance decrease by 68% and 18% respectively. The loosening of the collateral constraint increases both the total amount of bank loans distributed and the size of aggregate investment to be financed. Figure 9 shows the resulting changes in financing patterns across firm size. For all firms, the share of bank loans increases, while the share of retained earnings and alternative finance tends to decrease. This is less the case for very large firms, as many of them benefit from a "cheap" access to alternative finance and keep using it.

Figure 9: Shares of financial sources for investment (baseline in dashed lines, scenario *b.* in solid lines)



At the extensive margin, the quantitative impact of reforms on bank borrowing is relatively small and, if anything, tends to decrease the total amount borrowed from banks. 6.4% 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 – but 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 2.3% of borrowing before the liberalization.

The bulk of the increase in bank borrowing is at the intensive margin. Firms that were already borrowing from the banks before and keep on doing so 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.

The easier access to bank loans goes hand in hand with a marked decrease in the use of alternative finance and retained earnings. At the extensive margin, 10% and 27%, respectively, of the firms that were using alternative finance or retained earnings to finance investment before the reforms stop doing so. While this extensive margin effect dominates in explaining the decrease in retained earnings use, most of the lower use of alternative finance is happening at the intensive margin.

Misallocations, efficiency and welfare

Misallocation issues are striking when alternative finance is fully shut down (scenario *c.*): although aggregate capital increases, production decreases slightly. There are two effects in this case: first, the strong drop in the bank loan rate and the relaxation of the collateral constraint favors a higher aggregate level of capital than in the baseline – though far from the increase seen when alternative finance is always allowed (scenario *b.*). Second, financial constraints are still present in this scenario, alternative financial sources cannot be used any more to alleviate them and more productive firms are unable to invest as much as they should. Aggregate capital is higher, but its allocation is worse, as is shown by the increased dispersion of the marginal productivity of capital (MPK) across firms, from 0.142 to 0.157. As a consequence, aggregate production decreases, and so does aggregate consumption.

More generally, in all scenarios except scenario *c.*, the dispersion of MPK decreases after the reforms. While liberalization improves capital allocation, tightening the regulation of alternative finance dampens or even cancels this progress in scenarios *c.* and *d.*. MPK dispersion decreases by 3.6% in scenario *b.* (alternative finance always allowed), whereas it decreases only by 0.9% in scenario *d.* (only "cheap" alternative finance allowed). This is confirmed by the evolution of the total factor productivity, that increases by 0.5% in scenario *b.* against 0,1% in scenario *d.*, and decreases by 1.9% in scenario *c.*.[33]

[33]The reader may be interested in comparing these results to the ones obtained by Hsieh and Klenow (2009) in

The absolute level of the MPK for different types of firms tells us which ones are more financially constrained. As expected, type H firms are more constrained than type L: their average MPK is 16% higher in scenario *b.*, and 17% higher in scenario *d.*. This corroborates the importance of alternative finance in alleviating resource misallocations and improving aggregate welfare. Yet, in both scenarios, the MPK of H firms decreases more compared to the baseline case, confirming that H firms benefit more from the liberalization.

Another important aspect of the credit allocation relates to the riskiness of loans. Due to liberalization, all firms are able to borrow larger amounts. As a consequence, the average default probability for L and H firms quadruples and decreases by 30%, respectively, in scenario *b.*. Small firms are more easily able to roll over their debt and avoid default, while larger firms borrow more and default more often in this scenario, resulting in an increase in the share of non-performing loans by 11%. Conversely, the average default probability becomes negligible in scenario *c.*, where all alternative finance is banned. Scenario *d.* is in-between, with the default probability of L and H firms respectively moving in opposite directions and the share of non-performing loans decreasing by 55%. These results show the trade-off between efficiency and financial stability behind the regulation of alternative finance. A tighter regulation increases capital misallocation, but also decreases firms' default probability by limiting the amount they can borrow and their ability to roll-over their debt.

The results of all scenarios including alternative finance (scenarios *b.*, *c.* and *d.*) imply that the welfare loss due to an inefficient use of resources is higher than the one due to non-performing loans. Facilitating investment for small, young, high productivity firms has a positive impact despite the higher default probabilities it implies. Apart from the thought experiment of scenario *a.*, the increase in consumption and welfare is the highest (1.82%) in scenario *b.*, where misallocation is less important. While banning both forms of alternative finance deteriorates both capital allocation and welfare, banning only expensive alternative finance has the advantage of limiting misallocation and reducing the resources spent in accessing alternative finance (corresponding to the access cost $x^H(a^H)$). This slight tightening of regulation brings a result similar to scenario *b.* in terms of consumption and welfare, and could be a reasonable compromise between banking sector liberalization and alternative finance regulation, allowing for a more efficient resource allocation and a more limited increase in non-performing loans.

Ten years later

A more recent version of the Enterprise Survey, conducted in 2012, provides additional data on investment financing sources. The financing sources defined in the questionnaire have changed, so that an exact comparison with the data from 2003 is not possible. However, we can see from the 2012 data that the share of investment financing by internal funds and retained earnings is much

their study of resource misallocation in India and China. In the baseline situation, suppressing capital distortions following a similar procedure would lead to an increase of TFP by 17.3%. Even after the reforms in scenarios *a.* to *d.*, following the same procedure, TFP could still be increased by 19.6%, 16.8%, 19.6% and 17.2% respectively. While these numbers remain smaller than the ones obtained by Hsieh and Klenow (2009), they are much larger than the TFP impact of liberalization reforms studied in my paper. Indeed, my set-up contains uncertainty regarding future productivity which mechanically creates additional ex-post capital misallocation, regardless of distortions in capital access. These misallocations are still present in all scenarios after the reforms, but are removed by Hsieh and Klenow (2009)'s methodology. This fundamental difference renders difficult a relevant comparison.

higher on average (almost 90%), and more so for smaller firms (cf. Table 27 in Appendix A). The use of alternative finance[34] (resp. bank loans) is still decreasing (resp. increasing) with firm size, but their general importance has strongly decreased between 2003 and 2012.

This evolution seems to indicate that the government's efforts to limit the use of alternative finance were relatively successful, not only at "curbing usury", but also at encouraging more formal financing sources in general. It also shows that firms have accumulated profits during this decade and are able to finance most of their investment through internal finance, which is generally considered as the cheapest. This is related to a change in the age distribution of firms between 2003 and 2012. Less than 3% of private firms surveyed in 2012 are below 5 years old, against 14% in 2003. While more than half of the firms surveyed in 2012 are 10 to 20 years old, the majority of the firms surveyed in 2003 were created less than 5 years before. Logically, these older firms operating in 2011 have more retained earnings at hand to finance their investment.

Access to bank loans however does not seem to have become easier. While 58% of firms needed collateral to obtain their loan in 2003, this proportion reaches 76% of firms in 2012. Among firms needing a loan in 2011, the lack of collateral remains the first reason for renouncing to apply, followed by the restricted loan size and maturity, and the high interest rates. It seems therefore that the constraints faced by firms to obtain bank loans were not loosened as expected, but rather tightened – driving firms into using less bank loans to finance their investment.

7 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 idiosyncratic productivity shocks, a collateral constraint and different costs of access to alternative sources of funding. It 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.

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. Behind these reforms, there is a trade-off between improving resource allocation and efficiency, and decreasing the occurence of non-performing loans. I show that a banking sector liberalization has a positive general impact on the economy, although not as large as one could expect if a "naive" view of the economy is taken and alternative finance or general equilibrium effects are not accounted for. By alleviating the credit constraints faced by enterprises ex ante, alternative finance reduces the efficiency and welfare impact of the liberalizing reforms. Although these reforms increase the

[34] In the 2012 data, I define alternative finance as the following categories: credit from suppliers and advances from customers, non-bank financial institutions and others. Separated categories for family, friends, informal sources and non-listed equity do not exist any more in the questionnaire.

firms' default probability, they increase both aggregate consumption and welfare, and improve the development speed of newborn enterprises. A liberalization of the banking sector increases aggregate production and consumption respectively by 5.5% and 3.1%. This results in a welfare improvement of 1.8%.

Tightening the regulation of alternative finance simultaneously to the banking liberalization, besides reducing the share of non-performing loans, may diminish —or even cancel —the benefits of the liberalization in terms of consumption and welfare. A full ban on alternative finance is found to impact younger, smaller, more productive firms, by reducing their access to credit and their investment, thus slowing down their growth. Restricting only expensive alternative finance while keeping cheap alternative finance alive could be a possible path to avoid this pitfall. The resulting efficiency gains are relatively small, but most of the welfare gains from the reforms are preserved, and the share of non-performing loans decreases.

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 benefit to all enterprises, especially small, highly productive ones. Results also imply that non-bank credit institutions should be regulated carefully to prevent a rise in non-performing loans. 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 reached the final steps of this liberalization in late 2015. This paper shows that such a liberalization is a useful step before regulating more tightly the alternative financing sector. Survey data from 2012 indicate that, while investment financing sources have become less informal between 2003 and 2012, smaller firms still face difficulties in accessing bank loans. Despite on-going efforts from the Chinese authorities, there is still a long way to go to ensure an efficient credit distribution through the formal banking sector.

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Appendix

A Tables

Table 13: 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 from the 2002 and 2003 Enterprise Survey conducted by the Workd Bank, available at `http://www.enterprisesurveys.org/`

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.

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

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

Table 14: 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
Total		100	100	100	100
Observations		58	630	27	124

Source: Enterprise survey, 2003.

Table 15: 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
Total		100	100	100	100
Observations		164	121	178	167

Source: Enterprise survey, 2003. Private firms only. Small firms: annual total sales below 2.5 million RMB, medium firms: between 2.5 and 10 million RMB, large firms: between 10 and 50 million RMB, very large firms: above 50 million RMB.

Table 16: 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

Source: Enterprise survey, 2003.

Table 17: 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

Source: Enterprise survey, 2003. Private firms only. Small firms: annual total sales below 2.5 million RMB, medium firms: between 2.5 and 10 million RMB, large firms: between 10 and 50 million RMB, very large firms: above 50 million RMB.

Table 18: 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 19: 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

Source: Enterprise survey, 2003. Private firms only. Small firms: annual total sales below 2.5 million RMB, medium firms: between 2.5 and 10 million RMB, large firms: between 10 and 50 million RMB, very large firms: above 50 million RMB.

Table 20: 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 21: 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

Source: Enterprise survey, 2003. Private firms only. Small firms: annual total sales below 2.5 million RMB, medium firms: between 2.5 and 10 million RMB, large firms: between 10 and 50 million RMB, very large firms: above 50 million RMB.

Table 22: 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
Total		100	100	100	100	100
Observations		1177	935	122	109	11

Source: Enterprise survey, 2005. Private firms only. Small firms: below 50 employees, medium firms: between 50 and 250, large firms: between 250 and 1000, very large firms: above 1000 employees.

Table 23: 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
Total		100	100	100	100	100
Observations		1468	918	320	109	24

Source: Enterprise survey, 2005. Private firms only. Small firms: below 50 employees, medium firms: between 50 and 250, large firms: between 250 and 1000, very large firms: above 1000 employees.

Table 24: 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
Total		100	100	100	100	100
Observations		559	404	122	25	8

Source: Enterprise survey, 2006. Private firms only. Small firms: below 50 employees, medium firms: between 50 and 250, large firms: between 250 and 1000, very large firms: above 1000 employees.

Table 25: Average interest rate and collateral required for bank loans, by amount invested (in thousand yuan)

	0-100	100-1000	1000-10000	>10000
	mean	mean	mean	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

26 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 Estimation of the production function

There is an 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. The approach suggested by Olley and Pakes (1996, hereafter OP) takes this simultaneity into account by using investment as a proxy for the productivity shock. They correct both for endogeneity and sample selection issues due to firms' exit (for instance if they stop their activity during the survey). 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

Table 26: 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

Table 27: Sources of funding for new investment for China in 2012, by firm size (in terms of employment)

	All	Small	Medium	Large	Very Large
Internal funds/retained earnings	89.54	91.40	87.15	86.71	84.53
Private and state-owned banks	4.564	2.708	7.128	6.219	10.47
Alternative sources	2.755	3.479	1.969	0.767	1.096
Owners' contribution or new equity shares	3.139	2.414	3.752	6.302	3.901
Observations	1261	391	638	179	53

Source: Enterprise survey, 2012. Private firms only. Small firms: below 50 employees, medium firms: between 50 and 250, large firms: between 250 and 1000, very large firms: above 1000 employees.

LP's approach are available upon request.

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. 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 28: 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 28 presents the results of the estimation of the production function for OP's method. Results obtained with OLS and fixed effects for the whole sample are shown in Table 29 for reference. The variable used for output 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 an 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 discretize this AR(1) process into a Markov-Chain using Tauchen (1986)'s procedure. 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.[35] I obtain the following values for the shocks matrix A and for the transition matrix T.

$$A = \begin{pmatrix} 0.35 & 0.75 & 1 & 1.6 & 2.7 \end{pmatrix} \tag{39}$$

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

$$T = \begin{pmatrix} 0.8765 & 0.1235 & 0 & 0 & 0 \\ 0.0164 & 0.9146 & 0.0690 & 0 & 0 \\ 0 & 0.0352 & 0.9295 & 0.0352 & 0 \\ 0 & 0 & 0.0690 & 0.9146 & 0.0164 \\ 0 & 0 & 0 & 0.1235 & 0.8765 \end{pmatrix} \tag{40}$$

Table 29: 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

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

C Proofs

C.1 The first order conditions of the firms

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 each 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 (10), (11), (12) and (13). For better readability, I describe the Lagrangian separately for three cases: positive profits and dividends, positive profits and zero dividends, negative profits.

Positive dividends

$$\mathcal{L} = \Pi_E - x^j(a') - e' + \beta(1-\xi)\mathbb{E}V + \lambda(\theta k - qb') + \mu(\Pi_E - e' - x^j(a')) \tag{41}$$

Positive profit, zero dividends

$$\mathcal{L} = \beta(1-\xi)\mathbb{E}V + \lambda(\theta k - qb') + \nu(qb' + \Pi_E - x^j(a')) \tag{42}$$

Negative profits

$$\mathcal{L} = \beta(1-\xi)\mathbb{E}V + \lambda(\theta k - qb') + \nu(qb' - x^j(a')) + \zeta(\Pi_E - x^j(a') + qb' + q_a^j a') \tag{43}$$

From the first order conditions of the problem and the envelop theorem, I obtain equations (44) to (50) 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

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{1+\mu}{\beta(1-\xi)} \tag{44}$$

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{\lambda}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial \mathbb{E}V}{\partial d'} \tag{45}$$

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{x^{j\prime}(a')(1+\mu)}{\beta(1-\xi)q_a^j} - \frac{1}{q_a^j}\frac{\partial \mathbb{E}V}{\partial d'} \tag{46}$$

Positive profits, zero dividends

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{\lambda-\nu}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial \mathbb{E}V}{\partial d'} \tag{47}$$

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{\nu x^{j\prime}(a')}{\beta(1-\xi)(q_a^j - x^{j\prime}(a'))} - \frac{1}{q_a^j - x^{j\prime}(a')}\frac{\partial \mathbb{E}V}{\partial d'} \tag{48}$$

Negative profits

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{\lambda-\nu-\zeta}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial \mathbb{E}V}{\partial d'} \tag{49}$$

$$\frac{\partial \mathbb{E}V}{\partial k'} = \frac{\nu x^{j\prime}(a')}{\beta(1-\xi)(q_a^j - x^{j\prime}(a'))} - \frac{\zeta}{\beta(1-\xi)} - \frac{1}{q_a^j - x^{j\prime}(a')}\frac{\partial \mathbb{E}V}{\partial d'} \tag{50}$$

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.

C.2 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:

- Positive dividends:

$$\frac{\partial V^{ND}}{\partial k} = (1+\mu)\alpha A k^{\alpha-1} l^{\gamma} + \lambda\theta > 0 \tag{51}$$

$$\frac{\partial V^{ND}}{\partial d} = -1 - \mu < 0 \tag{52}$$

- Positive profits, zero dividends:

$$\frac{\partial V^{ND}}{\partial k} = \nu\alpha A k^{\alpha-1} l^{\gamma} + \lambda\theta \geq 0 \tag{53}$$

$$\frac{\partial V^{ND}}{\partial d} = -\nu \leq 0 \tag{54}$$

- Negative profits:

$$\frac{\partial V^{ND}}{\partial k} = \zeta\alpha A k^{\alpha-1} l^{\gamma} + \lambda\theta \geq 0 \tag{55}$$

$$\frac{\partial V^{ND}}{\partial d} = -\zeta \leq 0 \tag{56}$$

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 (45) and (46), I define the marginal benefit of investing (the same for all sources of funding) as:

$$B_m(b') = B_m(a') = B_m(e') = \frac{\partial EV}{\partial k'} \tag{57}$$

Focusing on the case where the firm distributes positive dividends, I then examine the marginal cost of investment depending on the financing source:

$$C_m(e') = \frac{1+\mu}{\beta(1-\xi)} \tag{58}$$

$$C_m(b') = \frac{\lambda}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial EV}{\partial d'} \tag{59}$$

$$C_m(a') = \frac{x^{j\prime}(a')(1+\mu)}{q_a^j \beta(1-\xi)} - \frac{1}{q_a^j}\frac{\partial EV}{\partial d'} \tag{60}$$

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

$$C_m(a') - C_m(e') = \underbrace{\frac{1+\mu}{\beta(1-\xi)}}_{\geq 0}\left(\frac{x^{j\prime}(a')}{q_a^j} - 1\right) - \frac{1}{q_a^j}\underbrace{\frac{\partial EV}{\partial d'}}_{\leq 0} \tag{61}$$

$q_a^j - x^{j\prime}(a') < 0$ 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.*

$$C_m(a') - C_m(b') = \underbrace{\frac{x^{j\prime}(a')(1+\mu)}{q_a^j \beta(1-\xi)}}_{\geq 0} - \frac{\lambda}{\beta(1-\xi)} + \left(\frac{1}{q} - \frac{1}{q_a^j}\right) \underbrace{\frac{\partial EV}{\partial d'}}_{\leq 0} \tag{62}$$

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. □

C.3 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:

$$B_m(b') = B_m(a') = \frac{\partial EV}{\partial k'} \tag{63}$$

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:

$$C_m(b') = \frac{\lambda - \nu}{\beta(1-\xi)} - \frac{1}{q}\frac{\partial EV}{\partial d'} \tag{64}$$

$$C_m(a') = \frac{x^{j\prime}(a')}{\beta(1-\xi)(q_a^j - x^{j\prime}(a'))} - \frac{1}{q_a^j - x^{j\prime}(a')}\frac{\partial EV}{\partial d'} \tag{65}$$

$$C_m(a') - C_m(b') = \underbrace{\frac{x^{j\prime}(a')}{\beta(1-\xi)(q_a^j - x^{j\prime}(a'))}}_{\geq 0} + \frac{\nu - \lambda}{\beta(1-\xi)} + \left(\frac{1}{q} - \frac{1}{q_a^j - x^{j\prime}(a')}\right) \underbrace{\frac{\partial EV}{\partial d'}}_{\leq 0} \tag{66}$$

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.

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

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

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

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

□