Internal finance and growth: microeconometric evidence on Chinese firms

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Abstract

Using a panel of 79,841 Chinese firms over the period 2000-2007, we examine the extent to which liquidity constraints affect firms' assets growth. We find that state owned enterprises are not affected, while the availability of internal finance represents a binding constraint for the growth of private firms, especially those operating in coastal regions, with negligible foreign ownership. Thanks to their high productivity, cash flow is, however, so abundant for these firms that they are able to grow at a very fast rate, despite being discriminated against by financial institutions. Hence, well developed external capital markets may not always be needed for fast economic growth.

Keywords: Assets growth, Cash flow, Financial constraints

JEL Classification: C23; D92; E44; G32; L25; O16

* We thank three anonymous referees, E. Cannon, M. Chen, S. Fazzari, H. Kruiniger, B. Fleischer, M. Marchica, P. Mizen, R. Mura, L. Parisi, Y. Yao, and the participants to seminars at the Universities of Bath, Bristol, Durham, Manchester, and Newcastle; and to the 2007 workshop on the use of panel data in macroeconomics and finance organized by the Money, Macro and Finance Research Group, the 19th UK Chinese Economic Association Annual Conference, the "Microeconomic Drivers of Growth in China" Oxford Conference, and the "Post-Olympic China: Globalisation and Sustainable Development after three Decades of Reform" Nottingham Conference for helpful comments. A. Guariglia and L. Song gratefully acknowledge financial support from the University of Nottingham Research on and in Asia Fund ASIA4246, and from the Leverhulme Trust under Programme Grant F/00 114/AM.
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1. Introduction

Over the period 2000-2007, Chinese firms achieved very high growth rates and generated large cash flow streams: their average assets growth was 8.6% and their average cash flow to total assets ratio, 8.05%[1]. Are these two features related? And if so, what is the nature of the link that connects them? Our paper seeks to answer these questions.

We provide a meaningful contribution to the literature on finance and economic growth. Numerous papers in this literature have used macro data to investigate the links between broad measures of financial development and growth, and generally found a positive relationship (see Levine, 2005, for a survey). Yet, China is a counterexample to these findings: in spite of a malfunctioning financial system, it has one of the fastest growing economies (Allen at al., 2005). The present paper helps to rationalize this puzzle (which we denote hereafter as the Chinese growth puzzle) by investigating the role played by the availability of internally generated funds in determining firm-level growth[2].

Our research also relates to the literature on financing constraints and firm behavior. In recent years, a number of papers have analyzed the extent to which measures of internal finance (such as cash flow) affect firm investment in fixed capital, inventories, or R&D, which can be seen as specific components of firm growth. Most of these studies interpret a positive link between cash flow and investment as an indicator of financial constraints[3]. A financially constrained firm, for which it is difficult or too expensive to obtain external finance, will in fact only invest if it has sufficient internal funds, and will be forced to reduce its investment, and hence its growth, following drops in its cash flow.

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[1] These figures are obtained from our dataset, which is a large-scale enterprise survey conducted by the Chinese National Bureau of Statistics (NBS) and covering all state owned enterprises and other types of enterprises with annual sales of five million yuan (about $650,000) or more. This dataset is thoroughly described in Section 3. Throughout the paper, we will refer to firm assets growth and firm growth interchangeably. It should be noted, however, that for firms having over-capacity in assets, output growth (which is what is often referred to as firm growth) may not necessarily require assets growth.

[2] To the best of our knowledge, this approach, which was pioneered in 2002 by Carpenter and Petersen who applied it to small US listed firms, has never been used with reference to a developing country. See Hutchinson and Xavier (2006) for an application to Belgium and Slovenia. Hereafter, we will use the terms internal finance, internally generated funds, and cash flow, interchangeably.

[3] This view (the financing constraints hypothesis) has, however, been challenged by Kaplan and Zingales (1997), Cleary (1999), and Cummins et al. (2006). See Schiantarelli (1995), Hubbard (1998), and Bond and Van Reenen (2007), for surveys of the literature on financing constraints and firm behavior.

Given the heterogeneity that characterizes it, the Chinese economy represents an ideal laboratory for testing the financing constraints hypothesis. It contains in fact several types of firms, likely to face very different degrees of credit constraints. The two extreme groups are the state owned and the private enterprises. Because of their need to respond to both political and social stresses, as well as to economic objectives, the state owned enterprises (SOEs) typically experience soft budget constraints, and are able to obtain large amounts of loans from the banking system, despite their low profitability (Bai et al., 2006). These firms are therefore unlikely to face any financial constraints, and we do not expect their growth to be significantly affected by their internally generated funds. Private firms, on the other hand, make up the largest group, and constitute the engine of growth of the Chinese economy, with assets growth rates in excess of 8%. Yet, these firms are typically discriminated against in terms of access to external funding (Allen et al., 2005)[4]. For these financially constrained firms, the ability to generate high cash flow streams may have played a significant role in financing their spectacular growth rates.

Despite China being a very interesting case study, only a handful of papers attempted to test whether the financing constraints hypothesis holds for Chinese firms (Chow and Fung, 1998, 2000; Héricourt and Poncet, 2009; Poncet et al., 2010). These studies are based on datasets made up of relatively small numbers of firms, which are typically not representative of the population of Chinese firms and are likely to suffer from serious sample selection bias.

We contribute to this literature in four important ways. First, we use a very large and relatively unexplored dataset, compiled by the Chinese NBS over the period 2000-2007, and made up of 79,841 unlisted manufacturing and mining firms, which sum up to 499,001 observations. This dataset includes a large proportion of small and young firms, which are particularly likely to suffer from liquidity constraints. It

[4] Until 1998, state owned commercial banks were instructed to lend only to state owned enterprises. The system was liberalized at the end of 1990s, when the Chinese Constitution acknowledged the private sector to be an integral part of the economy, and theoretically it is not in place any more. However, in practice, banks still consider private enterprises to be riskier than their public peers due to their short credit history and lower chance of being bailed out by the government. Evidence for this is given in World Bank (2003), which documents that over the period 1997-2000, only 12% of the working capital of Chinese small and medium-sized enterprises (which are mainly private) came from bank loans. As a result of this bank discrimination, the strongest determinant of the allocation of investment funds in China appears to be the prominence of SOEs in local economies (World Bank, 2005). Given the low productivity of SOEs, this means that capital is typically allocated away from the most productive regions and towards the least productive ones. World Bank (2005) also documents that the share of SOEs in local industries has a clear positive and statistically significant effect on the size of investment financed by bank loans in these industries.

provides us with a unique opportunity to carry out much sharper tests of the financing constraints hypothesis than those typically performed in the literature, which are mostly based on samples of relatively healthy listed US or UK firms[5]. To the best of our knowledge, the financing constraints hypothesis has never been tested using such a comprehensive dataset[6].

Second, unlike Chow and Fung (1998, 2000), Héricourt and Poncet (2009), and Poncet et al. (2010), who only concentrate on firms' investment, we focus on the growth of firms' total assets, which encompasses all possible uses of cash flow. For financially constrained firms, we predict a relationship between internal finance and assets growth of the order of one-for-one. Considering the phenomenal growth that has characterized Chinese firms in recent years, in spite of a poorly developed financial system, this represents a meaningful contribution.

Third, for the first time in the Chinese context, we investigate whether different categories of private firms face different degrees of financing constraints.

Finally, for the first time in the literature, we compute and analyze firm-level assets growth to cash flow sensitivities, with the aim of assessing whether simultaneous pervasive credit constraints (proxied by high cash flow sensitivities) and high growth may induce efficiency losses, which could reduce the potential for future growth.

We find that the growth of SOEs' and collective firms' assets is not affected by the availability of cash flow, while that of private and foreign owned firms is most affected. These results are robust to accounting for investment opportunities in several ways, to considering assets growth net of cash, and to defining our ownership categories in different ways. We also find evidence of heterogeneity across private firms: it is those private firms that operate in the coastal regions and have negligible foreign ownership that are most affected by financing constraints. Furthermore, we find that those private firms characterized by high sensitivities of assets growth to

[5] Most of the studies based on US data make use of Compustat, while studies based on the UK make use of Datastream. Only a few papers in the literature have tested the financing constraints hypothesis using panels containing unlisted firms (see for instance Benito, 2005, and Guariglia, 2008), but their datasets are generally much smaller than ours.

[6] Another advantage of our dataset is that it contains a continuous measure of ownership, based on the fraction of the firms' total capital paid in by various agents. This variable gives a better picture of the firms' ownership than the time-invariant registration codes used in Poncet et al. (2010); the subjective assessment of the firms' ownership provided at one point in time by the firms' managers, used in Héricourt and Poncet (2009); or the four broad ownership categories (state-owned enterprises, collectively-owned enterprises, international joint-ventures, and other enterprises) used in Chow and Fung (1998, 2000).

cash flow (i.e. by a high degree of financing constraints) and rapid growth display higher cash flow than their counterparts with low sensitivities. This suggests that these firms use internal funds to finance their growth. Yet, the accumulation of high cash flow does not occur at the expense of wages and training expenses. The simultaneous presence of credit constraints and high growth is therefore unlikely to induce significant efficiency losses. Finally, we find that firms characterized by high sensitivities of assets growth to cash flow and high growth display high productivity and productivity growth, suggesting that high productivity may be key in explaining how these firms manage to accumulate the high cash flow that enables them to grow despite heavy financing constraints.

Considering that private firms make up on average about 64% of the observations in our sample, the Chinese miracle, which was driven by these highly productive firms, may have been made possible by their ability to generate vast amounts of internal funds, which enabled them to grow, in spite of their inability to obtain external finance. Hence, high growth rates may be compatible with binding financing constraints as long as there are sufficient levels of internal finance.

The paper proceeds as follows: Section 2 reviews the literature on the links between finance and growth in China, both from a macro and a micro perspective. Section 3 describes our dataset and presents some descriptive statistics. Section 4 illustrates our baseline specification and estimation methodology. Section 5 describes our main empirical findings and the results of some robustness tests and extensions. Section 6 concludes.

2. Links between finance and growth in China

2.1 A macro perspective

A number of studies use provincial level panel data, over different time periods ranging between 1985 and 2003, to analyze the relationship between financial development and economic growth in China, in an attempt to understand the Chinese growth puzzle. They reach contrasting conclusions: some papers find a positive link (e.g. Cheng and Degryse, 2010), others document a negative link (e.g. Boyreau-Debray, 2003), and others no link at all (e.g. Aziz and Duenwald, 2002). These studies make use of different financial indicators, and different econometric techniques, and focus on different time periods, which might explain their mixed results. Yet, provincial data do not permit a full understanding of the relationship between finance and growth in China, as they ignore the considerable heterogeneity characterizing individual Chinese firms. Studies based on micro data are therefore necessary for this purpose.

2.2 A micro perspective

Other studies adopt a micro perspective and use firm-level data to understand the links between finance and growth in China. Among these, a group of papers look at the relationship between specific sources of external finance and firm growth; another at the links between financial variables and investment in fixed capital (which is a significant component of firm growth).

Within the first group, Ayyagari et al. (2008) and Cull et al. (2009) focus on firm-level data to explain the high growth rates experienced in China, in spite of a poorly developed financial system. The former rely on the World Bank Investment Climate Survey dataset, which covers 2400 Chinese firms across 18 different cities, over the period 2000-2003. The authors show that a relatively small percentage of firms in their sample use formal bank finance, while reliance on informal finance is much stronger. They then question whether it is non-standard financing mechanisms that promote growth in China, but are unable to find conclusive evidence in favor of this hypothesis. Cull et al. (2009), on the other hand, use data drawn from the annual accounting reports filed by industrial firms with the NBS to investigate whether trade credit could have been what financed China's spectacular growth, in spite of its malfunctioning financial system. They conclude that trade credit did not play a significant role in explaining China's growth[7]. Neither of these studies provides therefore a solution to the Chinese growth puzzle.

Among the second group of papers, Chow and Fung (1998) study the relationship between investment and cash flow using a panel of 5825 manufacturing firms operating in Shanghai over the period 1989-1992, with the objective of testing the financing constraints hypothesis. They find that firms' investment is constrained by cash flow, and that the sensitivity of investment to cash flow is highest for private firms and lowest for foreign owned firms. State owned and collective firms also exhibit positive sensitivities, higher for the former. Chow and Fung (2000) exploit the

[7] Allen et al. (2008) reach a similar conclusion in a recent study of the financial system capacities of China and India.

same data set as Chow and Fung (1998) and, focusing once again on investment equations, show that small firms exhibit lower sensitivities of investment to cash flow than large firms. They explain this finding considering that small firms are dominated by non-state, fast growing enterprises, which may be using their working capital to smooth their fixed investment. Using an Euler equation framework and data from 1300 firms operating in 18 Chinese cities, and 14,967 firms operating over the entire Chinese territory, respectively, Héricourt and Poncet (2009) and Poncet et al. (2010) show that, contrary to SOEs, private firms' investment is strongly affected by financial variables. These studies suggest that as cash flow plays an important role in determining firm investment, it is also likely to affect firm growth[8].

We provide a synthesis between these two groups of studies. Our paper connects with Ayyagari et al. (2008) and Cull et al. (2009), in the sense that it also uses firm-level data to analyze firm growth. Yet, instead of focusing on the actual links between growth and specific sources of external finance, it follows the approach of the investment literature by assessing the extent to which firms' assets growth is affected by the availability of internal finance (proxied by cash flow). As in the investment literature, a strong dependence of assets growth on cash flow can be seen as an indicator of financing constraints. If, following a decline in its internal funds, a firm is forced to reduce its growth (by reducing, for instance, its investment in fixed capital and/or working capital), one can infer that the firm finds it difficult to access external finance.

Yet, these financial constraints could be accompanied by increasing growth rates for firms with good investment prospects, able to generate large amounts of internal funds. This could have been the case for Chinese private firms and could explain why, in spite of a malfunctioning financial system, China has one of the fastest growing economies, and can be seen as a counterexample to the findings of the finance-growth literature (Allen et al., 2005). The Chinese miracle could in fact have been driven by highly profitable private firms, which were able to finance high growth levels only through their retained earnings. High growth rates may hence be compatible with binding financial constraints, as long as firms have sufficiently high levels of internal finance.

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[8] Héricourt and Poncet (2009) and Poncet et al. (2010) use an Euler equation framework, and include the leverage ratio and the coverage ratio as their main financial variables.

3. Data and summary statistics

3.1 Data

We use data drawn from the annual accounting reports filed by industrial firms with the NBS over the period 2000-2007. All state-owned enterprises and other types of enterprises with annual sales of five million yuan (about $650,000) or more are covered. These firms operate in the manufacturing and mining sectors and come from 31 provinces or province-equivalent municipal cities. We dropped observations with negative sales; as well as observations with negative total assets minus total fixed assets; total assets minus liquid assets; and accumulated depreciation minus current depreciation. Firms that did not have complete records on our main regression variables were also dropped. To control for the potential influence of outliers, we excluded observations in the one percent tails of each of the regression variables. Finally, we dropped all firms with less than 5 years of consecutive observations[9]. Our final panel covers 79,841 mainly unlisted firms, which corresponds to 499,001 firm-year observations[10]. It is unbalanced, with number of observations ranging from a minimum of 39,781 in 2000 to a maximum of 72,296 in 2003[11].

The NBS data contains a continuous measure of ownership, which is based on the fraction of paid-in-capital contributed by six different types of investors, namely the state; foreign investors (excluding those from Hong Kong, Macao, and Taiwan); investors from Hong Kong, Macao, and Taiwan; legal entities; individuals; and collective investors. The rationale for dividing foreign investors into those from Hong Kong, Macao, and Taiwan, and those from other parts of the world is that the former capture the so-called "round-tripping" foreign direct investment, whereby domestic firms may register as foreign invested firms from nearby regions to take advantage of the benefits (such as tax and legal benefits) granted to foreign invested firms (Huang,

[9] We thank an anonymous referee for suggesting this. Our results were robust to including firms with 3 and 4 years of consecutive observations. Also note that between 2000 and 2007, we observe entry of new firms, and exit of existing firms from the sample. These decisions are potentially not random and could bias our results. Our findings were generally robust to using a balanced panel in estimation.

[10] The Chinese NBS dataset does not allow separate identification of publicly listed companies in China. Specifically, it is difficult to track these companies as their legal identification numbers were changed as they went public (Liu and Xiao, 2004). Over the period considered, there were slightly more than 1000 listed companies operating in the manufacturing and mining sectors. This amounts to less than 0.3% of the total number of firms in our sample.

[11] See Appendix 1 for details about the structure of our panel and about China's provincial units and regions; as well as for complete definitions of all variables used.

2003). Ownership by legal persons is a mixture of ownership by state legal persons and private legal persons[12], which represents a form of corporate ownership. Finally, collective firms are typically owned collectively by communities in urban or rural areas (the latter are known as Township and Village Enterprises or TVEs) and managed by local governments.

We grouped all foreign owned firms (from Hong-Kong, Macao, Taiwan, and other parts of the world) into a single category (which we labelled *foreign*); and all firms owned by legal entities, and individuals into a single category (labelled *private*)[13]. We then classified our firms into state owned, foreign, private, and collective, based on the shares of paid-in-capital contributed by our four types of investors in each year. Specifically, we classified firms according to majority average ownership shares. For instance, we classified a firm as foreign owned in a given year if the share of its capital owned by foreign investors in that year is at least 50% (see Ayyagari et al., 2008; and Dollar and Wei, 2007, for a similar approach) [14].

Table 1 presents the distribution of our observations by ownership type and year. We can see that the composition of our sample underwent considerable changes over the period 2000-2007. In particular, the share of the sample comprised by SOEs has declined from 13.4% in 2000 to just 4.2% in 2007, while the share comprised by private investors has increased from 45.7% to 70.6% over the same period, as a consequence of an ongoing process of privatization. The share of collectively owned firms also suffered a significant decline, from 20.9% to 7.2%. Collective enterprises

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[12] Legal persons represent a mix of various domestic institutions, such as industrial enterprises, construction and real estate development companies, transportation and power companies, securities companies, trust and investment companies, foundations and funds, banks, technology and research institutions etc.

[13] Within this category, firms owned by individuals represent 64% of the total. As firms owned by legal persons include firms owned by state legal persons, one could question their inclusion in the *private* category. One reason for including them is that while the state's primary interest is mainly political (i.e. aimed at maintaining employment levels or control over certain strategic industries), legal persons are profit-oriented (Wei et al., 2005). Since our dataset does not allow us to discriminate between state and non-state legal persons, we were unable to exclude the former from our *private* category. All our results were, however, robust to excluding all firms owned by legal persons from the *private* category.

[14] We derived ownership categories on the basis of the fraction of capital paid in by the various groups in every year, rather than using registration codes. Registration codes are in fact not entirely reliable, as they are updated only with considerable delay (Dollar and Wei, 2007). Moreover, firms might have an incentive to falsely register as foreign simply to take advantage of the tax benefits accorded to the latter. All our results were robust to using registration-based ownership categories. Note that our way of classifying firms into ownership groups leads to excluding from our sample those firms characterized by mixed ownership, whereby no group has a majority share. For instance, a firm characterized by a 40% private ownership, a 30% state ownership, and a 30% foreign ownership would automatically be excluded from our sample. Firms characterized by this type of mixed ownership only make up 1.5% of our sample.

were extremely successful in the 1980s, and were typically granted tax advantages and easy bank loans (Byrd and Lin, 1990). Yet, in the 1990s, due to the increased competition by private firms and to the banking reforms, whereby banks started to scrutinize loan applications more carefully, these enterprises experienced declining profitability, and a slowdown in their growth. Reforming their ownership structure became a priority to reverse these trends (Song, 1990; Ho et al., 2003). Finally, the share comprised by foreign investors remained largely constant at around 18-20% between 2000 and 2007.

As our objective in this paper is not the study of the effects of firms' transitions from state owned to private or foreign, and to minimize the effects of measurement error in the ownership variables, in our subsequent analysis, we make use of time-invariant measures of ownership. Hence, we classify firms into our four ownership categories, based on majority average ownership shares calculated over the sample period.

3.2 Summary statistics

In our empirical analysis, we focus on firm-level growth defined as the growth of firms' total assets. Total assets include tangible fixed assets, intangible fixed assets, other fixed assets, accounts receivable, inventories; and other current assets (the main component of which is cash and equivalents). Table 2 shows the composition of total assets by ownership types[15]. The share of the total assets of SOEs made up by tangibles (39.6%) is much higher than the corresponding average share for the other three ownership groups (32.5%). This can be explained by the overinvestment behavior that has historically characterized Chinese SOEs (Qin and Song, 2009). SOEs also have lower shares of accounts receivable and inventories: 13.9% and 18.8%, compared to averages of 20.0% and 20.3% for the other groups. This suggests that SOEs are fairly different from other ownership types in terms of assets composition.

Table 3 presents sample means and medians for a number of variables for our four ownership types. Once again, we see that SOEs are notably different from the other groups. Specifically, they exhibit very low growth rates: their mean assets

[15] Because the years 2000 and 2001 are used to construct lagged values of the variables that appear in our estimating equations (see Section 4.1 for details), our regression results are only based on the years 2002 to 2007. To ensure compatibility between the data used in the regressions and those used in the descriptive statistics, Tables 2 and 3 also refer to the period 2002-2007.

growth is 1.0%, compared to an average of 7.3% for the other three groups; their average sales growth is 5.6%, compared to an average of 9.6% for the rest of the sample; and their average employment growth rate is negative (-3.3%, compared to 0.9% for the other groups). These low growth rates may reflect the fact that SOEs respond to social and political needs, as well as to economic objectives (Bai et al., 2006). SOEs are typically larger (in terms of assets and number of employees) and older than other groups: they employ an average of 430.4 employees, compared to 250.0 for the rest of the sample; their total assets are worth 771.8 (thousands of yuan) compared to 466.4 for the other three groups; and their average age is 30.1, compared to 12.3 for the rest of the sample. SOEs also display very low levels of cash flow, and high levels of leverage: their cash flow to assets ratio is 4.5%, compared to an average of 8.3% for the other groups; their cash flow to tangible fixed assets ratio is 15.9% compared to 33.0% for the rest of the sample[16]; and their total liabilities to total assets ratio is 63.2%, compared to 56.9% for the other groups. Finally, SOEs display a very low level of labor productivity (measured as the ratio of real sales to total number of employees): 159.9% compared to 279.5% for the rest of the sample.

As for foreign firms, they are large (employing 316.0 people), and very young (their average age being 9.9 years). Compared to the other ownership categories, they display the highest levels of labor productivity (315.7%), and the lowest ratio of total liabilities to total assets (45.3%).

Despite being small in terms of average number of employees (232.8), private firms exhibit the highest average assets growth and sales growth rates, respectively 8.5% and 10.4%. They also exhibit a high cash flow to assets ratio (8.3%). This figure is much higher compared to the corresponding figure reported by Carpenter and Petersen (2002) for US small listed firms (6.2%). It is also very similar to their assets growth figure (8.5%), suggesting that, in a world of binding constraints, these firms' growth is in line with what their internal resources might permit.

It is interesting to note from Table 3 that the foreign, private, and collective firms, all exhibit a cash flow to tangible fixed assets ratio in excess of 30%. This

[16] As cash flow is defined as net income plus depreciation, one could question whether these data could be biased due to firms' tendency to misreport profits. Liu and Xiao (2004) document that it is mainly private firms, and not SOEs, which have the highest propensity to disguise profits. Hence, the rankings of the cash flow to asses ratios reported in Table 3 should not change taking this under-reporting into account. Furthermore, considering that it is reasonable to assume that measurement error due to misreporting of profits is time-invariant, in our regressions, we account for it in the firm-specific time-invariant component of the error term of our estimating equations (see section 4.1).

figure is very high compared to corresponding figures registered for the US or Europe. For instance, Bond et al. (2003) report cash flow to capital ratios of 13.4% for the UK; 17.8% for Belgium; 11.9%, for France; and 16%, for Germany. Similarly, Cummins et al. (2006) report a ratio of 19% for US firms. The high cash flow to capital ratios displayed by Chinese non-state firms suggests that these firms have the ability to generate high profits. This can be explained considering their high labor productivity, which amounts to an average of 279.5% over our sample period. This high productivity may be, among other factors, a consequence of the country's extremely high saving rate (averaging around 40%), which has enabled it to "rapidly build up its capital stock and shift a massive pool of underutilized labor from the subsistence-agriculture sector into higher-productivity activities that use capital." (Mishkin, 2006, p. 205).

In the sections that follow, we estimate firm-level dynamic assets growth equations that incorporate cash flow, for our four categories of firms, to formally assess the extent to which the growth of firms in each of the categories is affected by the availability of internal finance.

4. Empirical specifications and estimation methodology

4.1 Baseline model

We initially estimate the following simple dynamic assets growth model that incorporates the cash flow to assets ratio[17]:

$$(Assets\ growth)_{it} = a_0(Assets\ growth)_{i(t-1)} + a_1(Cash\ flow/total\ assets)_{it} + error\ term, \quad (1)$$

where the subscript i identifies firms, and the subscript t, time. The error term in Equation (1) comprises a firm-specific time-invariant component, encompassing all time-invariant firm characteristics likely to influence growth, as well as the time-invariant component of the measurement error affecting any of the regression

[17] This specification differs from that estimated by Carpenter and Petersen (2002) in two main respects. First, we estimate a dynamic model, while they estimate a static one. We chose a dynamic model, as the static model was clearly rejected by our specification tests. Second, as Carpenter and Petersen's (2002) sample is made up of listed US firm, they include Tobin's *Q* as an additional regressor. As most of the firms in our sample are not listed, we were unable to construct Tobin's *Q*, and therefore exclude it from our regression. Later, we will show that our results are robust to controlling for investment opportunities in various alternative ways.

variables; a time-specific component accounting for possible business cycle effects; and an idiosyncratic component. We control for the firm-specific time-invariant component of the error term by estimating our equation in first-differences, and for the time-specific component by including time dummies in all our specifications. We estimate Equation (1) separately for the four ownership groups[18].

As discussed in Carpenter and Petersen (2002), in the presence of capital market imperfections, one should expect the coefficient a_1 in Equation (1) to be slightly greater than one for those firms more likely to face financial constraints. This is because for these firms, external finance is typically more expensive than internal finance. Thus, should cash flow increase, financially constrained firms would be able to increase their assets (which make up all possible uses of firms' cash flow) one-for-one[19]. Furthermore, as a higher cash flow also indicates a higher collateral, firms that benefit from a higher cash flow are also likely to find it easier to obtain loans. Thus, in the presence of an increase in cash flow, firms more likely to face financing constraints may be able to increase their total assets slightly more than one-for-one, due to this collateral effect. On the other hand, financially healthy firms can always access external finance: changes in their internal finance should therefore only have a moderate effect or no effect at all on their growth.

Figure 1, which is adapted from Carpenter and Petersen (2002), illustrates this argument. The horizontal axis measures cash flow (*CF*) and the change in assets (ΔTA), and the vertical axis measures the cost of finance. *S* denotes the supply of finance. The horizontal portion of this schedule reflects a situation in which internal finance (*CF*) is used and priced at a constant shadow cost *R*. Once internal finance is exhausted, the firm must turn to debt finance. Yet, the more leveraged a firm is, the more incentives it will have to undertake more risky investment projects. This moral hazard situation implies that the cost of debt finance will rise with the degree of leverage of the firm, and is reflected by the upward sloping portion of the *S* curve (Hubbard, 1998)[20]. If cash flow rises from *CF* to *CF*', then the horizontal portion of

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[18] All results were robust to including cash flow divided by beginning-of-period instead of contemporaneous total assets.

[19] In theory, it is also possible for firms to use part of their cash flow to pay off debts. In this case, the coefficient associated with cash flow could drop below one, even in the presence of liquidity constraints.

[20] One can interpret debt finance in a broad sense, also including accounts payable. Contrary to Carpenter and Petersen (2002), our Figure 1 does not include an upper horizontal portion of the *S* curve

the *S* curve becomes longer. Moreover, due to the increase in net worth from which the firm benefits as a consequence of the rise in cash flow, the upward sloping portion of the *S* curve becomes slightly flatter. If the investment opportunities schedule (*IO*) intersects the *S* curve in its upward sloping portion, ΔA rises to $\Delta A'$. This implies that, in the presence of financing constraints, a given increase in cash flow may be associated with a slightly more than one-for-one increase in total assets[21]. This precise quantitative prediction allows for a sharper test of the financing constraints hypothesis than could be achieved simply focusing on the links between investment and cash flow[22].

It should be noted that Figure 1 is unlikely to apply to Chinese SOEs. As widely documented in the literature, these firms are in fact able to receive as many cheap loans from the state owned banks as they need, independent on profitability (Boyreau-Debray, 2003). This is a consequence of their need to respond to both social and political stresses, as well as to economic objectives (Bai et al., 2006). The supply of funds schedule is therefore likely to be horizontal for SOEs, and we do not expect their asset growth to be significantly affected by their cash flow[23]. A similar scenario is likely to hold for collective firms, which being generally managed by local governments, may still benefit from easy credit. On the other hand, we would expect a rise in cash flow to generate a one-for-one (or slightly more than one-for-one) rise in total assets for the private firms, which are typically discriminated against by the banking sector. As for foreign firms, the link between their cash flow and growth would depend on whether they make use of domestic credit markets or are financed by their parent company. In the former case, one could expect a one-to-one (or

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relating to equity issuance. This is because our sample consists mainly of unlisted firms and equity markets are still poorly developed in China.

[21] This prediction relies on the assumption that the *IO* schedule is highly elastic compared to the supply of finance. This is a reasonable assumption considering that none of the firms in our sample is sufficiently large to be able to affect prices by growing. Note that, in the absence of a collateral effect, as cash flow rises from *CF* to *CF'*, the upward sloping portion of the new *S* curve would not become flatter and the rise in cash flow would be associated with a rise in total assets of similar magnitude.

[22] It has been argued that the links between investment and cash flow observed in the literature could be due to the latter variable proxying for investment opportunities, rather than to financing constraints (Cummins et al., 2006; Carpenter and Guariglia, 2008). If this were the case, however, a slightly higher than one-to-one relationship between investment and cash flow would not necessarily follow. Hence, finding such a relationship can be seen as reliable evidence for the presence of financing constraints (Carpenter and Petersen, 2002).

[23] Note, however, that a positive association between assets growth or, more specifically, investment and cash flow could still be observed for SOEs if managers wishing to pursue private objectives overinvested relative to the optimum, by using 'free cash flow' for unprofitable investment projects (Jensen, 1986; Carpenter, 1995). In our empirical analysis, we never observe such a positive association.

slightly more than one-to-one) relationship, while in the latter, one would observe a cash flow coefficient either lower than one, or poorly determined altogether.

Equation (1) does not take into account investment opportunities, which are reflected in shifts in the *IO* curve in Figure 1. This could induce bias in the cash flow coefficient, as cash flow could be accounting for the omitted investment opportunities (Cummins et al., 2006; Carpenter and Guariglia, 2008). Typically, investment opportunities are accounted for through Tobin's *Q*, which is defined as the market value of the firm over the replacement value of its total assets. Yet, because our sample is made up of unlisted firms, we are unable to calculate *Q*. We therefore account for investment opportunities in two alternative ways. First, we proxy them with industry-level value added growth. Value added is considered an overall measure of efficiency within a certain disaggregated industry. It is plausible to assume that increased efficiency gives rise to a number of investment opportunities emerging in that specific industry. This measure closely follows the intuition of Whited and Wu (2006) who argue that industry efficiency is a good proxy to assess the degree of investment opportunities. Second, we include in our model time dummies interacted with industry dummies (in addition to the aggregate time dummies). This approach can be seen as an indirect way to account for investment opportunities, or more in general demand factors, as the dummies account for all time-varying demand shocks at the industry level (Brown et al., 2009; Duchin et al., 2010). If the correlation of cash flow with investment opportunities were an important source of bias, then the cash flow coefficients should decline substantially when we include industry-level value added growth or industry-level time dummies in our specification.

4.2 Estimation methodology

All equations are estimated in first-differences, to control for firm-specific, time-invariant effects. Given the possible endogeneity of our regressors, we use a first-difference Generalized Method of Moments (GMM) approach (Arellano and Bond, 1991), which makes use of lagged values of the regressors as instruments.

To check whether the first-difference GMM estimator is likely to suffer from finite sample bias, we compare the GMM and the Within Groups estimates of the coefficient on the lagged dependent variable in Equation (1). Because the Within Groups estimate is typically downward biased in short panels (Nickell, 1981), one would expect a consistent estimate of the coefficient on the lagged dependent variable to lie above this estimate. As our GMM coefficient is larger than its Within Groups counterpart, we conclude that the first-difference GMM estimates are unlikely to be subject to serious finite sample bias[24].

To evaluate whether our instruments are legitimate and our model is correctly specified, we assess whether the variables in the instrument set are uncorrelated with the error term in the relevant equation. To this end, we use two criteria. The first is the Sargan test (also known as *J* test), which is a test for overidentifying restrictions. Under the null of instrument validity, this test is asymptotically distributed as a chi-square with degrees of freedom equal to the number of instruments less the number of parameters.

Our second criterion is based on the serial correlation in the differenced residuals. In the presence of serial correlation of order 2 in the differenced residuals, the instrument set needs to be restricted to lags 3 and deeper. The latter instruments are valid in the absence of serial correlation of order 3 in the differenced residuals (Brown and Petesen, 2009; Roodman, 2006). We assess the presence of n^{th}-order serial correlation in the differenced residuals using the *m(n)* test, which is asymptotically distributed as a standard normal under the null of no n^{th}-order serial correlation of the differenced residuals.

We select our instruments on the basis of the following strategy. We initially use our regressors lagged twice and three times as instruments. If the Sargan test and/or the test for second order autocorrelation of the differenced residuals fail (which could happen, for instance, in the presence of measurement error), we omit the regressors lagged twice from the instrument set (Bond, 2002).[25] Deeper lags of the instruments are only included if they improve the specification tests.

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[24] These estimates, which are based on the full sample, are not reported for brevity, but are available upon request. If the estimates obtained using the first-difference GMM estimator lie close or below the Within Groups estimates, one could suspect the GMM estimate to be downward biased as well, possibly due to weak instruments**.** In such case, the use of a GMM system estimator (which combines in a system the original specification expressed in first differences and in levels) would be required (Blundell and Bond, 1998).

[25] The exact instruments used in each specification are reported in the Notes to the Tables. All Tables report the *m*1 test for first-order serial correlation of the differenced residuals. Considering that our equations are estimated in first-differences, in most cases we find evidence of significant negative first-order serial correlation in the differenced residuals. For those specifications in which the most recent instruments are dated *t*-2 (*t*-3), we report the *m2* (*m3*) test for second- (third-) serial correlation of the differenced residuals. For those specifications that make use of both instruments dated *t*-2 and *t*-3, we report both the *m2* and the *m3* tests. Note that neither the *J* test nor the test for *n*-th order serial correlation in the differenced residuals allow to discriminate between bad instruments and model specification. All our results were generally robust to using GMM with an "orthogonal deviations" transformation, instead of a first-difference transformation (Arellano and Bover, 1995). They were also

5. Empirical tests

5.1 Main results

Table 4 presents estimates of Equation (1). Column 1 refers to SOEs, and columns 2 to 4, respectively to foreign owned, private, and collective firms. The coefficient associated with the lagged dependent variable is negative and precisely determined for all groups of firms, except the collective ones. This can be seen as evidence for convergence. Furthermore, the cash flow coefficient is positive and precisely determined for foreign and private firms, while it is poorly determined for SOEs and collective firms. It is equal to 1.09 for foreign owned firms and to 0.98 for privately owned firms. Considering that these two groups of firms also exhibit large cash flow to total assets ratios (respectively, 8.30% and 8.28%), these results suggest that their growth is restricted by their profit generating capacity. As for SOEs, their insignificant cash flow coefficient reflects on the one hand, their very low level of cash flow to total assets (4.51%), and on the other, the fact that these firms may still experience soft budget constraints. State owned banks typically lend to these firms, independently of their profitability, preventing them to go bankrupt, as this would generate a significant social unrest (Bai et al., 2006; Boyreau-Debray, 2003). In terms of Figure 1, this suggests that SOEs indeed face a horizontal *S* curve. The same is likely to apply to collective firms, given their links with local governments. Our results compare favorably with Héricourt and Poncet (2009) and Poncet et al. (2010) who, focusing on investment, also find that SOEs are the least financially constrained, while private firms are the most constrained.

Table 4 contains a row which reports in every column the *p*-values of an *F*-test of the null hypothesis (H_0) that the cash flow coefficient is greater than or equal to 1. The aim of this test is to see whether there is indeed a one-to-one (or slightly larger than one-to-one) relationship between firms' assets growth and their cash flow to assets ratio, as discussed in the previous section. The lower the *p*-value, the stronger the evidence in favor of rejection of H_0. We can see that the *p*-values are the highest for privately owned and foreign owned firms, for which they are equal to 0.95 and 0.81

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robust to using a simple fixed effects instrumental variable (IV) estimator, the results of which are reported in Table A1 of Appendix 2. Yet, because the IV estimator is less efficient than the GMM estimator, the latter remains our preferred one.

respectively. The *p*-value is smallest for state-owned firms (0.09). The *p*-value for collective firms falls in between (0.27). Hence, the *p*-values confirm that the cash flow coefficient is much more likely to be greater than or equal to 1 for privately and foreign owned firms, than for collective firms and SOEs.

The Sargan and *m2/m3* tests generally do not highlight significant problems with the validity of the instruments and/or the specification of the model. In column 3, where the most recent instruments are lagged three times, the *m3* test shows some mild evidence of third order serial correlation of the residuals. Yet, because the Sargan test is satisfactory, we do not think this to be a serious issue.

Table 5 presents estimates of variants of Equation (1), which also control for investment opportunities. Columns 1, 3, 5, and 7 contain the estimates of the Equation where demand factors are accounted for with industry-level value added growth, while columns 2, 4, 6, and 8 contain the estimates of the Equation which includes time dummies interacted with industry dummies.

From the odd columns, we can see that industry-level value added growth always has a positive coefficient, which is statistically significant for all firms except the collective ones. As for the coefficient on cash flow, we can see, both from the even and the odd columns, that it remains poorly determined for SOEs and collective firms, while for the other groups of firms, it is statistically significant and close to one. The *p*-values associated with the testing of the hypothesis that the cash flow coefficient is greater than or equal to 1 are always the highest for private and foreign owned firms, and the lowest for SOEs. Furthermore, when investment opportunities are accounted for with value added growth, the cash flow coefficients for foreign owned and private firms become slightly lower than those reported in Table 4. Yet, when we include time dummies interacted with industry dummies, they remain very similar to those in Table 4, suggesting that the correlation between cash flow and investment opportunities is unlikely to be a significant source of bias. In all subsequent regressions, we will take into account investment opportunities including time dummies interacted with industry dummies.

In columns 5 and 7, the Sargan test indicates some problems with the specification of the model and/or the validity of the instruments. The *m2*/*m3* test in columns 5 and 6 indicate that the null that the differenced residuals are not autocorrelated of order two/three can only be accepted at the 1% level. Yet, because column 5 is the only case in which both tests highlight problems, we conclude that our instruments and specification are generally acceptable.

These results confirm our initial conjecture that Chinese firms are very heterogeneous in terms of their degree of dependence on internal finance. Specifically, SOEs and collective firms are the least dependent, while private and foreign owned firms are the most dependent. The dependence of foreign owned firms on cash flow can be seen as evidence that these firms cannot only finance themselves through their parent company, but also need to rely on the profits that they generate internally, as well as on local financial markets. Their reliance on local financial markets can be inferred from their cash flow coefficient, which is larger than one in column 4, suggesting the presence of a colateral effect, whereby higher cash flow is associated with the possibility of obtaining more leverage.

It is likely that because private firms have very good investment opportunities[26], and do not always have access to reasonably priced external finance, the higher and higher cash flows that they have been generating, have translated themselves into higher and higher growth rates. Whether there will be a limit to such growth will hence depend on whether these firms' competitive advantage will be eroded. If this happened, due for instance, to increasing raw materials or labor costs, to a realignment of the exchange rate, and/or to increased competition, then private firms' ability to generate profits may be reduced, which could seriously limit their growth.

5.2 Robustness tests

5.2.1 Excluding cash and equivalents from total assets

Firms' total assets include the stock of cash and equivalents. It is possible that firms might absorb some of the short-run fluctuations in cash flow with cash and equivalents, leading to a positive relationship between changes in assets and cash flow, even in the absence of financing constraints (Carpenter and Petersen, 2002). To rule out this effect, we remove the "other current assets category" from our definition of growth and re-estimate our Equation (1) using this alternative definition of assets

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[26] Evidence that Chinese firms face particularly good investment opportunities can be inferred from the fact that China is now one of the few low or low-middle income countries whose level of R&D intensity has risen beyond 1% (Hu and Jefferson, 2008).

growth[27]. We account for investment opportunities by including time dummies interacted with industry dummies. The results are presented in Table 6. The coefficient on cash flow declines substantially for all firms. This is not surprising as the dependent variable no longer captures all potential uses of internal finance. The fact that the coefficient is still precisely determined only for foreign owned and private firms confirms that these firms face a certain degree of financial constraints[28].

5.2.2 Alternative definition of ownership categories

Table 7 presents results where firm ownership categories are defined on the basis of a 100% of paid-in-capital rule. According to this rule, a firm is defined as privately owned if private agents own 100% of its capital in each of the eight years making up our sample. Foreign owned, state owned, and collectively owned firms are defined in a similar way. These new categories obviously contain fewer observations than the previous ones, as they exclude firms that changed their ownership status over the period considered. Time dummies interacted with industry dummies are included in all specifications to control for investment opportunities. The results are once again similar to those reported in Tables 4 and 5: growth at SOEs and collective firms is not affected by internal finance, while growth at foreign owned and private firms is most affected.

5.2.3 Estimating a fixed investment regression

Many empirical studies in the financing constraints literature have estimated equations of fixed investment as a function of cash flow. To provide a comparison with this literature, we substitute the fixed investment to assets ratio for the growth of assets and re-estimate Equation (1). The results are presented in Table 8. Like in our assets growth regressions, only the foreign owned and private firms exhibit positive and precisely determined investment-cash flow sensitivities. The cash flow coefficient for foreign owned firms is 0.36, and that for private firms is 0.37. The size of these

[27] Our data do not allow us to separately identify cash and equivalents. These are included in the "other current assets category", which also includes prepaid expenses and advances, other current assets, deferred charges, and short term investments.

[28] Our results were also robust to replacing assets growth with sales growth or employment growth. However, when using these alternative measures of growth, one would not expect a one-to-one relationship between changes in cash flow and growth. Furthermore, our results were robust to including in our regressions other financial variables used in the financing constraints literature, such as the coverage ratio or the total liabilities to total assets ratio.

coefficients confirms that to ensure a one-to-one relationship between the dependent variable and cash flow, the former must contain all uses of internal finance, not just fixed investment. Our findings, which are in line with Héricourt and Poncet (2009), also reinforce the idea that SOEs and collective firms do not appear to face binding financial constraints[29].

5.3 Exploring private firms' heterogeneity

5.3.1 Estimating Equation (1) for different subsamples of private firms

As private firms represent our largest group (64% of our sample), which is likely to be characterized by considerable heterogeneity, we next investigate whether the sensitivities of assets growth to cash flow vary for different types of private firms. To this end, we estimate Equation (1) for the following sub-groups of firms: firms operating inside and outside the coastal region; firms with foreign participation above and below 10%; firms with state participation above and below 10%; and firms with and without affiliation with the central and/or provincial governments. These sample splits can be motivated as follows.

With reference to location, firms operating in central and western areas may benefit from financial incentives, thanks to policies aimed at developing those regions (Goodman, 2004). In contrast, firms operating in coastal regions are likely to suffer from significant financing constraints, due to high competition for a limited pool of funds.

As for ownership, those private firms with some degree of foreign capital may face less financing constraints than those without: private firms may in fact choose to team up with foreign firms, in order to obtain equity finance from them, and bypass in this way, the financing constraints they face at home (Huang, 2003). If this were the case, this argument could also explain the empirical findings in Greenaway et al. (2009), according to which in China, joint ventures typically perform better than purely domestic firms. Similarly, by teaming up with state firms, private firms could benefit from the soft budget constraints that typically characterize the former.

[29] Our findings contradict those in Chow and Fung (1998) and Poncet et al. (2010), who find that the sensitivity of investment to cash flow is lowest for foreign owned firms. This is probably due to the fact that our study is not directly comparable to theirs as the former only focus on a very small sample of firms operating in Shanghai, over the period 1989-92, while the latter focuses on 7,316 observations for foreign firms, compared to our 46,561. Our much larger dataset is likely to include those smaller foreign firms, which are more likely to face credit constraints.

Coming to political connections (*Guanxi*), these could be beneficial for private firms, giving them "better access to key resources that are controlled by the Party and the government, such as business operation licenses, bank loans, land, and eligibility for favorable but discretionary government policies such as tax benefits and the waiver of "extralegal" fees" (Li et al., 2008, p. 288).

The estimates of Equation (1) for these subsamples of firms are reported in columns 1 to 8 of Table 9. For each of the four groupings, an *F* test is performed to test for the equality of the cash flow coefficient across groups. The *p*-values of this test are reported in the Table.

We can see that only firms operating in the coastal region (column 2), firms with foreign and state ownership lower than 10% (columns 3 and 5), and firms with no affiliation with the central or provincial governments (column 7) exhibit positive and statistically significant assets growth to cash flow sensitivities. This confirms that there is some heterogeneity within the private firm category, i.e. that not all private firms suffer from the same degree of financing constraints. Yet, the *F* test for the difference of cash flow coefficients across sub-samples suggests that the coefficients across firms with different degrees of state participation, and firms with and without central and/or provincial political affiliation are not statistically different from each other at the 10% level. Hence, we can conclude that it is mainly those private firms that differ in terms of their location and their degree of foreign ownership, which also differ in the degree of financing constraints that they face.

Focusing on the *p*-values associated with the *F* test for the hypothesis that the cash flow coefficient is greater than or equal to 1, we can see that firms operating in coastal areas are much more likely to have a cash flow coefficient greater than or equal to 1 (*p*-value= 0.8) than firms operating in central or western areas (*p*-value=0.0). The same applies to firms with no foreign ownership (*p*-value = 0.55) relative to their counterparts with some foreign ownership (*p*-value = 0.02).

In summary, our results so far show that there exists some heterogeneity in the degree of financing constraints faced by Chinese private firms, whereby firms operating in the coastal region, and characterized by negligible foreign participation show the highest sensitivities of assets growth to cash flow[30]. In order to reduce the

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[30] One could ask why, considering that foreign ownership alleviates the degree of financing constraints faced by private firms, majority owned foreign firms appear to suffer from significant financing constraints (see, for instance, columns 3 and 4 of Table 5). It could be that increased foreign

entity of financing constraints that they face, private firms could therefore locate in central or western regions, and/or team up with foreign firms. These are important findings as they can be used by firm managers to adopt strategies aimed at overcoming the financing constraints that they face.

To shed further light on the heterogeneity of private firms in terms of the degree of financing constraints that they face, we move beyond the partitioning of our firms into sub-samples ex-ante more and less likely to face financing constraints and use a methodology recently proposed by Hovakimian and Hovakimian (2009) to construct a firm-level measure of the degree of financing constraints faced by each firm. This measure is based on the sensitivity of assets growth to cash flow characterizing each firm (CFS_i), and is calculated as follows:

$$CFS_i = \sum_{t=1}^{n}\left(\frac{\left(Cash\ flow/_{Assets}\right)_{it}}{\sum_{t=1}^{n}\left(Cash\ flow/_{Assets}\right)_{it}} * Assets\ growth_{it}\right) - \frac{1}{n}\sum_{t=1}^{n} Assets\ growth_{it} \quad (2)$$

where n is the number of annual observations for firm i, and t indicates time. In sum, our firm-level cash flow sensitivities are given by the difference between the cash flow weighted time-series average assets growth of a firm and its simple arithmetic time-series average assets growth[31]. This difference will be higher for firms that tend to display a higher assets growth in years with relatively high cash flow and a lower assets growth in years with low cash flow, i.e. for firms more likely to face financing constraints (Hovakimian and Hovakimian, 2009)[32].

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participation is beneficial to the financial health of a joint-venture only up to a certain point. Local banks may in fact be reluctant to lend money to majority owned foreign firms. As documented in World Bank (2006), fully foreign owned firms operating in China have limited access to domestic direct finance, and have to finance much of their investment from abroad. Along similar lines, Greenaway et al. (2009) find that corporate performance increases as foreign participation rises up to the range 47% to 64%, depending on the measure of performance used, and declines thereafter.

[31] It is noteworthy that the sensitivities constructed by Hovakimian and Hovakimian (2009) are sensitivities of investment to cash flow, not sensitivities of assets growth to cash flow. As in Hovakimian and Hovakimian (2009), to avoid negative and extreme weight values, negative cash flows in Equation (2) are set equal to zero.

[32] It should be noted that these firm-level cash flow sensitivities cannot be interpreted as the rise in assets growth that follows a rise in cash flow, controlling for other factors. Hence, we do not expect them to be greater than or equal to 1 for firms more likely to be financially constrained. Yet, we expect these sensitivities to be higher for firms that exhibit higher (lower) assets growth in years characterized by high (low) cash flow. Hence, high sensitivities can be seen as an indicator of binding financing constraints. Hovakimian (2009) proposes an alternative way of calculating cash flow sensitivities. In Appendix 3, we show that all results reported in this sub-section are robust to using this alternative methodology.

We next identify firms with sensitivities above and below the third quartile of the distribution of the sensitivities of all firms in our sample, and run our assets growth equations on these two sub-samples. The results are reported in columns 9 and 10 of Table 9. We can see that the coefficient associated with cash flow is poorly determined for observations with sensitivities below the third quartile of the distribution (column 9), which are allegedly the least constrained. In contrast, the same coefficient is positive, strongly significant, and greater than 1 for observations with sensitivities above the third quartile, which are more likely to face binding financing constraints (column 10). The difference between the two coefficients is statistically significant. The *F*-test for the hypothesis that the cash flow coefficient is greater than or equal to 1 suggests that firms with high *CFS* are much more likely to display a coefficient greater than or equal to unity (*p*-value = 0.99) than their counterparts with low *CFS* (*p*-value = 0.00). These findings suggest that our firm-level cash flow sensitivities correctly identify firms that are more and less likely to face financing constraints, and further confirm that private firms are indeed heterogeneous in the degree of financing constraints that they face.

5.3.2 Do the simultaneous pervasive credit constraints and high growth that characterize private firms induce significant efficiency losses?

Despite the heterogeneity that characterizes them, we have found that, as a group, private firms are severely financially constrained. Yet, they exhibit high assets growth (8.46% according to Table 3). Considering that their cash flow to assets ratio is also very high and of similar magnitude as their assets growth rate (8.3% according to Table 3), the question arises of whether the high growth characterizing these firms may be accompanied by significant efficiency losses. In particular, one could ask whether financially constrained private firms tend to accumulate high levels of internal finance in order to achieve present growth, by reducing expenditures that could sustain growth in the future, such as expenditure on personnel wages and training[33]. If this were the case, the high growth rates achieved by these firms today, would inevitably be associated with lower growth rates tomorrow, and would therefore not be sustainable. A quick glance at the figures suggests that this is not necessarily the case. Although wages per employee are on average lower at private

[33] We thank an anonymous Referee for suggesting this exercise.

firms (13.15%) compared to the rest of the sample (16.58%), wage growth, training expenses, and training expenses growth are higher[34]. The average figures are respectively 8.58%, 0.09% and 8.73% for private firms, and 7.89%, 0.07%, and 4.28% for the rest of the sample. Yet, these figures are only indicative, as they do not account for the heterogeneity of private firms.

To explore this issue further, in Panel A of Table 10, we present mean and median values of a number of variables for firms with high (column 1) and low (column 2) cash flow sensitivities. These variables include the following three categories: assets growth and cash flow, which make up category 1; wages per employee, training expenses, and their growth, which make category 2; labor productivity, total factor productivity (TFP, calculated using the Levinsohn and Petrin, 2003, method), and their growth, which form category 3. Lower values of the variables in category 2 for high *CFS* firms could be seen as an indication that credit constraints are associated with efficiency losses. Yet, we can see that firms with high and low *CFS* display similar levels of all four variables. As can be seen from the *p*-values of the *F*-test for the equality of means reported in column 3, the differences in the means of these four variables across the two groups are in fact never statistically significant at the 5% level. Credit constraints (measured in terms of assets growth sensitivities to cash flow) do not therefore seem to be associated with significant efficiency losses. Yet, observations characterized by high cash flow sensitivities exhibit lower assets growth, cash flow, labor productivity, TFP and labor productivity growth than their counterparts with low sensitivities. All these differences are statistically significant and suggest credit market imperfections do represent a significant impediment to firm behavior.

Although there is no evidence that compared to their counterparts with low *CFS*, private firms with high *CFS* suffer from efficiency losses, these losses could be limited to those financially constrained firms characterized by high growth. The latter could in fact realize high growth rates by accumulating internal funds, at the expense of wage increases and training of personnel, thus reducing the potential for future growth. If this were the case, it could be seen as evidence of efficiency losses induced by simultaneous pervasive credit constraints and high growth. To investigate this

[34] By wages, we mean wages per employee, i.e. the ratio between the firm's total wage bill and its total number of employees. Education expenses are defined as the total expenditure incurred by the firm on the training of personnel. These expenditures are normalized by total assets.

hypothesis, in Panel B of Table 10, we report means and medians of our variables for high growth firms characterized by high (column 1) and low *CFS* (column 3)[35].

Comparing column 1 of Panel B of Table 10 with column 2 of Panel A of the same Table, we can see that those firms with high *CFS* and high assets growth display a much higher cash flow to tangible assets ratio (40.08%) than their counterparts with low cash flow (32.48%). This suggests that financially constrained firms may be using internally generated funds to finance their growth. But does this accumulation of high cash flow happen at the expense of expenditures that could sustain growth in the future? We attempt to answer this question by comparing the mean values of wages per employee, training expenses, and their growth at firms characterized by high growth and high *CFS*, on the one hand; and firms characterized by low *CFS*, on the other. Comparison of the figures in column 1 of Panel B and column 2 of Panel A of Table 10 suggests that the former have an average level (14.6%) and growth rate (11.5%) of wages per employee, which are much higher, compared to the corresponding figures for the latter (13.1% and 8.7%). They also have a higher training expenses growth rate (16.3%, which compares with 9.0% for firms with low *CFS*). These differences are all statistically significant. In sum, although there is evidence that accumulating high cash flows plays an important role in explaining how financially constrained firms manage to achieve high growth, there is no evidence whatsoever that financially constrained firms characterized by high growth accumulate high cash flows by reducing expenditures that could in the future sustain growth.

Finally, Table 10 shows that compared to firms with low *CFS*, firms simultaneously characterized by high *CFS* and high growth display very high labor productivity and TFP, as well as very high growth rates of both types of productivity measures. For firms with high *CFS* and high growth, the two figures are respectively 340.4% and 13.50% for labor productivity, and 442.3% and 15.9% for TFP (column 1, Table 10, Panel B), which compare with values of 275.5% and 9.7%, and 351.9% and 8.8%, for firms with low *CFS* (column 2, Table 10, Panel A). All these differences are statistically significant. These statistics suggest that these firms' high productivity is more likely to explain their ability to generate high cash flows, than the reduction of expenses on wages and personnel training. Chinese private firms' high

[35] We define high growth firms as firms whose average assets growth over the sample period falls in the top quartile of the distribution of the average assets growth of all firms in the sample.

productivity levels, coupled with an environment characterized by relatively low labor and raw material costs, an undervalued exchange rate, and relatively lax environmental and labor standards may therefore have played an important role in explaining how financially constrained firms have managed to invest and grow despite the financing constraints that they face.

Comparing the means in columns 1 and 3 of Panel B of Table 10, we see that with the exception of assets growth, the cash flow to tangible fixed assets ratio, the wage to employee ratio, and TFP, none of the differences in the means of the other variables across high growth firms with high and low *CFS* are statistically significant at the 5% level. In particular, although high growth firms with high *CFS* grow at a lower rate, accumulate more cash flow, and pay higher wages than their counterparts with low sensitivities, the two groups of firms are quite similar with respect to wage growth, training expenses and training expenses growth. Yet, they display higher TFP, which could, once again, explain their higher cash flow to tangible fixed assets ratio.

In conclusion, the statistics in Table 10 suggest that there is no evidence of significant efficiency losses induced by simultaneous pervasive credit constraints (proxied by high cash flow sensitivities) and high growth. We have shown that these characteristics are generally accompanied by higher productivity. It is therefore likely that Chinese firms manage to invest and grow despite the significant financial constraints that they face, because their high productivity enables them to generate large amounts of internal funds, which they then use to invest and grow. Yet, had external finance been available for them, these firms would have been able to grow at even higher rates.

6. Conclusions

What is the final verdict on the effect of internal finance on the growth of Chinese firms? We have found that the growth of SOEs and collective firms is not affected by the availability of cash flow, while that of private and foreign firms is most affected. These results are robust to accounting for investment opportunities in different ways, to considering assets growth net of cash, and to using different criteria to define our ownership categories. They suggest that SOEs are not subject to financing constraints, probably because of the important role they play in absorbing surplus labor and helping to maintain social stability, which guarantees them unlimited loans from the state banks. In contrast, private firms are the most financially constrained, being typically discriminated against by the banking sector. We have also found some degree of heterogeneity across private firms: it is those private firms that operate in the coastal regions and have negligible foreign ownership that are most affected by the financing constraints. These are important findings as they can be used by firm managers to adopt strategies aimed at overcoming the financing constraints that they face. Furthermore, based on firm-level cash flow sensitivities, we have found that there is no evidence of significant efficiency losses induced by the simultaneous pervasive credit constraints and high growth that characterize private firms.

Considering that over the period examined, private firms have achieved very high assets growth rates, in spite of being discriminated against by the banking sector, we can conclude that this has been made possible by the high cash flows that these highly productive firms have been able to accumulate. High growth rates are hence compatible with binding financial constraints as long as there are high levels of internal finance. Well developed external capital markets may therefore not always be needed for faster growth.

Our paper complements Ayyagari et al. (2008) and Cull et al. (2009), who found that neither informal financing, nor trade credit played an important role in explaining the Chinese growth miracle, by suggesting that firms' ability to generate cash flow may have been an important factor instead. As private firms represent 64% of the firms in our sample, their ability to generate internal finance may therefore represent the solution to the puzzle of why, despite a malfunctioning financial system, the Chinese economy has grown at stellar rates in recent years.

Yet, if the competitive advantage of Chinese private firms were to be eroded, due for instance to rising raw materials and labor costs, to a realignment in the exchange rate, or to increasing competition, then these firms' ability to generate internal funds could be limited. This could cause a significant reduction in their growth, and hence in the country's growth. Thus, to make sure that the Chinese economy continues to thrive, measures will have to be taken ensuring a more widespread access to institutional finance.

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Appendix 1: Data

Structure of the unbalanced panel

Number of obs. per firm	*Number of observations*	*Percent*	*Cumulative*
5	135,195	27.09	27.09
6	123,138	24.68	51.77
7	122,948	24.64	76.41
8	117,720	23.59	100.00
Total	499,001	100.00	

Year	*Number of observations*	*Percent*	*Cumulative*
2000	39,781	7.97	7.97
2001	53,088	10.64	18.61
2002	62,460	12.52	31.13
2003	72,296	14.49	45.62
2004	70,797	14.19	59.80
2005	70,664	14.16	73.96
2006	67,583	13.54	87.51
2007	62,332	12.49	100.00
Total	499,001	100.00	

Definitions of the variables used

Total assets: sum of the firm's fixed and current assets, where fixed assets include tangible fixed assets, intangible fixed assets, and other fixed assets; and current assets include inventories, accounts receivable, and other current assets.

Other current assets: sum of cash and equivalents, prepaid expenses and advances, other current assets, deferred charges, and short term investments.

Cash flow: net income plus depreciation.

Fixed investment: It is constructed as the difference between the book value of tangible fixed assets (which include land and building; fixtures and fittings; and plant and vehicles) of end of year t and end of year t-1 adding depreciation of year t.

Total liabilities: sum of current liabilities and non-current liabilities, where current liabilities include bank loans, accounts payable, and other current liabilities; and non-current liabilities include long-term debt and other non-current liabilities.

Coverage ratio: ratio of operating profits to interest payments.

Sales: firm's total sales (including domestic and overseas sales).

Employees: total number of people employed by the firm.

Wage per employee: ratio of total real wage bill to number of employees.

Training expenditures: total expenditure incurred for the training of personnel.

Labor productivity: ratio of total real sales to number of employees

TFP: total factor productivity calculated using the Levinsohn and Petrin (2003) method, applied separately to different industrial groups.

Collateral: ratio of tangible assets to total assets.

Leverage: ratio of current liabilities plus non-current liabilities to total assets, where current liabilities include bank loans, accounts payable, and other current liabilities.

Exprat: ratio of exports to total sales.

Deflators: all variables are deflated using provincial ex-factory producer price indices taken from various issues of the China Statistical Yearbook.

Chinese provincial units

China is administratively decomposed into 31 provincial units, which fall into three categories: 22 provinces or *sheng*; 4 autonomous regions or *zizhiqu* (Inner Mongolia, Xinjiang, Tibet, Ningxia and Guangxi); and 4 municipal cities or *zhixiashi*, under direct supervision of the central power (Shanghai, Tianjin, Beijing, and, since 1997, Chongqing). The distribution of these provincial units across regions is as follows (Qin and Song, 2009):

Coastal region	*Central region*	*Western region*
Beijing	Shanxi	Chongqing
Tianjin	Inner Mongolia	Sichuan
Hebei	Jilin	Guizhou
Liaoning	Heilongjiang	Yunnan
Shanghai	Anhui	Tibet
Jiangsu	Jiangxi	Shaanxi
Zhejiang	Henan	Gansu
Fujian	Hubei	Qinghai
Shandong	Hunan	Ningxia
Guangdong		Xinjiang
Hainan		
Guangxi		

Appendix 2: Using an IV fixed effects estimator

In Table A1, we report the estimates of our assets growth equation estimated using an IV fixed effects model. Contrary to GMM, this approach does not involve first-differencing the data. We instrument cash flow and lagged assets growth using two or three lags of these same variables[36]. Instrument adequacy is assessed using the Kleibergen-Paap *rk* Wald *F*-statistic, which is the robust analog of the *F*-statistic form of the Cragg-Donald (1993) statistic suggested by Stock and Yogo (2002) as a global test for the presence of weak instruments. In three out of four cases, our *F*-statistics are above 10, verifying the Staiger-Stock (1997) "rule of thumb" (also see Baum et al, 2007). This suggests that our instruments do not suffer from a weakness problem. Although these estimates are consistent with our main results obtained with GMM, the IV fixed effects estimator is typically less efficient than the GMM estimator, which remains our preferred estimator.

Appendix 3: Measuring firm-specific assets growth to cash flow sensitivities using the methodology outlined in Hovakimian (2009)

In this Appendix, we verify the robustness of the results reported in Section 5.3 to using an alternative way to calculate firm-specific assets growth to cash flow sensitivities. In particular, we use the two-step methodology developed in Hovakimian (2009). Considering that cash flow is not the only determinant of the firm's assets growth, the first step of this methodology consists in estimating the following regression, which excludes cash flow:

$$(Assets\ growth)_{it} = a_0(Assets\ growth)_{i(t-1)} + a_1 Leverage_{it} + a_2 Collateral_{it} + \\ + a_3(Employees)_{it} + a_4(Labor\ productivity)_{it} + a_5 Exprat_{it} + v_i + v_t + e_{it} \qquad \text{(A1)}$$

Leverage is defined as the firms' ratio of total liabilities to total assets; *Collateral*, as the ratio of tangible assets to total assets; and *Exprat*, as the ratio of exports to total sales. Our choice of regressors in Equation (A1) is aimed at mirroring the regressors

[36] The number of observations in Table A1 is smaller than that in Tables 3 and 4 because the fixed-effects IV estimator automatically drops observations for which the requested instruments are missing. Results similar to those in Table A1 were obtained when the missing instruments were set to 0.

usually included in cross-country growth models[37]. v_i represents a firm-specific effect; v_t, a time specific effect; and e_{it}, an idiosyncratic error term. The latter is used in the second-step to calculate a measure of the firm's assets growth to cash flow sensitivity. In particular, if the firm's assets growth is not influenced by its cash flow, then the average e_{it} in periods characterized by high cash flow should not be significantly different from the average e_{it} in periods with low cash flow. Hence, the average e_{it} weighted by the firm's cash flows should not be significantly different from the simple average e_{it}[38]. Yet, if the firm's assets growth is positively (negatively) correlated with its cash flows, then the average e_{it} weighted by cash flows should be higher (lower) than the simple average e_{it}. Following this line of reasoning, the following alternative measure of the firm's sensitivity of assets growth to cash flow (CFS_i^{alt}) can be derived, where t indexes time and n, the number of observations available for firm i:

$$CFS_i^{alt} = \sum_{t=1}^{n}\left(\frac{\left(Cash\ flow/_{Assets}\right)_{it}}{\sum_{t=1}^{n}\left(Cash\ flow/_{Assets}\right)_{it}} * e_{it}\right) - \frac{1}{n}\sum_{t=1}^{n} e_{it} \quad \text{(A2)}$$

CFS^{alt} will be higher for firms that exhibit higher (lower) assets growth in periods of high (low) cash flow, controlling for other factors. Like *CFS*, it can be considered as a firm-specific indicator of the degree of financing constraints faced by each firm in our sample.

To assess whether CFS^{alt} is a valid measure of the degree of financing constraints faced by firms, Table A2 reports the estimates of Equation (1) for firms with high and low CFS^{alt}. As in columns 9 and 10 of Table 9, a firm is classified among the high (low) CFS^{alt} group if its CFS^{alt} falls in the top quartile (bottom three quartiles) of the CFS^{alt} of all the firms in the sample. We can see that the cash flow coefficient is only statistically significant (and equal to 2.68) for the high CFS^{alt} firms. This confirms that, like *CFS*, CFS^{alt} is a valid measure of the degree of financing constraints faced by firms[39].

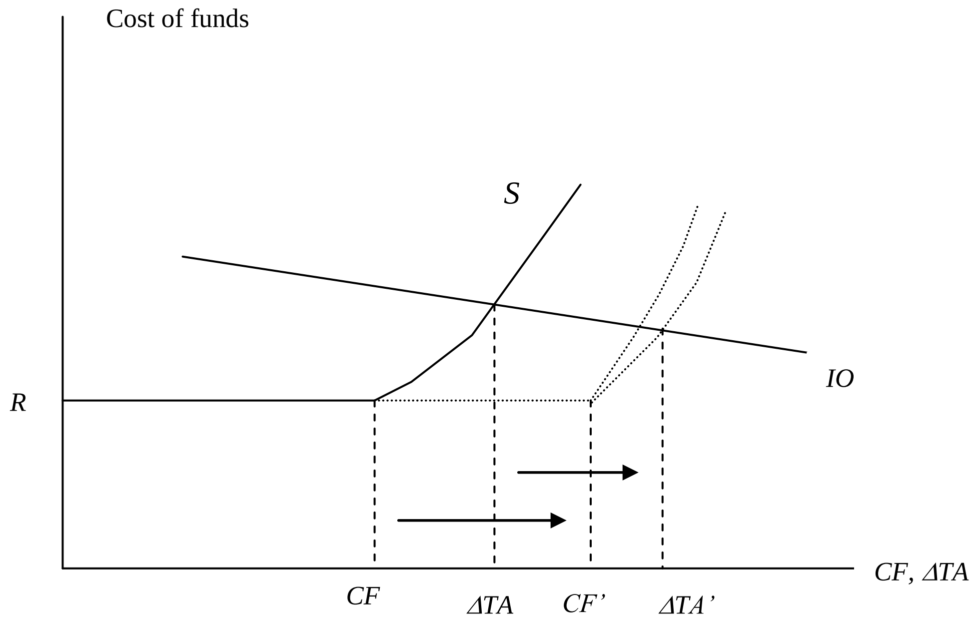
Table A3 reports mean and medians of the same variables reported in Table 10, for all firms characterized by high and low CFS^{alt} on the one hand (Panel A), and for

[37] Our results were robust to using different regressors in Equation (A1).
[38] As for *CFS*, the minimum weight is set to 0 in order to obtain legitimate weighted averages.
[39] Like in Section 3.5.1, these findings were robust to using a 50% cut-off point.

high growth firms characterized by high and low CFS^{alt}, on the other (Panel B). Once again, it can be seen that while firms with low CFS^{alt} typically exhibit higher growth, higher cash flow, and higher labor productivity than their high CFS^{alt} counterparts, they do not display statistically significantly different values of wages per employee, training expenses over assets, and their growth.

Focusing on those firms with high assets growth and high CFS^{alt}, we can see that they typically perform better than firms with low CFS^{alt}, not only in terms of growth and productivity, but also in terms of wages per employee and its growth, and of the growth in training expenses. In summary, the results reported in Section 5.3.2 and in this Appendix suggest that whatever the measure of firm-level assets growth to cash flow sensitivities that we use, it appears that there is no evidence of significant efficiency losses induced by the simultaneous pervasive credit constraints (proxied by high cash flow sensitivities) and high growth that characterize Chinese private firms.

Figure 1: Financing hierarchy and investment opportunities



Note: *CF*= cash flow; *ΔTA* = change in total assets; *R*= constant shadow cost of internal finance; *IO* = investment opportunities schedule; *S* = supply of finance schedule.
Source: Adapted from Carpenter and Petersen (2002).

Table 1: Distribution of observations by ownership type

	State-owned (1)	*Foreign* (2)	*Private* (3)	*Collective* (4)
2000	13.43	20.34	45.66	20.94
2001	10.03	18.69	54.98	16.61
2002	8.62	17.93	59.70	14.04
2003	7.20	17.60	64.32	11.13
2004	6.21	17.97	66.36	9.77
2005	5.48	18.20	68.19	8.40
2006	4.75	18.32	69.49	7.69
2007	4.19	18.26	70.60	7.17
All	6.16	18.26	64.94	9.21

Note: All numbers in this Table are percentages.

Table 2: Asset composition by ownership type

	State-owned (1)	*Foreign* (2)	*Private* (3)	*Collective* (4)
Tangibles	39.65	33.01	33.02	31.86
Intangibles	1.71	1.91	2.37	1.16
Other fixed assets	5.06	3.48	4.87	4.24
Accounts receivable	13.93	19.56	20.41	21.71
Inventories	18.83	21.95	19.01	19.55
Other current assets	20.83	20.08	20.33	21.48

Note: All numbers in this Table are percentages.

Table 3: Sample means and medians (in parentheses)

	State-owned	*Foreign*	*Private*	*Collective*
	(1)	(2)	(3)	(4)
Assets growth	1.05 (-0.77)	5.54 (3.12)	8.46 (4.94)	4.12 (1.32)
Sales growth	5.63 (5.03)	7.95 (7.90)	10.41 (9.90)	7.80 (7.19)
Employment growth	-3.35 (-1.18)	2.99 (0.00)	0.68 (0.00)	-1.44 (0.00)
Assets	771.79 (411.00)	649.14 (371.38)	427.18 (202.38)	327.40 (181.93)
Sales	521.08 (272.86)	674.83 (412.78)	483.38 (270.49)	393.82 (218.53)
Nb. of employees	430.38 (275.00)	315.99 (200.0)	232.76 (145)	227.41 (145)
Age	30.12 (32)	9.91 (10)	12.31 (9)	18.51 (15)
Cash flow/total assets	4.51 (3.25)	8.30 (6.63)	8.28 (5.74)	8.82 (5.64)
Cash flow/tangible fixed assets	15.88 (9.09)	35.21 (22.09)	31.99 (20.06)	35.90 (21.28)
Total liabilities / total assets	63.22 (63.89)	45.26 (44.82)	60.06 (61.97)	58.98 (60.41)
Fixed investment/total assets	2.26 (0.54)	3.30 (1.32)	4.18 (1.78)	3.15 (1.04)
Labor productivity	159.91 (100.09)	315.68 (202.15)	273.26 (187.19)	243.52 (155.68)
Observations	16,719	46,601	158,981	23,691

Notes: Assets and sales are expressed in thousands of yuan. All other variables except age and number of employees are expressed in percentage terms. All variables were deflated using provincial ex-factory producer price indices. See Appendix 1 for complete definitions of all variables.

Table 4: Assets growth model

	State-owned	*Foreign*	*Private*	*Collective*
	(1)	(2)	(3)	(4)
Assets growth $_{i(t-1)}$	-0.40***	-0.07***	-0.14**	-0.16
	(0.15)	(0.01)	(0.06)	(0.17)
(Cash flow / total assets) $_{it}$	0.25	1.09***	0.98***	0.63
	(0.58)	(0.11)	(0.33)	(0.60)
J (p-value)	0.10	0.21	0.04	0.02
m1	-1.72	-44.32	-7.36	-2.60
m2		0.75		
m3	-0.87	-0.06	2.34	-1.53
p-value of F-test of H_0*: cash flow coeff≥1*	0.09	0.81	0.95	0.27
Observations	16,719	46,601	158,981	23,690

Notes: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Assets growth)*$_{i(t-3)}$, *(Cash flow / total assets)*$_{i(t-3)}$. Instruments in column 2 also include *(Assets growth)*$_{i(t-2)}$ and *(Cash flow / total assets)*$_{i(t-2)}$. Time dummies were always included in the instrument set. The *J* statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. *m1* is a test for first-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m3* is a test for third-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Also see Notes to Table 3. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 5: Assets growth model controlling for investment opportunities

	State-owned	*State-owned*	*Foreign*	*Foreign*	*Private*	*Private*	*Collective*	*Collective*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Assets growth $_{i(t-1)}$	-0.41*** (0.15)	-0.37** (0.15)	-0.07*** (0.01)	-0.07*** (0.01)	-0.11** (0.06)	-0.14** (0.06)	-0.15 (0.15)	-0.20 (0.18)
(Cash flow / total assets) $_{it}$	0.35 (0.53)	0.07 (0.60)	1.05*** (0.10)	1.09*** (0.11)	0.83*** (0.27)	0.99*** (0.18)	0.56 (0.39)	0.77 (1.30)
Industry-level value added growth $_{it}$	0.41*** (0.13)		0.21** (0.09)		0.30*** (0.06)		0.001 (0.14)	
Time dummies interacted with ind. dummies	No	Yes	No	Yes	No	Yes	No	Yes
J (p-value)	0.34	0.13	0.04	0.23	0.004	0.04	0.00	0.06
m1	-1.81	-1.85	-44.49	-44.23	-8.17	-7.10	-2.90	-2.45
m2			0.79	0.65				
m3	-0.95	-1.11	-0.07	-0.04	2.25	2.38	-1.53	-1.40
p-value of F-test of H_0*: cash flow coeff≥1*	0.11	0.06	0.69	0.81	0.26	0.50	0.13	0.35
Observations	16,700	16,719	46,595	46,601	158,952	158,981	23,681	23,691

Notes: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies were included in all specifications. In columns 2, 4, 6, and 8, time dummies interacted with industry dummies were also included. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Assets growth)*$_{i(t-3)}$, *(Cash flow / total assets)*$_{i(t-3)}$. Instruments in column 3 and 4 also include *(Assets growth)*$_{i(t-2)}$ and *(Cash flow / total assets)*$_{i(t-2)}$. In columns 1, 3, 5, and 7, (*Industry level value added growth)*$_{j(t-3)}$ are also included in the instrument set (the subscript *j* identifies industries); column 3 also includes (*Industry level value added growth)*$_{j(t-2)}$. Time dummies were always included in the instrument set. In columns 2, 4, 6, and 8, time dummies interacted with industry dummies were also included in the instrument set. The *J* statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. *m1* is a test for first-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m3* is a test for third-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Also see Notes to Table 3. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 6: Assets growth model augmented with industry-specific time dummies: firm assets growth measured net of other current assets

	State-owned	*Foreign*	*Private*	*Collective*
	(1)	(2)	(3)	(4)
Assets growth $_{i(t-1)}$	-0.32**	-0.03	-0.03	-0.08
	(0.12)	(0.08)	(0.05)	(0.10)
(Cash flow / total assets) $_{it}$	-0.17	0.52*	0.61**	0.02
	(0.81)	(0.31)	(0.33)	(0.54)
J (p-value)	0.92	0.64	0.43	0.04
m1	-2.94	-6.51	-11.01	-5.43
m3	-0.29	1.47	1.79	1.54
Observations	14,244	41,953	146,872	20,680

Notes: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Assets growth)*$_{i(t-3)}$, *(Cash flow / total assets)*$_{i(t-3)}$. In column 4, the instrument set also includes: *(Assets growth)*$_{i(t-4)}$ and *(Cash flow / total assets)*$_{i(t-4)}$. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. The *J* statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. *m1* is a test for first-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m3* is a test for third-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Also see Notes to Table 3. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 7: Assets growth model augmented with industry-specific time dummies: alternative ownership definition (based on a 100% paid-in capital rule)

	State-owned	*Foreign*	*Private*	*Collective*
	(1)	(2)	(3)	(4)
Assets growth $_{i(t-1)}$	-0.25	-0.18*	-0.09	-0.06
	(0.17)	(0.10)	(0.08)	(0.24)
(Cash flow / total assets) $_{it}$	0.21	0.97***	0.85**	0.30
	(0.63)	(0.26)	(0.35)	(0.84)
J (p-value)	0.54	0.04	0.01	0.05
m1	-1.88	-4.56	-6.48	-2.22
m3	0.22	0.86	1.54	-0.60
p-value of F-test of H_0*: cash flow coeff≥1*	0.11	0.45	0.34	0.21
Observations	7,435	26,267	91,570	7,338

Notes: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Assets growth)*$_{i(t-3)}$, *(Cash flow / total assets)*$_{i(t-3)}$. In columns 1 to 3, the instrument set also includes: *(Assets growth)*$_{i(t-4)}$ and *(Cash flow / total assets)*$_{i(t-4)}$. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. The *J* statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. *m1* is a test for first-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m3* is a test for third-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Also see Notes to Table 3. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 8: Investment model augmented with industry-specific time dummies

	State-owned	*Foreign*	*Private*	Collective
	(1)	(2)	(3)	(4)
(Fixed investment / total assets) $_{i(t-1)}$	-0.01 (0.01)	-0.92*** (0.25)	-0.60*** (0.12)	-0.04 (0.01)
(Cash flow / total assets) $_{it}$	-0.18 (0.30)	0.36*** (0.10)	0.37*** (0.10)	-0.20 (0.19)
J (p-value)	0.85	0.08	0.86	0.17
m1	-20.01	-0.14	-1.10	-27.81
m2	1.34			1.46
m3	-0.66	0.48	1.15	-1.20
Observations	16,688	46,561	158,860	23,658

Notes: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in columns 2 and 3 are (*Fixed investment/total assets)*$_{i(t-3)}$ and *(Cash flow / total assets)*$_{i(t-3)}$. Instruments in columns 1 and 4 are (*Fixed investment/total assets)*$_{i(t-2)}$ and *(Cash flow / total assets)*$_{i(t-3)}$. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. The *J* statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. *m1* is a test for first-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m2* is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m3* is a test for third-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Also see Notes to Table 3. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 9: Assets growth model augmented with industry-specific time dummies: looking at different types of private firms

	$TYPE_{it}$= f(Region)	$TYPE_{it}$= f(Region)	$TYPE_{it}$= f(Foreign ownership)	$TYPE_{it}$= f(Foreign ownership)	$TYPE_{it}$= f(State ownership)	$TYPE_{it}$= f(State ownership)	$TYPE_{it}$= f(Political affiliation)	$TYPE_{it}$= f(Political affiliation)	$TYPE_{it}$= f(CFS)	$TYPE_{it}$= f(CFS)
	$TYPE_{it}$=0	$TYPE_{it}$=1	$TYPE_{it}$=0	$TYPE_{it}$=1	$TYPE_{it}$=0	$TYPE_{it}$=1	$TYPE_{it}$=0	$TYPE_{it}$=1	$TYPE_{it}$=0	$TYPE_{it}$=1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Assets growth $_{i(t-1)}$	-0.24** (0.12)	-0.15** (0.07)	-0.18*** (0.06)	-0.013 (0.20)	-0.13** (0.07)	-0.60** (0.25)	-0.15* (0.07)	-0.39* (0.23)	-0.14 (0.10)	-0.07 (0.07)
(Cash flow / total assets) $_{it}$	-0.95 (0.65)	1.23*** (0.30)	1.04*** (0.36)	-0.10 (0.54)	0.79** (0.33)	-0.07 (0.69)	0.98*** (0.33)	0.21 (0.37)	2.43*** (0.33)	-0.13 (0.41)
J (p-value)	0.05	0.66	0.03	0.81	0.04	0.74	0.05	0.62	0.06	0.02
m1	-2.86	-6.38	-6.54	-2.51	-7.13	-0.52	-7.14	-1.02	-3.97	-7.11
m3	1.60	2.48	2.58	0.02	1.90	1.99	2.35	0.90	1.32	2.08
p-value of F-test of H_0*: cash flow coeff.* ≥ 1	0.00	0.77	0.55	0.02	0.26	0.06	0.95	0.21	0.99	0.95
Diff	0.003		0.07		0.27		0.11		0.00	
Observations	37,084	121,897	143,254	15,727	147,066	11,915	157,766	1,215	43,652	115,329

Notes: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. In columns 1 and 2, $TYPE_{it}$ is a dummy equal to 1 if the firm is located in the coastal regions of China, and 0 otherwise. In columns 3 and 4, $TYPE_{it}$ is a dummy equal to 1 if the firm has an average share of foreign capital of more than 10%, and 0 otherwise. In columns 5 and 6, $TYPE_{it}$ is a dummy equal to 1 if the firm has an average share of state capital of more than 10%, and 0 otherwise. In columns 7 and 8, $TYPE_{it}$ is a dummy equal to 1 if firm *i* is affiliated with the state and/or provincial governments, and 0 otherwise. In columns 9 and 10, $TYPE_{it}$ is a dummy equal to 1 if firm *i'*s assets growth to cash flow sensitivity (*CFS*) falls in the bottom three quartiles of the distribution of the *CFS* of all firms in the sample, and 0 otherwise. *CFS* represents the firm-specific assets growth to cash flow sensitivities calculated using the methodology outlined in Hovakimian and Hovakimian (2009).Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Assets growth)* $_{i(t-3)}$ and *(Cash flow / total assets)* $_{i(t-3)}$. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. The *J* statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. *m1* is a test for first-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m3* is a test for third-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *Diff* is the *p*-value associated with the *F*-test for the equality of the cash flow coefficients for firms characterized by *TYPE* equal to 0 and 1. Also see Notes to Table 3. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 10: Firm characteristic by firm-specific cash flow sensitivity (*CFS*) type

	Panel A:	***All firms***		***Panel B:***	***High growth firms***		
	High CFS (1)	*Low CFS (2)*	*Diff (3)*	*High CFS (1)*	*Diff1 (2)*	*Low CFS (3)*	*Diff2 (4)*
Category 1							
Assets growth	7.81	8.70	0.00	28.34	0.00	29.09	0.00
	(4.66)	(5.06)		(25.53)		(25.67)	
Cash flow/ assets	7.45	8.60	0.00	8.80	0.04	8.71	0.43
	(5.05)	(5.97)		(6.09)		(6.12)	
Cash flow/tang. fixed assets	30.86	32.42	0.00	40.08	0.00	36.59	0.00
	(18.36)	(20.61)		(23.55)		(22.98)	
Category 2							
Wage per employee	13.14	13.15	0.81	14.59	0.00	14.32	0.02
	(11.22)	(11.38)		(12.40)		(12.27)	
Wage per employee growth	8.33	8.68	0.20	11.46	0.00	11.76	0.60
	(5.88)	(6.26)		(8.92)		(8.89)	
Training expenses/ assets	0.09	0.09	0.08	0.08	0.09	0.09	0.07
	(0.01)	(0.01)		(0.02)		(0.02)	
Training expenses growth	8.14	8.96	0.48	16.29	0.00	16.89	0.81
	(6.45)	(8.73)		(14.80)		(17.59)	
Category 3							
Labor productivity	267.30	275.52	0.00	340.39	0.00	336.65	0.31
	(180.47)	(189.87)		(239.82)		(237.80)	
Labor productivity growth	8.60	9.73	0.00	13.50	0.00	13.61	0.84
	(7.85)	(9.03)		(12.46)		(13.44)	
TFP	354.56	351.86	0.10	442.33	0.00	410.17	0.00
	(266.88)	(271.77)		(344.12)		(322.91)	
TPF growth	6.92	8.79	0.00	15.88	0.00	14.90	0.05
	(6.49)	(7.94)		(13.71)		(14.06)	
Number of observations	43,652	115,329		9,722		26,860	

Note: CFS represents the firm-specific assets growth to cash flow sensitivities calculated using the methodology outlined in Hovakimian and Hovakimian (2009). The Table reports means and medians (in parenthesis). All figures are in percentage terms. Firms with high *CFS* are defined as firms whose *CFS* falls in the top quartile of the distribution of the *CFS* of all firms in the sample. Firms with low *CFS* are defined as firms whose *CFS* falls in the bottom three quartiles of the distribution of the *CFS* of all firms in the sample. The statistics reported in Panel B refer to firms with high growth, defined as firms whose average assets growth falls in the top quartile of the distribution of the average assets growth of all firms in the sample. *Diff* is the *p*-value of the test statistic for the equality of the means reported in columns (1) and (2) of Panel A. *Diff1* is the *p*-value of the test statistic for the equality of the means reported in column (2) of Panel A and column (1) of Panel B. *Diff2* is the *p*-value of the test statistic for the equality of the means reported in columns (1) and (3) of Panel B. See Appendix 1 for precise definitions of all variables.

Table A1: Assets growth model augmented with industry-specific time dummies: using an IV fixed effects estimator

	State-owned	*Foreign*	*Private*	*Collective*
	(1)	(2)	(3)	(4)
Assets growth $_{i(t-1)}$	1.16*** (0.28)	0.54*** (0.12)	0.44*** (0.06)	0.25*** (0.04)
(Cash flow / total assets) $_{it}$	-1.04 (1.06)	0.96*** (0.43)	1.04*** (0.44)	1.25 (0.81)
Kleibergen-Paap rk Wald F-statistic	12.43	39.59	28.70	7.83
Observations	11,759	30,964	98,083	18,002

Notes: The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in columns 1, 2, and 3 are *(Assets growth)*$_{i(t-3)}$ and *(Cash flow / total assets)*$_{i(t-3)}$. Instruments in column 4 are *(Assets growth)*$_{i(t-2)}$ and *(Cash flow / total assets)*$_{i(t-3)}$. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. The Kleibergen-Paap *rk* Wald *F*-statistic, which is the robust analog of the *F*-statistic form of the Cragg-Donald (1993) statistic suggested by Stock and Yogo (2002) is used as a global test for the presence of weak instruments. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table A2: Assets growth model augmented with industry-specific time dummies for private firms with high and low firm-specific cash flow sensitivities (CFS^{alt}).

	High CFS^{alt}	*Low* CFS^{alt}
	(1)	(2)
Assets growth $_{i(t-1)}$	-0.17 (0.13)	-0.05 (0.07)
(Cash flow / total assets) $_{it}$	2.68*** (0.41)	-0.28 (0.42)
J (p-value)	0.94	0.02
m1	-3.45	-7.03
m3	1.97	1.69
Diff	0.00	
p-value of F-test of H_0*: cash flow coeff.* ≥ 1	0.99	0.002
Observations	44,169	114,812

Notes: CFS^{alt} represents the firm-specific assets growth to cash flow sensitivities calculated using the methodology outlined in Hovakimian (2009). Firms with high CFS^{alt} are defined as firms whose CFS^{alt} falls in the top quartile of the distribution of the CFS^{alt} of all firms in the sample. Firms with low CFS^{alt} are defined as firms whose CFS^{alt} falls in the bottom three quartiles of the distribution of the CFS^{alt} of all firms in the sample. All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Assets growth)*$_{i(t-3)}$, *(Cash flow / total assets)*$_{i(t-3)}$. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. The *J* statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. *m1* is a test for first-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m3* is a test for third-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *Diff* is the *p*-value associated with the *F*-test for the equality of the cash flow coefficients for firms characterized by high and low CFS^{alt}. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table A3: Firm characteristic by firm-specific cash flow sensitivity (CFS^{alt}) type

	Panel A: All firms			Panel B: High growth firms			
	High CFS^{alt} (1)	*Low CFS^{alt} (2)*	*Diff (3)*	*High CFS^{alt} (1)*	*Diff1 (2)*	*Low CFS^{alt} (3)*	*Diff2 (4)*
Category 1							
Assets growth	7.75	8.72	0.00	28.15	0.00	29.16	0.00
	(4.61)	(5.09)		(25.10)		(25.99)	
Cash flow/ assets	7.79	8.47	0.00	8.98	0.00	8.65	0.02
	(5.27)	(5.90)		(6.24)		(6.08)	
Cash flow/tang. fixed assets	31.79	32.07	0.21	40.82	0.00	36.31	0.00
	(18.90)	(20.43)		(24.04)		(22.83)	
Category 2							
Wage per employee	13.17	13.14	0.50	14.70	0.00	14.28	0.00
	(11.20)	(11.39)		(12.38)		(12.28)	
Wage per employee growth	8.68	8.54	0.60	12.05	0.00	11.54	0.39
	(6.12)	(6.16)		(9.18)		(8.78)	
Training expenses/ assets	0.09	0.09	0.68	0.09	0.77	0.09	0.64
	(0.01)	(0.01)		(0.02)		(0.02)	
Training expenses growth	8.59	8.79	0.86	16.86	0.00	16.68	0.84
	(6.93)	(8.70)		(15.41)		(17.43)	
Category 3							
Labor productivity	270.52	274.32	0.01	340.87	0.00	336.50	0.24
	(183.09)	(188.96)		(240.38)		(237.73)	
Labor productivity growth	9.40	9.40	0.99	14.55	0.00	13.21	0.01
	(8.67)	(8.78)		(13.48)		(13.16)	
TFP	359.43	350.00	0.00	447.10	0.00	408.61	0.00
	(270.46)	(270.59)		(348.08)		(321.74)	
TPF growth	8.04	8.37	0.17	17.02	0.00	14.51	0.05
	(7.56)	(7.67)		(14.57)		(13.80)	
Number of observations	44,169	114,812		9,607		26,975	

Note: CFS^{alt} represents the firm-specific assets growth to cash flow sensitivities calculated using the methodology outlined in Hovakimian (2009). The Table reports means and medians (in parenthesis). All figures are in percentage terms. Firms with high CFS^{alt} are defined as firms whose CFS^{alt} falls in the top quartile of the distribution of the CFS^{alt} of all firms in the sample. Firms with low CFS^{alt} are defined as firms whose CFS^{alt} falls in the bottom three quartiles of the distribution of the CFS^{alt} of all firms in the sample. The statistics reported in Panel B refer to firms with high growth, defined as firms whose average assets growth falls in the top quartile of the distribution of the average assets growth of all firms in the sample. *Diff* is the *p*-value of the test statistic for the equality of the means reported in columns (1) and (2) of Panel A. *Diff1* is the *p*-value of the test statistic for the equality of the means reported in column (2) of Panel A and column (1) of Panel B. *Diff2* is the *p*-value of the test statistic for the equality of the means reported in columns (1) and (3) of Panel B. See Appendix 1 for precise definitions of all variables.

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Working Paper List 2005

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