Does China overinvest? Evidence from a panel of Chinese firms

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Abstract

This paper uses a dataset of more than 100,000 firms over the period of 2000-07 to assess the extent to which Chinese firms overinvest. We find that corporate investment in China has become increasingly efficient over time, which suggests that overinvestment has been declining. However, making use of direct measures of overinvestment, we find evidence of this phenomenon for all types of firms. The free cash flow hypothesis provides a good explanation for China's overinvestment in the collective and private sectors, whereas in the state sector, overinvestment is attributable to the poor screening and monitoring of enterprises by banks.

JEL classification: G31; O16; O53

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1. Introduction

China has experienced an investment boom in recent years. Gross fixed capital formation has averaged 33 percent of GDP since economic reform commenced in 1978, and 39 percent over the last decade (*World Development Indicators*, December 2010). A wide range of arguments has been offered by way of explanation. For instance, Gong and Lin (2008) argue that the vast surplus of labor in rural areas, and the easy and cheap credit provided by the government via its state banking system, are the preconditions for the high investment rate. According to Aziz and Dunaway (2007), it is the attractive returns on investment that provide Chinese firms with strong incentives to invest. They point out that low bank lending rates and abundant retained earnings have kept the cost of investment funds low. Barnett and Brooks (2006) provide evidence that the non-state sector has been the driver in the recent investment surge, and that it has been funded mainly by 'self-raised' funds emanating from the growth of company profits. Knight and Ding (2010) stress the high growth expectations and investment confidence that flow from China's 'developmental state'.

Nevertheless, whether or not China overinvests is a matter of controversy. Although investment and investment-generated improvements in productivity are important drivers of China's rapid economic growth, the high investment rate may also be an important source of macroeconomic imbalances. Concern has been expressed that too much investment may create industrial overcapacity, generate inefficiency, and threaten profits and employment.

Overinvestment in China has been mainly looked at using aggregated provincial data: contrasting results have been found as to whether or not China overinvests. A limited number of papers have addressed the issue using micro data. However, these papers have generally looked at overinvestment only indirectly, focusing on investment efficiency, which is negatively related to overinvestment. To the best of our knowledge, direct measures of overinvestment have not been devised for firms in China. Hence, a direct analysis of the extent to which Chinese firms overinvest and of the possible determinants of this overinvestment does not exist. Our main contribution is to fill this gap in the literature. To this end, we use a firm-level dataset of more than 100,000 firms over the period 2000-2007. This dataset is much more comprehensive than those previously used in the literature to analyze overinvestment in China. The use of such a comprehensive dataset enables us to move the literature forward, by taking into account the vast heterogeneity characterizing Chinese firms in analyzing their overinvestment behavior. This represents our second contribution.

Following the literature, we first look at overinvestment indirectly, constructing firm-level measures of investment efficiency, and provide descriptive statistics so as to shed light on the linkages between investment efficiency and firm ownership, industry, time, geographic location, and political affiliation. A Generalized Methods of Moments (GMM) estimator is then used to examine the determinants of investment efficiency. We subsequently proceed to measure firm-level overinvestment directly, by employing an approaches pioneered by Bates (2005) for US firms. Where overinvestment does exist, we examine whether it can be explained by the free cash flow hypothesis (Jensen, 1986) or the absence of a disciplinary role of debt (Stulz, 1990).

We find that, despite significant differences across ownership groups, industries, regions, and levels of political affiliation, the general investment efficiency of Chinese firms has increased over time. This suggests that overinestment has been declining. Regression results show that investment efficiency is positively associated with internal funds and investment opportunities. After controlling for several firm-, industry-, time-, and region-specific factors, state owned enterprises (SOEs) are found to invest much less efficiently than non-state firms. Yet, when a direct measure is used, evidence of overinvestment is found for all types of firms. In the state sector, overinvestment is attributable to the poor screening and monitoring of SOEs by banks, whereas in the collective and private sectors, it can be explained by abundant cash flow generated from high profits. Finally, we find that debt limits the overinvestment bias only for firms with 'medium' or no political affiliation: banks are in fact unlikely to impose restrictions on firms affiliated with central or provincial governments, irrespective of their ownership.

The remainder of the paper is organized as follows. Section 2 briefly reviews the relevant theories and empirical evidence on overinvestment, both in general and in the context of China. Section 3 describes the data. Section 4 examines the investment efficiency of Chinese firms using both descriptive statistics and regression methods. Section 5 employs and analyzes direct measures of overinvestment. Section 6 draws conclusions.

2. Literature review

2.1 Overinvestment – general literature

According to the free cash flow hypothesis (Jensen, 1986), managers have incentives to expand their firms beyond the optimal size. The underlying reason is that growth strengthens managers' power by increasing the resources under their control: as a firm becomes larger,

more opportunities exist for managers to indulge their desires for pecuniary and non-pecuniary (power and prestige) benefits. Hence, there exist conflicts of interest between shareholders and managers. The conflict is especially severe when firms have 'free cash flow', i.e. cash flow in excess of that required to fund all projects that have positive net present value (NPV) when discounted at the relevant cost of capital. Managers have to be monitored in order to prevent them from investing their free cash flow at below the cost of capital or wasting it on organizational inefficiencies. Jensen (1986) argues that, by serving this monitoring role, external capital markets in general, and debt in particular, could and should discipline managerial use of funds and prevent overinvestment.

Stulz (1990) develops a theoretical model of the relationship between the source of financing and agency costs of managerial discretion over investment funds. Given poor investment opportunities, the likelihood that management invests in negative NPV projects increases in the level of managerial discretion over investment funds. It is shown that debt reduces such overinvestment by forcing managers to pay out cash flow when it accrues. Thus, firms with poor investment opportunities benefit from higher leverage because increased capital market monitoring and discipline reduce the overinvestment problem. In other words, debt financing pre-commits managers to pay out free cash flow rather than to waste it when positive NPV investment opportunities are exhausted.

Similarly, Aghion *et al*. (1999) argue that debt instruments reduce the agency costs of free cash flow by reducing the cash available for spending at the discretion of managers. In their theoretical model, this not only mitigates managerial slack but also accelerates the rate at which managers adopt new technologies and thus fosters growth.

Much empirical work has been conducted in this field. Using either US or Canadian data, Lang *et al*. (1996), Aivazian *et al*. (2005) and Ahn *et al*. (2006) find a negative relationship between investment and leverage. The correlation is much stronger for firms with low growth. This is consistent with Stulz's (1990) hypothesis that leverage prevents managers of low-growth firms from investing in non-profitable capital expenditures. Using US data of 400 sales of subsidiaries in the 1990s, Bates (2005) relates the use of proceeds from asset sales to overinvestment. He finds that retaining firms systematically overinvest relative to an industry benchmark. Richardson (2006) adopts an accounting-based framework to measure overinvestment and free cash flow[1]. He finds that overinvestment is concentrated in firms with the highest levels of free cash flow. D'Mello and Miranda (2010) investigate the

[1] Excess investment is defined as the (positive) residuals from a regression of new investment on a group of explanatory variables. Free cash flow is defined as the amount of cash flow in excess of that needed to maintain the existing assets of the firm and to undertake new positive net present value investment.

impact of long-term debt on the overinvestment decisions of firms. Employing a sample of 366 debt issues in the US over the period 1968-2001, they find that managers of unleveraged firms retain excessive liquidity, and that the issue of debt leads to a dramatic reduction in cash ratios and in abnormal capital expenditures. Their results provide support for the hypothesis that debt reduces overinvestment.

2.2 Overinvestment in China

2.2.1 The Chinese institutional framework. China in the 2000s has become a semi-marketized economy, although product markets are more developed than factor markets. Financial markets, in particular, have lagged behind, partly because they provide levers for continued state control of the economy and partly because the (still largely state-owned or state-controlled) banks are required to keep unprofitable SOEs afloat during the reform process (Naughton, 2007: 460-1). The major banks provide ready funds to state-owned or state-controlled firms at rates below what would have been the competitive rate of interest for borrowers, and they do so without exercising close monitoring. Non-bank financial markets are poorly developed. For instance, stock markets remain small, subject to weak disclosure and poor regulation, and open to insider trading (Naughton, 2007: 468-76). Foreign-owned private firms might have external sources of funds, but domestically-owned private firms are tightly credit-constrained. They have to pay high interest rates on rationed loans and they relied heavily on informal sources of funding, in particular retained profits (Knight and Ding, 2010). These institutional arrangements suggest that public sector enterprises would overinvest and private sector enterprises underinvest by comparison with a free market outcome.

The normal explanation for excessive investment in market economies relies on the separation of ownership from control, combined with the absence of strong market competition. This explanation applies also to China, both in the private sector (except in the case of small, owner-managed, firms) and in the public sector. Ownership is often unclear in the public sector, and the motivations of owners are also unclear. However, revenue-raising is an important objective of governments at all levels. By contrast, state-owned and state-controlled enterprise managers often faced incentives for expansion - their pay and promotion within their *nomenklatura* system depended on achieving growth targets - as part of the 'developmental state' incentive structures that the central government had created (Knight and Ding, 2010). It is plausible for China that owners are more concerned with enterprise profitability and managers more concerned with enterprise growth.

2.2.2 Studies based on aggregate data. Several recent studies have used aggregate data to explore the question of whether China invests too much, obtaining contradictory results. Some have adduced evidence against overinvestment and declining investment efficiency. Among these, Zhang (2003) calculates incremental capital-output ratios over the period 1978-2000, and finds an improvement of investment efficiency at the aggregate level. He argues that this may have been due to rural industrialization and the proliferation of small firms, which could have improved allocative efficiency. Bai *et al*. (2006) derive estimates of the real rate of return on capital in the economy as a whole over the reform period and find that the return to capital in China has been remarkably high despite the high investment rate, owing to the rapid growth in total factor productivity (TFP) and a trend towards more capital-intensive industries.

Other studies hold a negative view of China's investment performance. Among these, Rawski (2002) suggests that there were low investment returns and widespread excess capacity across many industries throughout the 1990s. There is in fact direct evidence of underutilization of capital in certain industries, particularly heavy industries dominated by the state (European Chamber, 2009)[2]. Barnett and Brooks (2006) claim that the increase in investment over the period 1990-2005 led to a rise in the capital-output ratio and a fall in the marginal product of capital, suggesting declining capital efficiency and therefore overinvestment. Using provincial data for the period 1989-2004 and defininig overinvestment as the difference between actual and profit-maximizing investment, Qin and Song (2009) find evidence of widespread overinvestment in China, especially in the coastal provinces. In brief, studies based on aggregate time-series data do not reach a consensus answer to our question: microeconomic evidence is needed.

2.2.3 Studies based on micro data. Research based on micro data also provides inconclusive evidence on Chinese firms' investment efficiency. For instance, Liang (2006) shows that the return on firm investment has been high and rising since the late 1990s, as a result of the declining share of investment undertaken by SOEs. He argues that China's investment remains profitable and sustainable. Similar findings are reached by Lu *et al*. (2008). Taking into account the effects of both financial constraints and agency costs, Lian and Chung (2008) discover underinvestment rather than overinvestment by China's listed firms.

[2] For instance, in 2005, the percentage rate of excess capacity was reported to be 34, 46, 73, 84, and 88 percent respectively in the steel, aluminium, calcium carbide, ferroalloy, and container industries.

Less optimistic views are held by others. Using data for over 100,000 Chinese firms over the period 2000-2004, Liu and Siu (2011) find that the implied cost of capital is much lower in the state than in the non-state sector. Owing to soft budget constraints, managers of SOEs perceive a cost of capital that is inefficiently low, and therefore tend to overinvest. Dollar and Wei (2007) echo these findings by using a sample of over 12,000 firms in 120 Chinese cities for the years 2002-04, and conclude that the immature financial system has imposed costs on the economy, in the form of investment misallocation towards inefficient SOEs, equal to about 5% of GDP. Firth *et al*. (2008) find a negative relationship between leverage and investment among 1,200 listed firms over the period 1991-2004, which is, however, weaker for firms with low growth opportunities, poor operating performance, and a high degree of state shareholding. Hence, the latter firms are more likely to overinvest. Hsieh and Klenow (2009) find evidence of greater distortions in resource allocation in China than in the US, and show that if capital and labor were hypothetically reallocated to equalize marginal products to the extent observed in the US, manufacturing, TFP would rise by 30-50% in China. Using a panel of listed firms in China from 2001 to 2006, Chen *et al*. (2011) argue that government intervention through majority state ownership or the appointment of politically connected managers distorts SOEs' investment behavior and harms investment efficiency, particularly in those SOEs that are controlled by local governments.

Although the literature on China contains some intuitively appealing results, the datasets used in most studies cover either a fairly small number of firms or a relatively short time period, putting into question the representativeness of their findings. Moreover, none of these studies proposes direct measures of overinvestment, and each particular method of indirectly measuring overinvestment or investment efficiency inevitably involves strong assumptions. We contribute to this literature by proposing direct measures of overinvestment, new to the Chinese context, by adopting several methodologies to measure investment efficiency and overinvestment, and by using a more comprehensive dataset which enables us to take full account of the wide heterogeneity among firms, and with the objective of understanding the extent, nature and causes of overinvestment in China.

3. Data

Firm-level data offer several advantages for the study of investment behavior: the problem of aggregation over firms is eliminated in estimation, and heterogeneity among various types of firms can be taken into account (Bond and Van Reenen, 2007). This is particularly important for China owing to the institutional differences between state and non-state enterprises.

We use data drawn from the annual accounting reports filed by industrial firms with the National Bureau of Statistics (NBS) over the period of 2000-2007. This dataset includes all SOEs and other types of enterprises with annual sales of five million yuan (about $650,000) or more. These firms operate in the manufacturing and mining sectors and are in all 31 Chinese provinces or province-equivalent municipal cities. We deleted observations with negative values of: sales; total assets minus total fixed assets; total assets minus liquid assets; and accumulated depreciation minus current depreciation. Firms that did not have complete records of 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 regression variable. Finally, we removed all firms with less than five years of consecutive observations.

Our final dataset covers 100,112 (mainly unlisted) firms, which corresponds to 639,382 firm-year observations[3]. Our sample is unbalanced, and its structure can be observed in Table A1 in the Appendix. The number of observations ranges from a minimum of 49,639 in 2000 to a maximum of 93,330 in 2003. There was entry and exit of firms during our sample period: less than 30 percent of firms have the full 8-year accounting information. The active entry and exit of firms is the consequence of enterprise restructuring, which began in earnest in the mid-1990s. It can be viewed as a source of dynamism in this sector (Brandt *et al*., 2009).

The NBS data contain a continuous measure of ownership, which is based on the fraction of paid-in-capital contributed by the following six different types of investors: 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[4]. We group all foreign firms (from Hong Kong, Macao, Taiwan, and other parts of the world) into a single *foreign* category; and all firms owned by legal entities and individuals into a single *private* category[5]. Thus our firms fall into four broad ownership groups - state-owned,

[3] The NBS dataset does not allow separate identification of publicly listed companies in China (Liu and Xiao, 2004). Over the period considered, listed companies operating in the manufacturing and mining sectors amounted to less than 0.3% of the total number of firms in our sample.

[4] Investors from Hong Kong, Macao, and Taiwan, and those from other parts of the world are analyzed separately because 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, 2003). Legal entities comprise industrial enterprises, construction and real estate development companies, transportation and power companies, security companies, trust and investment companies, foundations and funds, banks, technology and research institutions etc. Collective firms are generally owned collectively by communities in urban or rural areas. The latter are known as township and village enterprises (TVEs).

[5] Within this category, firms owned by individuals make up about two thirds of the total. Firms owned by legal entities include firms owned by state legal entities. One could therefore question their inclusion in the *private*

collective, private, and foreign - based on the shares of paid-in-capital contributed by the four types of investors each year.

We adopt two methods to classify firms by ownership. First, as in Guariglia et al. (2011), we group firms according to the majority average ownership shares. For instance, if the average share of capital paid-in by private investors over the period 2000-2007 is greater than 50%, then the firm is classified as privately owned. One potential problem with this method is that the size of the private ownership group is likely to be exaggerated. According to Haggard and Huang (2008), defining China's private sector is difficult, as genuinely private domestic firms are different from government-controlled firms. They argue that the former group has remained relatively small and subject to many controls and permissions, for instance with regard to the provision of finance and the requirement of official approval of investment projects above a certain size. To take account of this phenomenon, our second approach to classification is based on a 100% rule. For instance, a firm is classified as privately-owned when all the paid-in-capital in each year is contributed by private investors. This method allows us to focus on the *de jure* private firms which are more likely to represent the true private sector. The cost of the second approach is that a significant number of firms are left in a residual category. This is referred to as the mixed ownership group, in which firms do not have a dominant investor (by the majority rule) or a single-type investor (by the 100% rule).

Table A2 in the Appendix presents the distribution of observations by ownership using both methods. Our sample is dominated by private firms: 62% of firms are classified as privately-owned by the majority rule and 38% by the 100% rule. SOEs, collective firms and foreign firms represent 8%, 8% and 18% of our sample respectively, based on the majority rule, and 4%, 3% and 10% respectively using the 100% rule. The second approach leads to a decrease of the number of firms in four of these ownership groups, and an increase of firms in the mixed ownership group (46% of our observations are classified as mixed ownership firms). Since the composition of investors in this residual group is unclear, the second method involves a significant loss of observations despite its clearer identification of private ownership. In the remainder of this paper, we therefore mainly rely on the majority classification rule and use the 100% rule as a robustness test.

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category. One reason for including them is that while the state's primary interest is political (i.e. aimed at maintaining employment levels or control over certain strategic industries), legal entities are profit-oriented (Wei *et al*., 2005). Since our dataset does not allow us to discriminate between state and non-state legal entities, we are unable to exclude the former from our *private* category. Our results were generally robust to excluding all firms owned by legal entities from the latter category.

Table A2 also shows an interesting pattern of the evolution of ownership over the eight-year period. Taking the majority classification rule as an example, we find that the proportion of SOEs in our sample declined dramatically, from 12% in 2000 to 5% in 2007. A similar pattern holds for collective firms, whose share declines from 11% to 7%. In contrast, the share of private firms climbed from 52% to 66%. The share of foreign firms remained roughly stable at between 17% and 19%. Privatization of small SOEs and TVEs became significant after 1998 (Haggard and Huang, 2008). Our dataset reflects the restructuring process involved in the shrinkage of the state and collective sectors and the expansion of the private sector.

4. Investment efficiency in China

4.1 Methodology

We first adopt the method proposed by Dollar and Wei (2007) to measure the investment efficiency of Chinese firms. Investment efficiency can be seen as an indirect measure of overinvestment: firms that overinvest are likely to exhibit low levels of investment efficiency. In Dollar and Wei's (2007) simple model, the profit-maximizing firm i faces the following problem:

$$Max\ \pi_i = p_i Y_i - r_i K_i - w_i L_i \quad , \tag{1}$$

where π_i is the firm's profit, p_i is the output price, Y_i is output, r_i is the rental cost of capital, K_i is capital usage, w_i is the wage rate, and L_i is the firm's labour usage. The firm subscript i reflects the fact that distortions in the output and factor markets can be firm-specific and make the firm's effective output price and input costs deviate from the market prices. The production function is assumed to take the form: $Y_i = A_i K_i^{\alpha} L_i^{1-\alpha}$, where A_i is firm-specific TFP, and α, the capital share in output, is assumed to be the same for all firms in each industry.

The first-order condition for profit maximization is that the marginal revenue product of capital ($MRPK$) equals the firm-specific interest rate, i.e. $MRPK_i = p_i A_i f_k^{'}(K_i, L_i) = r_i$. Since not all distortions faced by the firm are observable, $MRPK$ is difficult to calculate. By virtue of the Cobb-Douglas production function, $MRPK$ is proportional to an observable variable, the average revenue product of capital ($ARPK$), where $ARPK_i = \frac{p_i Y_i}{K_i} = \frac{1}{\alpha} MRPK_i$. In our panel data context, we define $ARPK$ as the ratio of value added to capital, i.e.:

$$ARPK_{i,t} = \frac{VA_{i,t}}{K_{i,t}} \ , \tag{2}$$

where $VA_{i,t}$ is the real value added of firm i in period t, which is equal to the sum of pre-tax profit income and labor compensation, deflated by the provincial ex-factory producer price index; and $K_{i,t}$ is real tangible fixed assets, deflated using a fixed capital formation deflator.

Instead of inferring $MRPK$ from the estimated $ARPK$, we follow Dollar and Wei(2007) and use an alternative method to compute it from the rate of profit on capital. Specifically:

$$MRPK_{i,t} = \frac{VA_{i,t} - w_{i,t}L_{i,t}}{K_{i,t}} \ , \tag{3}$$

where $w_{i,t}L_{i,t}$ is the total wage bill of firm i at time t. Despite the very strong and contestable assumptions involved in such an approximation[6], this alternative approach has the advantage of not relying on the Cobb-Douglas production function specification, which assumes that the capital share is the same across firms. Since both $ARPK$ and $MRPK$ inevitably involve assumptions as measures of firm efficiency, we make use of both proxies in order to combine the strength of both and to circumvent the limitations of each.

We first compare $ARPK$ and $MRPK$ across various categories of firms using simple summary statistics. Subsequently, formal regression analysis is adopted to examine not only the disparity of investment efficiency but also its determinants. To this end, we initially estimate the following equation:

$$\begin{aligned} IE_{i,t} = \beta_0 + \beta_1 cash\ flow_{i,t-1} + \beta_2 sales\ growth_{i,t-1} + \beta_3 leverage_{i,t-1} + \beta_4 firm\ age_{i,t} + \\ \beta_5 firm\ size_{i,t-1} + \beta_6 ownership\ dummies_i + v_i + v_t + v_j + v_r + \varepsilon_{i,t} \ , \end{aligned} \tag{4}$$

where $IE_{i,t}$ is the investment efficiency of firm i at time t, measured in turn as $ARPK$ and $MRPK$. $cash\ flow_{i,t-1}$ is the ratio of cash flow over total tangible fixed assets of firm i at time $t-1$, where cash flow is defined as the sum of the firm's net income and depreciation. $sales\ growth_{i,t-1}$ is firm i's rate of growth of real sales, which is a proxy for investment opportunities; $leverage_{i,t-1}$ is the ratio of total debt divided by total assets. It is included to test whether high leverage discourages managers from undertaking non-profitable investments. $firm\ age_{i,t}$ is the natural logarithm of firm age; and $firm\ size_{i,t-1}$ is the natural

[6] The marginal revenue product of capital can be assumed to be equal to its rate of return in aggregate models of perfect competition, in which a single good is produced and used both in consumption and as a capital good, Equation (3) is also based on the assumption that wage payment can be accurately observed.

logarithm of the book value of the firm's real total assets[7]. $ownership\ dummies_i$ include three dummy variables equal to 1 if the firm is owned respectively by the state, collective, or foreign agents, and 0 otherwise. The private ownership group is the omitted category.

The error term in equation (4) comprises five components. v_i is a firm-specific time-invariant component, encompassing all time-invariant firm characteristics likely to influence investment efficiency, as well as the time-invariant component of the measurement error affecting any of the regression variables. v_t is a time-specific component accounting for possible business cycles; v_j is an industry-specific component reflecting industrial features associated with investment efficiency; v_r is a region-specific component which captures geographic factors that influence investment; and $\varepsilon_{i,t}$ is an idiosyncratic component. We control for v_i by estimating our equations in first-differences, and for v_t , v_j, and v_r by including year, industry and regional dummies in all our specifications.

The system GMM estimator (Blundell and Bond, 1998) is used to estimate equation (4) and its variants in order to take into account unobserved firm heterogeneity and the possible endogeneity and mismeasurement problems of the regressors. It combines the standard set of equations in first-differences with an additional set of equations in levels. By adding the original equation in levels to the system and exploiting these additional moment conditions, Arellano and Bover (1995) and Blundell and Bond (1998) found a dramatic improvement in efficiency and a significant reduction in finite sample bias compared with the simple first-differenced GMM.

In assessing whether our instruments are legitimate and our models are correctly specified, the Hansen *J* test of over-identifying restrictions is employed to evaluate the overall validity of the set of instruments. In addition, 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. In the presence of serial correlation of order *n* in the differenced residuals, the instrument set needs to be restricted to lags *n*+1 and further. We initially use two lags of all regressors as instruments in the differenced equation. However, since all our models generally fail the test for second-order autocorrelation of the differenced residuals, levels of all regressors lagged three times are used as instruments in the first-differenced equations. First-differenced variables lagged twice are used as additional instruments in the

[7] A deflator for capital stock is used to deflate tangible fixed assets, and the provincial ex-factory producer price indices taken from various issues of *China Statistical Yearbook* are used to convert other variables from nominal to real terms.

levels equations. Our method of restricting the number of instruments used in each first-differenced equation can help alleviate the potential instrument proliferation problem (Bowsher, 2002; Roodman, 2009).

4.2 Descriptive statistics

Table 1 presents descriptive statistics for the investment rate and investment efficiency proxies. Both means and medians are provided, as the latter are less influenced by outliers. We focus our discussion on means. When firms are classified by ownership (Panel A), we observe that fixed investment as a proportion of tangible fixed assets (I/K) is lowest for SOEs (2.6%)[8]. Private firms have the highest investment rate (9.9%), followed by foreign firms (8.9%). SOEs have the lowest investment efficiency as measured by both $ARPK$ (55.3%) and $MRPK$ (19.6%). On the contrary, all non-state firms have much higher investment efficiency. For instance, foreign firms have the highest $ARPK$ (118.8%) followed by collective (110.6%) and private firms (101.1%); collective firms have the highest $MRPK$ (52.8%) followed by private (47.6%) and foreign firms (47.3%). Although they are the least efficient sector in their use of capital, SOEs have accumulated capital less rapidly than other ownership groups.

In Panel B, we group firms into ten industries[9]. Electronic equipment and transport equipment have the highest values for the investment rate and very high investment efficiency (as measured by both $ARPK$ and $MRPK$). In contrast, food and tobacco, and non-metal products and petroleum processing industries have the lowest ratios for all three variables. Interestingly, the labor-intensive textile industry has the highest $ARPK$, perhaps reflecting the efficiency improvement associated with rapid expansion of textile exports and the profitability of exports. In summary, our results suggest that the industries that invest more are also those that are more efficient. There is no evidence supporting the hypothesis that overinvestment occurs particularly in heavy industries[10].

Both $ARPK$ and $MRPK$ follow a strictly rising trend over the period 2000-07 (Panel C), suggesting a consistent improvement of firm-level investment efficiency. The investment rate was lowest in 2004 (4.3%), probably reflecting the tight monetary and fiscal policies

[8] Fixed investment (*I*) is defined as the book value of tangible fixed assets at the end of year *t* – the book value of tangible fixed assets at the end of year *t*-1 + depreciation at year *t*.

[9] Our ten industrial groups are the following: metal and metal product; non-mental products and petroleum processing; chemicals and plastic products; machinery and equipment; electrical equipment; transport equipment; food and tobacco; textile; leather, timber and furniture; and mining and logging.

[10] Heavy industries refer to metal and metal product; non-mental products and petroleum processing; chemicals and plastic products; machinery and equipment; electrical equipment; transport equipment; and mining and logging.

implemented between August 2003 and October 2004 to reduce overheating in the economy. The co-existence of the highest investment rate (15.1%) and the lowest investment efficiency (as measured by both $ARPK$ and $MRPK$) in 2000 suggests the possible presence of overinvestment at the start of the period. Over time, investment efficiency gradually increased, implying that any overinvestment that existed initially had diminished by the end of the period[11].

Panel D shows that the coastal provinces have the highest investment rate (9.1%), the highest $ARPK$ (110.6%), and the highest $MRPK$ (48.7%), while the western provinces have the lowest ratios for all three variables (6.6%, 6.9%, and 3.2%, respectively). Capital accumulation was more rapid and more efficient in the regions with more productive and more profitable capital.

Panel E presents the summary statistics for firms with different degrees of political affiliation. Political affiliation refers to the fact that firms are affiliated (have a *lishu* relationship) with the central, provincial, prefecture, county, or township governments (Li, 2004; Tan *et al*., 2007; Xia *et al*., 2009) [12]. A *lishu* relationship is associated with government support and subsidies. In particular, governments can grant firms affiliated with them benefits such as bank loans at better conditions, waivers of import tariffs, tax reductions and so on. We find that firms with high political affiliation have the lowest investment rate as well as investment efficiency as measured by both $ARPK$ and $MRPK$. In contrast, firms with no political affiliation have the highest investment rate and investment efficiency.

Our initial descriptive statistics are not suggestive of much overinvestment. Firms with high investment rates (i.e., private and foreign firms, operating in electronic and transport equipment industries, located in the coastal region, with no political affiliation) are also those with high average and marginal revenue product of capital. The year 2000, with its high investment and low efficiency, might be the exception, but our proxies for investment efficiency increased consistently thereafter. It should be noted, however, that the examination of firm efficiency without standardizing for firm-specific factors such as firm size, firm age,

[11] To address the concern that the improvement of investment efficiency may simply reflect the rising number of private firms, in Table A3 in the Appendix, we present summary statistics of investment efficiency over time for different ownership groups. The statistics show that investment efficiency as measured both by *ARPK* and *MRPK* is on an increasing trend in both the state and non-state sectors.

[12] Our dataset contains a measure of firms' political affiliation, which distinguishes high political affiliation (i.e. affiliation with central or provincial governments); medium political affiliation (i.e. affiliation with local governments); and no political affiliation. In our sample, 6.4% of the firms have high political affiliation, 39.8% have medium affiliation, and 53.8% have no affiliation. This distribution is fully documented in Table A3 in the Appendix.

and growth opportunities may be misleading. We therefore next analyze the determinants of investment efficiency, making use of a regression analysis.

4.3 Regression analysis

The estimates of our basic model (equation 4) are reported in Table 2. In the $ARPK$ regression (column 1), we find that the cash flow ratio has a positive and significant coefficient, suggesting a positive relationship between investment efficiency and the abundance of internal funds. Cash flow, however, may be an imperfect proxy for changes in net worth, as it might contain information about expected future profitability or, more generally, demand factors (Bond *et al*., 2003; Carpenter and Guariglia, 2008). To ensure that this does not happen, we include in the regression a distinct measure of investment opportunities. Since most firms in our sample are not listed in the stock market, we follow Konings *et al*. (2003) and Guariglia (2008) and use the annual growth rate of real sales ($sales\ growth_{i,t-1}$) to this end[13]. Our results show that firms with higher investment opportunities tend to invest more efficiently.

The leverage ratio has a positive and statistically significant coefficient. This supports the argument that debt reduces managerial discretion to invest in negative NPV projects, and thus improves firms' investment efficiency. In addition, we find that investment efficiency measured by $ARPK$ is higher for firms that are older and smaller.

After accounting for firms' internal and external finance, investment opportunities, firm size, firm age and other factors, $ARPK$ is found to be statistically and substantially lower for SOEs than for domestic private firms. The difference is as much as 11.8 percentage points. The coefficient for collective firms is insignificant. Foreign firms have a higher $ARPK$ than private firms, and thus have the highest ratio among all ownership groups. These results are in line with our initial descriptive statistics.

In the case of $MRPK$ (column 2), we obtain similar results for the cash flow and sales growth variables. Yet, the coefficient on the leverage term is insignificant. This might reflect the offsetting effects of debt among various types of firms: banks may impose disciplinary pressures on their lending to certain types of firms but not to others. Firm age and firm size also have poorly determined coefficients. All three coefficients on the ownership category dummy variables are significantly different from the omitted category, private firms. The ranking of $MRPK$ by ownership category is consistent with their plausible (but unmeasured)

[13] Tobin's Q , i.e. the market to book ratio, is often used as measures of investment opportunities for listed firms.

ranking according to the difficulty of borrowing. For instance, SOEs, which are generally acknowledged to have the greatest ease of access to bank credit, also have the lowest estimated $MRPK$; they are followed in both rankings by foreign firms. Collective and private firms, which typically face the greatest difficulty of obtaining loans and the highest cost of borrowing, display the highest values of $MRPK$.

The validity of the instrument sets is confirmed by the *m3* test. The *p* values of the Hansen *J* test is significant, which may result from the large size of our panel. The Monte Carlo evidence of Blundell *et al*. (2000) show in fact that, when using system GMM on a large panel data to estimate a production function, the Sargan test tends to over-reject the null hypothesis of instrument validity. Consistent with this, Nickell and Nicolitsas (1999) report significant Sargan test statistics for all of their estimation results on UK firms, and Benito (2005), Benito and Hernando (2007), and Becker and Sivadasan (2010) for several of theirs. We are therefore inclined to pay little attention to the J test, as long as the test for third order autocorrelation of the differenced residuals is satisfactory.

To test the robustness of our findings in the baseline model, we first adopt an alternative measure of investment opportunities, the industry-level value added growth (Whited and Wu, 2006). In Panel A of Table 3, we replace sales growth with industrial value added growth, and find that our results are very similar to those of the basic model. Panel B presents results where firm ownership categories are defined on the basis of the 100% paid-in-capital rule. Once again, the results echo the findings of our basic model.

In summary, our regression analysis shows that having sufficient internal funds and more investment opportunities contributes positively to both the $ARPK$ and $MRPK$ measures of investment efficiency. The role of debt in alleviating overinvestment bias and in promoting investment efficiency is confirmed for $ARPK$ but not $MRPK$. There exist significant differences in investment efficiency among the four ownership groups after controlling for several firm-, industry-, time-, and region-specific factors. In particular, SOEs are found to invest much less efficiently, by both criteria, than their non-state counterparts, especially private and foreign firms. The differences in investment efficiency among various ownership groups might be attributed to China's inefficient financial system. For instance, banks are generous in their lending to SOEs without carrying out effective monitoring, which leads to overinvestment and low investment efficiency. By contrast, banks do have incentives to impose disciplinary pressures on their lending to private firms, which are generally discriminated against by the formal financial system, thus curbing bias towards overinvestment. We will test this hypothesis in the next section.

5. The determinants of overinvestment

5.1 Methodology

5.1.1 Definitions of overinvestment and free cash flow. By measuring and explaining the investment efficiency of firms, Section 4 provided only indirect evidence of overinvestment. In this section, we will devise and analyze a direct measure of overinvestment, which will enable us to find a more direct answer to the question: do Chinese firms overinvest? In addition, we will make use of this new measure of overinvestment to directly test for Jensen's (1986) free cash flow hypothesis of overinvestment, and to give a thorough assessment of whether debt plays a disciplinary role in curbing managerial discretion (Jensen, 1986; Stulz, 1990).

In order to measure overinvestment, we follow the approach developed by Bates (2005)[14]. Bates determines whether firms overinvest or not by comparing the capital expenditure ratios of each firm operating in a given industry in a given year with the median ratio of all firms operating in the same industry during that year. If the difference is positive (negative), then the firm overinvests (underinvests)[15]. The positive values of this difference are labeled $OVERINV$. Similarly, free cash flow (FCF) is defined as the cash flow of a sample firm in a given industry and year in excess of the median cash flow of all firms operating in the same industry in that year.

5.1.2 Testing the free cash flow hypothesis. To test for the free cash flow hypothesis of overinvestment, we first estimate the following basic regression:

$$OVERINV_{i,t} = \beta_0 + \beta_1 FCF_{i,t-1} + \beta_2 ownership\ dummies_i + v_i + v_t + v_j + v_r + \varepsilon_{i,t}, \qquad (5)$$

The free cash flow hypothesis (Jensen, 1986) predicts a positive β_1 coefficient. We then control for various types of firm heterogeneity. Specifically, we hypothesize that the impact of free cash flow on overinvestment may be different for firms with different levels of free

[14] It should be noted that the objective of Bates' (2005) paper is not a systematic study of firms' overinvestment. It is instead to examine the allocation of cash proceeds following asset sales. Bates (2005) posits that if retained proceeds enable firms to bypass external capital markets in financing positive NPV projects, a positive relationship should appear between post-sale capital investment and the likelihood of retention, and growth would be enhanced. However, if managerial discretion were to result in the financing of negative NPV projects, inefficiencies would be generated. In this case and in the absence of measures to align the incentives of managers and shareholders, retention decisions would bear little relation to the firm's growth opportunities.

[15] A similar aproach to calculate overinvestment was used, among others, by Servaes (1994) and Hendershott (1996), who studied the investment behavior of takeover targets.

cash flow, firms owned by different agents, and firms with different degrees of political affiliation. We first estimate the following equation:

$$OVERINV_{i,t} = \beta_0 + \beta_1 FCF_{i,t-1} * POSFCF_{i,t-1} + \beta_2 FCF_{i,t-1} * NEGFCF_{i,t-1} + \beta_3 ownership\ dummies_i + v_i + v_t + v_j + v_r + \varepsilon_{i,t}\ , \quad (6)$$

where $POSFCF_{i,t}$ is a dummy variable equal to 1 if $FCF_{i,t} > 0$, and zero otherwise; and $NEGFCF_{i,t}$ is a dummy variable equal to 1 if $FCF_{i,t} < 0$, and zero otherwise. According to the free cash flow hypothesis, only firms with positive free cash flow should overinvest. We therefore expect β_1 to be positively and precisely determined, and β_2 to be poorly determined in equation (6).

We further distinguish the effects of free cash flow on the overinvestment of firms owned by different agents by estimating the following equation:

$$OVERINV_{i,t} = \beta_0 + \beta_1 FCF_{i,t-1} * SOE_i + \beta_2 FCF_{i,t-1} * COL_i + \beta_3 FCF_{i,t-1} * PRIV_i + \beta_4 FCF_{i,t-1} * FOR_i + \beta_5 ownership\ dummies_i + v_i + v_t + v_j + v_r + \varepsilon_{i,t}, \quad (7)$$

where $FCF_{i,t-1} * SOE_i$, $FCF_{i,t-1} * COL_i$, $FCF_{i,t-1} * PRIV_i$ and $FCF_{i,t-1} * FOR_i$ are the interactions between our free cash flow measures and various ownership dummies. We expect all the coefficients of the interaction terms to be significantly positive if the free cash flow hypothesis holds, but keep an open view on their magnitudes. For instance, being much less profitable than their non-state counterparts, SOEs typically have less free cash flow at hand, which may lead to a low β_2 coefficient. Yet, SOEs are also less subject to external monitoring than non-state firms. The absence of control on their use of free cash flow may lead to a high β_2 coefficient.

We next examine the extent to which the free cash flow hypothesis holds among firms with different degrees of political affiliation by estimating the following equation:

$$OVERINV_{i,t} = \beta_0 + \beta_1 FCF_{i,t-1} * HIGHPA_i + \beta_2 FCF_{i,t-1} * MEDIUMPA_i + \beta_3 FCF_{i,t-1} * NOPA_i + \beta_4 ownership\ dummies_i + v_i + v_t + v_j + v_r + \varepsilon_{i,t}, \quad (8)$$

where $HIGHPA_i$, $MEDIUMPA_i$ and $NOPA_i$ are dummy variables equal to 1 if firms i has high, medium, and no political affiliation respectively, and 0 otherwise. Government intervention may distort firms' investment behavior, reduce investment efficiency, and lead to overinvestment. In particular, firms with high political affiliation are more likely to use their free cash flow to engage in investment that that aims not to maximise firm value but to

achieve objectives favored by government, so generating more investment. Using a sample of state-owned listed firms, Chen *et al*. (2011) find evidence in favor of this argument. We therefore expect β_1 to be higher than β_2 and β_3.

5.1.3 Testing whether debt has a disciplinary role on investment. Lastly, the following two models are estimated to examine the role of debt in alleviating the overinvestment bias for firms owned by different agents (equation 9), and firms with different degrees of political affiliation (equation 10):

$$OVERINV_{i,t} = \beta_0 + \beta_1 FCF_{i,t-1} + \beta_2 leverage_{i,t-1} * SOE_i + \beta_3 leverage_{i,t-1} * COL_i + \beta_4 leverage_{i,t-1} * PRIV_i + \beta_5 leverage_{i,t-1} * FOR_i + \beta_6 ownership\ dummies_i + v_i + v_t + v_j + v_r + \varepsilon_{i,t}\ , \quad (9)$$

$$OVERINV_{i,t} = \beta_0 + \beta_1 FCF_{i,t-1} + \beta_2 leverage_{i,t-1} * HIGHPA_i + \beta_3 leverage_{i,t-1} * MEDIUMPA_i + \beta_4 leverage_{i,t-1} * NOPA_i + \beta_5 ownership\ dummies_i + v_i + v_t + v_j + v_r + \varepsilon_{i,t}. \quad (10)$$

We expect debt to significantly reduce overinvestment for non-state firms and firms with medium or no political affiliation, but not for SOEs or firms with high political affiliation. This is because the banks' incentives and efforts in monitoring their lending might be compromised when the borrowing firms have state ownership or high political affiliation. All equations are estimated using the system GMM estimator discussed in Section 4.1.

5.2 Descriptive statistics

The descriptive statistics of the overinvestment and free cash flow variables together with the leverage ratio are presented in Table 4 for each ownership group. Overinvestment is by definition to be found in roughly or exactly half the firms in the sample as a whole because these are the firms that invest more than the median. In line with this argument, Table 4 shows that the percentage of firms that overinvest (%$OVERINV$) is equal to 48.5% of all firm-year observations. Similar percentages are observed for the four ownership groups. Once underinvesting firms are removed, overinvestment expressed as a proportion of tangible fixed assets ($OVERINV$) is 24.1% in the full sample. It is highest for private firms (25.4%) and lowest for SOEs (19.5%). The ratio of free cash flow to tangible fixed assets (FCF) is 15% for the full sample, being lowest for SOEs (-0.05%) and highest for collective firms (20.2%). The leverage ratio, also presented in Table 6, is 57.3% for the full sample: it is lowest for foreign firms (48.2%) and highest for SOEs (63.1%), providing some initial evidence of lax lending to the state sector.

5.3 Regression analysis

5.3.1 The free cash flow hypothesis

Our hypothesis is that managers of firms with funds in excess of those required to finance positive NPV projects are likely to overinvest. We test the hypothesis using equation (5) and report the results in Table 5. The free cash flow term is found to be positive and significant in the overinvestment equation: the elasticity calculated at sample means suggests that a 10% increase in freee cash flow is associated with a 0.4% rise in overinvestment. This positive relationship constitutes evidence in favor of the free cash flow hypothesis. Compared with the benchmark group of private firms, all other ownership groups (SOEs, collective firms, and foreign firms) exhibit lower overinvestment: the coefficients on the ownership dummies are in fact all negative and precisely determined. By contrast with conventional thinking, it is the private sector rather than the state sector that appears to have overinvested most in recent years. One possible explanation is that the rising profitability in the non-state sectors generates abundant free cash flow, which leads to excessive investment. SOEs do not have much free cash flow at hand because they are less profitable, and this curbs their proclivity to overinvest. Another possibility is that SOEs have divested to get rid of obsolete capital in the face of increasing competition, and that this restructuring has curbed their tendency to overinvest (Ding *et al*., 2010).

Table 6 reports the estimates of equations (6)-(8), which are aimed at testing the effects of free cash flow on overinvestment for firms with different levels of free cash flow, firms owned by different agents, and firms with different degrees of political affiliation. Panel A presents interesting results: the positive and significant effect of free cash flow on overinvestment is only found for firms with positive free cash flow, and not for those with negative free cash flow[16]. A χ^2 test suggests that the difference between the coefficients associated with the positive and negative free cash flow interactions is statistically significant. Overall, our findings suggest that overinvestment is less likely when firms have no free cash flow (i.e. $FCF < 0$). One possible explanation is that these firms have to access external markets to raise capital to finance any additional investment, and the capital markets serve an additional monitoring role in disciplining managerial use of funds.

In panel B, we see that the coefficient on free cash flow is positive and significant for all types of ownership groups. It is highest for private and collective firms, which being the most profitable sectors, have abundant free cash flow. The coefficient is lowest for foreign

[16] About 20% of the total firm-year observations in our sample have negative free cash flow.

firms, perhaps because of sound corporate governance in this sector: despite the presence of high profits and free cash flow, foreign firms might have better internal control of their use of free cash flow[17]. The coefficient for SOEs lies in between owing to the joint effects of low free cash flow and poor control of its use. A χ^2 test rejects the null hypothesis that the magnitude of the free cash flow coefficient is the same across all ownership groups.

Panel C shows that free cash flow has a significantly positive effect on the overinvestment of firms with high, medium, and no political affiliations. However, a χ^2 test, suggests that the difference in the magnitude of the interacted coefficients is not statistically significant. The sensitivity of overinvestment to free cash flow thus appears to be similar across firms characterized by different levels of political affiliation[18].

5.3.2 The disciplinary role of debt

We hypothesize that high leverage discourages management from undertaking non-profitable investments: debt pre-commits firms to pay cash as interest and principal, and such commitments reduce managerial discretion over free cash flow that might otherwise be allocated to negative NPV projects.

Table 7 shows estimates of equations (9) and (10), which aim at testing this hypothesis. Panel A presents results for firms with different ownerships. Free cash flow contributes positively and significantly to overinvestment after controlling for the interactions of leverage and ownership dummies. Leverage is found to reduce overinvestment for collective and private firms. No significant debt effects are found for SOEs and foreign firms. Hence, the disciplinary pressures from banks help to curb any tendency to overinvestment only in the non-state domestic sector. In contrast, SOEs, which have enjoyed relatively easy access to formal finance (reflected by their high leverage ratio), are unlikely to face strict screening and monitoring pressures from banks. In the case of foreign firms, the absence of a disciplinary role of debt can be explained by their relatively low leverage ratio.

We then compare the effects of debt on overinvestment among firms with different degrees of political affiliation (Panel B). The free cash flow hypothesis is again supported using both sets of definitions. Interesting results are found in terms of the effects of debt. Leverage has no impact on overinvestment for firms with high political affiliation, but has a significantly negative effect for firms with medium or no political affiliation. A χ^2 test

[17] We are unable to explicitly test this hypothesis owing to data limitations.

[18] Our results were robust to inclusion of more control variables (such as firm size and age) in the overinvestment equations, and to the use of the 100% rule of ownership classification.

suggests that the difference between the debt coefficients of firms with diffeent degrees of political affiliation is statistically significant at the 10% level. These findings can be explained as follows: when firms have high political affiliation, banks' incentives to exert disciplinary pressures on them may be compromised. Without sound monitoring by funders, external funds are unlikely to exert any control on overinvestment in firms with high political affiliation. In contrast, debt exerts a disciplinary role in reducing overinvestment for firms with medium or no political affiliation, this role being largest for the former. The lower debt effect for firms with no political affiliation compared to firms with medium affiliation may appear because the former are less capable of obtaining bank loans than the latter. In summary, a certain degree of political connection may be beneficial for Chinese firms in order to gain access to external finance and other opportunities, but too much government intervention may distort incentives and reduce investment efficiency.

6. Conclusion

China has achieved a remarkably high level of industrial investment in recent years. The rate of capital accumulation in our sample averaged no less than 10% per annum, so that the capital stock more than doubled over the brief period 2000-07. There was a danger - pointed out by several scholars - that such rapid capital deepening would cause diminishing returns to set in and would create underutilized capacity. Has the efficiency of industrial investment declined? Is there evidence of overinvestment? These are the questions that were posed in this paper.

Our data and methodology have enabled us to make a contribution to the literature on this subject. The dataset, containing rich and relevant information and being based on a very large sample of industrial firms, ensured that the results would be reliable. The methodology employed was, at least in part, original for China.

We first examined overinvestment indirectly, by calculating the average and marginal revenue product of capital as measures of investment efficiency. Our initial descriptive statistics suggested that firms that invest most (such as private and foreign firms, operating in the electronic and transport equipment sectors, located in the coastal region, and with no political affiliation) also have the highest investment efficiency. Furthermore, investment efficiency was found to rise consistently over time. This evidence is not suggestive of much overinvestment. Regression results show that investment efficiency is positively associated with internal funds and investment opportunities. After controlling for several firm-, industry-,

time-, and region-specific factors, SOEs are found to invest much less efficiently than non-state firms.

We next provided some direct evidence of overinvestment. To this end, we adopted the methodology suggested by Bates (2005) to construct measures of overinvestment and free cash flow. We used this overinvestment measure to test the free cash flow hypothesis (Jensen, 1986) and the hypothesis that leverage exerts a disciplinary role on investment (Jensen, 1986; Stulz, 1990). Our findings supported the free cash flow hypothesis. This offers a plausible explanation for the overinvestment of collective and private firms. Their rising profitability in recent years has generated significant free cash flow that has induced overinvestment.

The disciplinary role of debt on overinvestment was found to hold for collective and private firms, but not for SOEs. This result helps to explain overinvestment in the state sector: despite the gradual financial sector reforms, banks still impose fewer restrictions on SOEs' borrowing and investment decisions, which creates a bias towards overinvestment. We also found that debt curbs overinvestment bias for firms with no or medium, but not high political affiliation: banks are in fact unlikely to impose restrictions on firms affiliated with central or provincial governments, irrespective of their ownership.

It appears that the policies and processes of economic reform have generated industrial factor productivity growth sufficiently rapid as to offset the tendency towards diminishing returns on investment and to maintain the profitability of investment. Despite free cash flow effects in the collective and private sectors and loose bank lending to the public sector, there is little evidence of declining investment efficiency. Such overinvestment as exists is best dealt with by a deepening of financial sector reform that would raise the opportunity cost of overinvestment to collective and private firms and would ensure that commercial lending criteria were applied to state-owned firms.

References

Aghion, P., Dewatripont, M., and Rey, P. (1999). Competition, Financial Discipline and Growth. *Review of Economic Studies , 66* , 825-852.

Ahn, S., Denis, D. J., and Denis, D. K. (2006). Leverage and Investment in Diversified Firms. *Journal of Financial Economics , 79*, 317-337.

Aivazian, V., Ge, Y., and Qiu, J. (2005). The Impact of Leverage on Firm Investment: Canadian Evidence. *Journal of Corporate Finance , 11*, 277-291.

Arellano, M. and O. Bover. (1995). Another Look at the Instrumental Variable Estimation of Error-Components Models. *Journal of Econometrics , 68*, 29-52.

Aziz, J., and Dunaway, S. (2007). China's Rebalancing Act. *Finance and Development , 44*, 27-31.

Bai, C. E., Hsieh, C. T., and Qian, Y. Y. (2006). The Return to Capital in China. *Brookings Papers on Economic Activity , 2*, 61-88.

Barnett, S. and Brooks, R. (2006). What's Driving Investment in China? *IMF Working Paper No. WP/06/265* .

Bates, T. W. (2005). Asset Sales, Investment Opportunities, and the Use of Proceeds. *Journal of Finance , 60*, 105-135.

Becker, B. and Sivadasan, J. (2010). The Effects of Financial Development on the Investment-Cash Flow Relationship: Cross-Country Evidence from Europe. *B.E. Journal of Economic Analysis and Policy (Advances), 10*, 1-47.

Benito, A. (2005). Financial Pressure, Monetary Policy Effects and Inventories: Firm-Level Evidence from a Market-Based and a Bank-Based Financial System, *Economica, 72* , 201-24.

Benito, A. and Hernando, I. (2007). Firm Behavior and Financial Pressure: Evidence from Spanish Panel Data. *Bulletin of Economic Research*, *59*, 283-311.

Blundell, R. and S. Bond. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics, 87*, 115-143.

Blundell, R., Bond, S. and Windmeijer, F. (2000). Estimation in Dynamic Panel Data Models: Improving on the Performance of the Standard GMM Estimators, In: Fomby, T. B. and R. C. Hill (eds.), Nonstationary Panels, Panel Cointegration, and Dynamic Panels (Advances in Econometrics, Vol. 15), Amsterdam: JAI Press, Elsevier Science, 53-91.

Bond, S. and Van Reenen, J. (2007). Microeconometric Models of Investment and Employment. In *Handbook of Econometrics* (Vol. 6A, 4418-4498). London: Elsevier.

Bond, S., Elston, J. A., Mairesse, J., and Mulkay, B. (2003). Financial Factors and Investment in Belgium, France, Germany, and the United Kingdom: A Comparison Using Company Panel Data. *Review of Economics and Statistics , 85*, 153-165.

Bowsher, C. G. (2002). On Testing Overidentifying Restrictions in Dynamic Panel Data Models, *Economics Letters*, 77, 211-220.

Brandt, L., Biesebroeck, J. V., and Zhang, Y. F. (2009). Creative Accounting or Creative Destruction? Firm-Level Productivity Growth in Chinese Manufacturing. *NBER Working Paper 15152* .

Carpenter, R. E., and Guariglia, A. (2008). Cash Flow, Investment, and Investment Opportunities: New Tests Using UK Panel Data. *Journal of Banking and Finance, 32*, 1894-1906.

Chen, S., Sun, Z., Tang, S., and Wu, D. (2011). Government Intervention and Investment Efficiency: Evidence from China. *Journal of Corporate Finance, 17*, 259-71.

Ding, S., Guariglia, A. and Knight, J. (2010). Negative investment in China: financing constraints and restructuring versus growth, Economics Series Working Papers No. 519, University of Oxford, Department of Economics.

D'Mello, R. and Miranda, M. (2010). Long-Term Debt and Overinvestment Agency Problem. *Journal of Banking and Finance, 34*, 324-335.

Dollar, D. and Wei, S.-J. (2007). Das (Wasted) Capital: Firm Ownership and Investment Efficiency in China. *National Bureau of Economic Research Working Paper No. 13103*.

European Chamber. (2009). *Overcapacity in China: Causes, Impacts and Recommendations.* <www.europeanchamber.com.cn>.

Firth, M., Lin, C., and Wong, S. M. (2008). Leverage and Investment under a State-Owned Bank Lending Environment: Evidence from China. *Journal of Corporate Finance , 14*, 642-653.

Gong, G. and Lin, J. (2008). Deflationary Expension: An Overshooting Perspective to the Recent Business Cycle in China. *China Economic Review , 19*, 1-17.

Guariglia, A. (2008). Internal Financial Constraints, External Financial Constraints, and Investment Choice: Evidence from A Panel of UK Firms. *Journal of Banking and Finance , 32*, 1795-1809.

Guariglia, A., Liu, X., and Song, L. (2011). Internal Finance and Growth: Microeconometric Evidence on Chinese Firms." *Journal of Development* Economics, *96,* 79-94.

Haggard, S. and Huang, Y. S. (2008). The Political Economy of Private-Sector Development in China. In L. Brandt, and T. G. Rawski, *China's Great Economic Transformation* (pp. 337-374). New York: Cambridge University Press.

Hendershott, R. (1996), Which Takeover Targets Overinvest? *Journal of Financial and Quantitative Analysis*, 31, 563-580.

Hsieh, C. T., and Klenow, P. J. (2009). Misallocation and Manufacturing TFP in China and India. *Quarterly Journal of Economics , CXXIV*, 1403-1448.

Huang, Y. (2003). *Selling China: Foreign Direct Investment during the Reform Era.* New York: Cambridge University Press.

Jensen, M. C. (1988). Agency Costs of Free Cash Flow, Corporate Finance, adn the Market for Takeovers. *American Economic Review , 76*, 323-329.

Knight, J. and Ding, S. (2010). Why Does China Invest So Much? *Asian Economic Papers*, 9, 87–117.

Konings, J., Rizov, M., and Vandenbussche, H. (2003). Investment and Financial Constraints in Transition Economies: Micro Evidence from Poland, the Czech Republic, Bulgaria, and Romania. *Economics Letters , 78*, 253-258.

Lang, L., Ofek, E., and Stulz, R. M. (1996). Leverage, Investment and Firm Growth. *Journal of Financial Economics , 40*, 3-29.

Li, S. (2004). The Puzzle of Firm Performance in China: an Institutional Explanation. *Economics of Planning, 37*, 47-68.

Li, H., Meng, L., Wang, Q., and Zhou, L. A. (2008). Political Connections, Financing, and Firm Performance: Evidence from Chinese Private Firms. *Journal of Development Economics , 87*, 283-299.

Lian, Y. J., and Chung, C. F. (2008). Are Chinese Listed Firms Over-investing? Mimeograph, Sun Yat-Sen University.

Liang, H. (2006). China's Investment Strength is Sustainable. Global Economics Paper No. 146.

Liu, Q. and Siu, A. (2011). Institutions, Financial Development, and Corporate Investment: Evidence from an Implied Return on Capital in China. *Journal of Financial and Quantitative Analysis* (forthcoming).

Lu, F., Song, G., Tang, J., Zhao, H., and Liu, L. (2008). Profitability of China's Industrial Firms (1978-2006). *China Economic Journal , 1*, 1-31.

Naughton, B. (2007). *The Chinese Economy. Transitions and Growth*. Cambridge, MA: The MIT Press.

Nickell, S. and Nicolitsas, D. (1999). How does Financial Pressure Affect Firms? *European Economic Review*, Vol. 43, 1435-56.

Qin, D. and Song, H. Y. (2009). Source of Investment Inefficiency: The Case of Fixed -Asset Investment in China. *Journal of Development Economics, 90*, 94-105.

Rawski, T. (2002). Will Investment Behavior Constrain China's Growth? *China Economic Review , 13*, 361-372.

Richardson, S. (2006). Overinvestment of Free Cash Flow. *Review of Accounting Studies , 11*, 159-189.

Roodman, D. (2009). Practitioners' Corner: A Note on the Theme of too Many Instruments, *Oxford Bulletin of Economics and Statistics* , 71 (1), 135-158.

Servaes, H. (1994). Do takeover targets overinvest? *Review of Financial Studies*, 7, 253-277.

Stulz, R. M. (1990). Managerial Discretion and Optimal Financing Policies. *Journal of Financial Economics , 26*, 3-28.

Tan, J., Li, S., and J. Xia (2007). When Iron Fist, Visible Hand, and Invisible Hand Meet: Firm-Level Effects of varying Institutional Environments in China. *Journal of Business Research, 60*, 786-94.

Wei, Z., Xie, F., and Zhang, S. (2005). Ownership Structure and Firm Value in China's Privatized Firms. *Journal of Financial and Quantitative Analysis , 40*, 87-108.

Whited, T. and Wu, G. (2006). Financial Constraints Risk. *Review of Financial Studies, 19*, 531-59.

World Development Indicators (2010), World Bank, December.

Xia, J., Li, S., and C. Long (2009). The Transformation of Collectively Owned Enterprises and its Outcomes in China, 2001-05. *World Development, 37*, 1651-62.

Zhang, J. (2003). Investment, Investment Efficiency, and Economic Growth in China. *Journal of Asian Economics , 14*, 713-734.

Table 1. Descriptive statistics of investment efficiency measures

Panel A. By ownership

	SOEs	*Collective firms*	*Private firms*	*Foreign firms*
Fixed investment/tangible fixed assets (*I/K*)	0.026 (0.013)	0.061 (0.044)	0.099 (0.078)	0.089 (0.065)
Average revenue product of capital (*ARPK*)	0.553 (0.307)	1.106 (0.684)	1.011 (0.629)	1.188 (0.699)
Marginal revenue product of capital (*MRPK*)	0.196 (0.104)	0.528 (0.292)	0.476 (0.291)	0.473 (0.279)
Observations	23,739	21,709	163,095	65,815

Notes: Mean and median (in parentheses) values of each variable are reported. The ownership classification is based on the majority rule.

Panel B. By industry

	Metal and metal product	*Non-metal product and petroleum processing*	*Chemical and plastic*	*Machinery and equipment*	*Electronic equipment*
Fixed investment/tangible fixed assets (*I/K*)	0.097 (0.076)	0.063 (0.039)	0.087 (0.067)	0.096 (0.077)	0.106 (0.085)
Average revenue product of capital (*ARPK*)	0.971 (0.629)	0.821 (0.476)	0.859 (0.554)	1.002 (0.681)	1.259 (0.764)
Marginal revenue product of capital (*MRPK*)	0.475 (0.288)	0.396 (0.227)	0.459 (0.271)	0.492 (0.296)	0.535 (0.317)
Observations	24,409	24,326	48,688	32,336	40,356
	Transport equipment	*Food and tobacco*	*Textile*	*Leather, timber and furniture*	*Mining and logging*
Fixed investment/tangible fixed assets (*I/K*)	0.102 (0.083)	0.063 (0.036)	0.082 (0.059)	0.077 (0.049)	0.073 (0.048)
Average revenue product of capital (*ARPK*)	0.927 (0.602)	0.651 (0.400)	1.362 (0.780)	0.984 (0.553)	0.839 (0.485)
Marginal revenue product of capital (*MRPK*)	0.429 (0.259)	0.355 (0.209)	0.438 (0.264)	0.395 (0.242)	0.471 (0.244)
Observations	14,094	10,997	44,287	27,826	19,229

Notes: Mean and median (in parentheses) values of each variable are reported.

Panel C. By year

	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Fixed investment/tangible fixed assets (*I/K*)	0.151 (0.122)	0.082 (0.056)	0.093 (0.065)	0.092 (0.059)	0.043 (0.028)	0.107 (0.082)	0.101 (0.079)	0.082 (0.055)
Average revenue product of capital (*ARPK*)	0.772 (0.463)	0.823 (0.462)	0.839 (0.513)	0.919 (0.559)	0.986 (0.599)	1.023 (0.629)	1.100 (0.671)	1.219 (0.742)
Marginal revenue product of capital (*MRPK*)	0.320 (0.209)	0.341 (0.207)	0.382 (0.231)	0.422 (0.250)	0.432 (0.254)	0.458 (0.276)	0.491 (0.295)	0.544 (0.324)
Observations	34,674	19,083	26,553	37,311	45,491	54,680	53,279	50,151

Notes: Mean and median (in parentheses) values of each variable are reported.

Panel D. By region

	Coastal region	*Inner region*	*Western region*
Fixed investment/tangible fixed assets (*I/K*)	0.091 (0.069)	0.074 (0.051)	0.066 (0.038)
Average revenue product of capital (*ARPK*)	1.106 (0.679)	0.771 (0.435)	0.686 (0.409)
Marginal revenue product of capital (*MRPK*)	0.487 (0.295)	0.368 (0.191)	0.319 (0.183)
Observations	222,815	32,906	30,827

Notes: Mean and median (in parentheses) values of each variable are reported. The coastal region includes Liaoning, Hebei, Tianjin, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, and Hainan, plus Beijing (11 provinces). The inner region includes Shanxi, Inner Mongolia, Heilongjiang, Jilin, Anhui, Jiangxi, Henan, Hubei, and Hunan (9 provinces). The western region includes Chongqing, Gansu, Guangxi, Guizhou, Ningxia, Qinghai, Shaanxi, Sichuan, Tibet, Xinjiang and Yunnan (11 provinces).

Panel E. By political affiliation

	High political affiliation	*Medium political affiliation*	*No political affiliation*
Fixed investment/tangible fixed assets (*I/K*)	0.052 (0.037)	0.066 (0.044)	0.106 (0.084)
Average revenue product of capital (*ARPK*)	0.789 (0.429)	0.936 (0.549)	1.116 (0.691)
Marginal revenue product of capital (*MRPK*)	0.334 (0.171)	0.431 (0.246)	0.489 (0.299)
Observations	23,157	107,170	156,221

Notes: Mean and median (in parentheses) values of each variable are reported.

Table 2. Basic model of investment efficiency

	$ARPK$ *(1)*	$MRPK$ *(2)*
$cash\ flow_{i,t-1}$	1.153** (0.044)	0.896** (0.023)
$sales\ growth_{i,t-1}$	0.153** (0.046)	0.043* (0.023)
$leverage_{i,t-1}$	0.199** (0.072)	-0.036 (0.036)
$firm\ age_{i,t}$	0.121** (0.011)	0.004 (0.004)
$firm\ size_{i,t-1}$	-0.169** (0.014)	0.006 (0.006)
SOE_i	-0.118** (0.028)	-0.090** (0.005)
COL_i	0.012 (0.024)	0.016** (0.005)
FOR_i	0.199** (0.018)	-0.059** (0.006)
m3 test (*p* value)	0.986	0.331
Hansen *J* test (*p* value)	0.000	0.000
Observations	286,548	286,548

Notes: The dependent variables are the average revenue product of capital ($ARPK$) and the marginal revenue product of capital ($MRPK$) respectively in columns 1 and 2. SOE_i, COL_i, and FOR_i are dummy variables equal to 1 if firm *i* is owned respectively by the state, collective, and foreign agents, and 0 otherwise. All specifications were estimated using a system GMM estimator. Heteroskedasticity-consistent standard errors are reported in parentheses. Levels of *cash flow*, *sales growth*, *leverage*, and *firm size* lagged three times or more are used as instruments in the first-differenced equations. First-differences of these same variables lagged twice are used as additional instruments in the level equations. *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. The Hansen *J* test of over-identifying restrictions is distributed as Chi-square under the null of instrument validity. Time dummies, industry dummies, and regional dummies are included in both the regressions and the instrument set. The ownership classification is based on the majority rule. ** and * indicate significance at the 5 and 10 percent level respectively.

Table 3. Robustness tests for investment efficiency

Panel A. Alternative measure of investment opportunities

	$ARPK$	$MRPK$
	(1)	*(2)*
$cash\ flow_{i,t-1}$	1.185** (0.045)	0.893** (0.024)
$industrial\ value\ added\ growth_{i,t-1}$	0.556** (0.090)	0.168** (0.045)
$leverage_{i,t-1}$	0.390** (0.072)	-0.007 (0.035)
$firm\ age_{i,t}$	0.106** (0.009)	-0.002 (0.003)
$firm\ size_{i,t-1}$	-0.197** (0.013)	0.014** (0.006)
SOE_i	-0.093** (0.016)	-0.097** (0.006)
COL_i	0.022 (0.025)	0.023** (0.006)
FOR_i	0.242** (0.016)	-0.058** (0.007)
m3 test (*p* value)	0.325	0.206
Hansen *J* test (*p* value)	0.000	0.000
Observations	300,854	300,854

Notes: The sample in this regression is slightly larger than that in Table 2. The sample change arises when sales growth is replaced by the industrial value added growth as the latter has more observations than the former. Also see Notes to Table 2.

Panel B. Alternative measure of ownership (100% rule)

	$ARPK$	$MRPK$
	(1)	*(2)*
$cash\ flow_{i,t-1}$	1.149** (0.044)	0.899** (0.024)
$sales\ growth_{i,t-1}$	0.121** (0.047)	0.058** (0.024)
$leverage_{i,t-1}$	0.188** (0.072)	-0.046 (0.036)
$firm\ age_{i,t}$	0.122** (0.011)	0.001 (0.004)
$firm\ size_{i,t-1}$	-0.164** (0.015)	0.006 (0.007)
SOE_i	-0.224** (0.026)	-0.085** (0.006)
COL_i	0.031 (0.027)	0.022** (0.009)
FOR_i	0.173** (0.018)	-0.064** (0.006)
m3 test (*p* value)	0.992	0.336
Hansen *J* test (*p* value)	0.000	0.000
Observations	286,548	286,548

Notes: See Notes to Table 2.

Table 4. Descriptive statistics of overinvestment and free cash flow measures

	Full sample	*SOEs*	*Collective firms*	*Private firms*	*Foreign firms*
Overinvestment and free cash flow					
$OVERINV$	0.241 (0.178)	0.195 (0.129)	0.234 (0.168)	0.254 (0.194)	0.224 (0.159)
$\%OVERINV$	0.485 (0.000)	0.347 (0.000)	0.444 (0.000)	0.515 (1.000)	0.482 (0.000)
FCF	0.150 (-0.001)	-0.049 (-0.112)	0.202 (0.017)	0.151 (0.002)	0.199 (0.038)
leverage ratio					
$leverage$	0.573 (0.586)	0.631 (0.641)	0.594 (0.604)	0.599 (0.617)	0.482 (0.478)
Observations	286,379	23,714	21,695	163,032	65,762

Notes: $OVERINV$, $\%OVERINV$, and FCF are Bates' definitions of the same variables. $OVERINV$ is calculated on the samples of firms that actually overinvest. Mean and median (in parentheses) values of each variable are reported. The ownership classification is based on the majority rule.

Table 5. The free cash flow hypothesis of overinvestment (basic equation)

Dependent variable: $OVERINV_{i,t}$	
$FCF_{i,t-1}$	0.068** (0.006)
SOE_i	-0.046** (0.003)
COL_i	-0.026** (0.003)
FOR_i	-0.032** (0.002)
m3 test (*p* value)	0.972
Hansen *J* test (*p* value)	0.110
Observations	138,864

Notes: First-differences of these same variables lagged twice are used as additional instruments in the level equations. The relatively smaller sample sizes (compared with previous tables) are the joint result from the definitions of overinvestment and missing observations of the control variables. Also see Notes to Tables 2 and 6.

Table 6. The free cash flow hypothesis of overinvestment (further tests)

Panel A. Differentiating firms based on whether they have positive or negative free cash flow

Dependent variable: $OVERINV_{i,t}$	
$FCF_{i,t-1} * POSFCF_{i,t-1}$	0.065** (0.003)
$FCF_{i,t-1} * NEGFCF_{i,t-1}$	-0.003 (0.010)
SOE_i	-0.049** (0.002)
COL_i	-0.025** (0.002)
FOR_i	-0.033** (0.002)
H_0: impact of $FCF_{i,t-1}$ on $OVERINV_{i,t}$ is the same across firms with positive and negative free cash flow (*p* value)	0.000**
m3 test (*p* value)	0.970
Hansen *J* test (*p* value)	0.000
Observations	138,864

Panel B. Differentiating firms on the basis of ownership

Dependent variable: $OVERINV_{i,t}$	
$FCF_{i,t-1} * SOE_i$	0.073** (0.038)
$FCF_{i,t-1} * COL_i$	0.083** (0.018)
$FCF_{i,t-1} * PRIV_i$	0.089** (0.009)
$FCF_{i,t-1} * FOR_i$	0.040** (0.012)
SOE_i	-0.044** (0.003)
COL_i	-0.028** (0.006)
FOR_i	-0.021** (0.004)
H_0: impact of $FCF_{i,t-1}$ on $OVERINV_{i,t}$ is the same across all groups (*p* value)	0.008**
m3 test (*p* value)	0.960
Hansen *J* test (*p* value)	0.465
Observations	138,864

Panel C. Differentiating firms on the basis of political affiliation

Dependent variable: $OVERINV_{i,t}$	
$FCF_{i,t-1} * HIGHPA_{i}$	0.031** (0.009)
$FCF_{i,t-1} * MEDIUMPA_{i}$	0.058** (0.004)
$FCF_{i,t-1} * NOPA_{i}$	0.064** (0.003)
SOE_i	-0.047** (0.002)
COL_i	-0.024** (0.003)
FOR_i	-0.032** (0.002)
H_0: impact of $FCF_{i,t-1}$ on $OVERINV_{i,t}$ is the same across firms with high, medium, and no political affiliations (*p* value)	0.234
m3 test (*p* value)	0.971
Hansen *J* test (*p* value)	0.001
Observations	138,864

Notes: Levels of all time-varying regressors lagged three times or more are used as instruments in the first-differenced equations, and first-differences of these same variables lagged twice are used as additional instruments in the level equations. Also see notes to Tables 2, 6 and 7.

Table 7. The role of debt in alleviating the overinvestment bias

Panel A. Differentiating firms on the basis of ownership

Dependent variable: $OVERINV_{i,t}$	
$FCF_{i,t-1}$	0.030* (0.017)
$leverage_{i,t-1} * SOE_i$	0.010 (0.087)
$leverage_{i,t-1} * COL_i$	-0.284** (0.137)
$leverage_{i,t-1} * PRIV_i$	-0.057* (0.035)
$leverage_{i,t-1} * FOR_i$	0.034 (0.056)
SOE_i	-0.235** (0.112)
COL_i	-0.032 (0.059)
FOR_i	-0.110** (0.046)
H_0: impact of $leverage_{i,t-1}$ on $OVERINV_{i,t}$ is the same across SOEs and non-state firms (*p* value)	0.141
m3 test (*p* value)	0.896
Hansen *J* test (*p* value)	0.170
Observations	138,864

Panel B. Differentiating firms on the basis of political affiliation

Dependent variable: $OVERINV_{i,t}$	
$FCF_{i,t-1}$	0.051** (0.013)
$leverage_{i,t-1} * HIGHPA_i$	-0.041 (0.079)
$leverage_{i,t-1} * MEDIUMPA_i$	-0.192** (0.079)
$leverage_{i,t-1} * NOPA_i$	-0.153** (0.053)
SOE_i	-0.069** (0.014)
COL_i	-0.015* (0.009)
FOR_i	-0.051** (0.008)
H_0: impact of $leverage_{i,t-1}$ on $OVERINV_{i,t}$ is the same across firms with high, medium and no political affiliations (*p* value)	0.085*
m3 test (*p* value)	0.862
Hansen *J* test (*p* value)	0.116
Observations	138,864

Notes: Levels of all time-varying regressors lagged three times or more are used as instruments in the first-differenced equations, and first-differences of these same variables lagged twice are used as additional instruments in the level equations. Also see notes to Tables 2, 6 and 7.

Appendix

Table A1. Structure of our unbalanced panel

Panel I.

Year	*Number of observations*	*Percent*	*Cumulative*
2000	49,639	7.76	7.76
2001	66,241	10.36	18.12
2002	78,640	12.30	30.42
2003	93,330	14.60	45.02
2004	92,291	14.43	59.45
2005	91,147	14.26	73.71
2006	87,147	13.63	87.34
2007	80,947	12.66	100.00
Total	639,382	100.00	

Panel II.

Number of obs. per firm	*Number of observations*	*Percent*	*Cumulative*
5	154,645	24.19	24.19
6	140,316	21.95	46.13
7	153,685	24.04	70.17
8	190,736	29.83	100.00
Total	639,382	100.00	

Table A2. Distribution of observations by ownership

Panel I. By the majority rule

	SOEs	*Collective firms*	*Private firms*	*Foreign firms*	*Mixed ownership*	*Total*
2000	11.80	11.06	52.04	19.49	5.61	100.00
2001	9.49	9.62	58.00	18.20	4.69	100.00
2002	8.65	8.90	60.89	17.23	4.33	100.00
2003	7.57	8.04	63.36	17.25	3.77	100.00
2004	7.36	7.83	63.56	17.53	3.71	100.00
2005	6.75	7.62	64.42	17.47	3.73	100.00
2006	6.27	7.21	65.18	17.69	3.65	100.00
2007	5.28	6.93	66.25	17.99	3.55	100.00
Average	7.62	8.20	62.42	17.75	4.02	100.00

Notes: All numbers are in percentage terms.

Panel II. By the 100% rule

	SOEs	*Collective firms*	*Private firms*	*Foreign firms*	*Mixed ownership*	*Total*
2000	5.89	3.58	23.53	10.54	56.45	100.00
2001	4.75	3.13	31.18	10.04	50.90	100.00
2002	4.27	2.96	35.43	9.62	47.73	100.00
2003	3.71	2.71	39.57	9.96	44.05	100.00
2004	3.68	2.69	40.00	10.21	43.41	100.00
2005	3.25	2.57	40.52	10.21	43.45	100.00
2006	2.95	2.40	41.14	10.39	43.13	100.00
2007	2.23	2.27	42.04	10.62	42.85	100.00
Average	3.69	2.73	37.67	10.18	45.72	100.00

Notes: all numbers are in percentage terms.

Table A3. Descriptive statistics of investment efficiency measures over time for different ownership groups

					SOEs			
Year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Fixed investment/tangible fixed assets (*I/K*)	0.136 (0.095)	0.047 (0.023)	0.044 (0.028)	0.028 (0.002)	-0.037 (-0.034)	0.036 (0.019)	0.041 (0.029)	0.044 (0.019)
Average revenue product of capital (*ARPK*)	0.444 (0.259)	0.491 (0.262)	0.475 (0.274)	0.497 (0.277)	0.543 (0.298)	0.585 (0.329)	0.632 (0.354)	0.681 (0.411)
Marginal revenue product of capital (*MRPK*)	0.168 (0.094)	0.149 (0.088)	0.167 (0.095)	0.172 (0.094)	0.179 (0.094)	0.207 (0.112)	0.229 (0.119)	0.290 (0.155)
Observations	4875	2902	3447	3838	4058	3671	3244	2579
					Collective firms			
Year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Fixed investment/tangible fixed assets (*I/K*)	0.129 (0.114)	0.066 (0.047)	0.072 (0.049)	0.062 (0.036)	0.001 (-0.002)	0.092 (0.060)	0.068 (0.065)	0.068 (0.040)
Average revenue product of capital (*ARPK*)	0.886 (0.560)	0.852 (0.544)	0.946 (0.608)	1.009 (0.642)	1.141 (0.689)	1.148 (0.709)	1.240 (0.779)	1.292 (0.816)
Marginal revenue product of capital (*MRPK*)	0.432 (0.249)	0.407 (0.232)	0.447 (0.265)	0.494 (0.281)	0.532 (0.291)	0.550 (0.310)	0.597 (0.329)	0.616 (0.337)
Observations	4061	2082	2791	3345	3559	3603	3322	3007
					Private firms			
Year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Fixed investment/tangible fixed assets (*I/K*)	0.171 (0.153)	0.091 (0.071)	0.106 (0.084)	0.108 (0.083)	0.064 (0.051)	0.120 (0.095)	0.112 (0.089)	0.088 (0.061)
Average revenue product of capital (*ARPK*)	0.810 (0.502)	0.924 (0.501)	0.840 (0.545)	0.915 (0.578)	0.965 (0.608)	0.995 (0.626)	1.056 (0.661)	1.164 (0.731)
Marginal revenue product of capital (*MRPK*)	0.383 (0.233)	0.368 (0.235)	0.402 (0.255)	0.436 (0.272)	0.445 (0.271)	0.470 (0.289)	0.501 (0.306)	0.556 (0.340)
Observations	16887	7809	11889	19651	25625	33457	33055	31609
					Foreign firms			
Year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Fixed investment/tangible fixed assets (*I/K*)	0.127 (0.085)	0.099 (0.064)	0.108 (0.074)	0.099 (0.062)	0.046 (0.032)	0.101 (0.079)	0.098 (0.076)	0.079 (0.057)
Average revenue product of capital (*ARPK*)	0.805 (0.461)	0.845 (0.506)	0.962 (0.577)	1.064 (0.619)	1.151 (0.689)	1.198 (0.714)	1.310 (0.791)	1.469 (0.872)
Marginal revenue product of capital (*MRPK*)	0.365 (0.205)	0.365 (0.223)	0.417 (0.251)	0.465 (0.268)	0.456 (0.269)	0.472 (0.285)	0.501 (0.303)	0.546 (0.323)
Observations	6764	5067	6848	8670	10300	11975	11761	11194

Notes: Mean and median (in parentheses) values of each variable are reported. The ownership classification is based on the majority rule.