Institutions, Financial Development, and Corporate Investment: Evidence from an Implied Return on Capital in China*

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Abstract

This paper presents a new approach to infer return on capital from firms' capital expenditures, and then examines how institutions and financial development affect this implied return on capital. We apply the Generalized Method of Moments (GMM) estimator derived from a structural investment model to a large sample of Chinese industrial firms in China. Based on the estimated structural parameters, we compute the stochastic discount rate perceived by the managers to decide investment spending. We identify robust evidence that this return on capital measure is a function of variables capturing institutions and financial development. The results from our benchmark estimation show that return on capital for a non-state firm is more than 10 percentage points higher than that of an otherwise similar state firm. We document evidence that regions with better institutions and a market-prone financial system have more efficient non-state sectors. Our estimates show that redirecting the capital from less efficient state sector to more efficient private sectors can unleash a 4.5% GDP growth in China every year, and the deadweight loss due to capital mis-allocation is about 8% of China's GDP.

JEL Classification: G3; D21; O16
Keywords: institutions and financial development, implied return on capital, investment Euler equation model, Chinese economy

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Abstract

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1 Introduction

This paper studies the effect of institutions and financial development on corporate investment efficiency. Although the importance of institutions and financial development to economic performance has been well recognized (see, e.g., Acemoglu et al., 2001; Claessens and Laeven, 2003; Levine and Zervos, 1998; Rajan and Zingales, 1998; and Bekaert, Harvey, and Lundblad, 2005), much of the empirical work is based on cross-country studies, and is likely subject to contamination due to country differences in accounting standards, taxation, and bankruptcy laws. The empirical findings based on cross-country studies also fail to account for obvious outliers such as China — the unprecedented economic growth over the past quarter century in China has been largely based on weak institutions and inefficient financial intermediation (Allen et al., 2005). In addition, a broader review of the literature reports that most studies on this subject use indirect approaches.[1] Direct empirical evidence at micro-level that maps out the dynamics between corporate investment efficiency and institution measures is scant, partly due to the difficulty in computing firm-level return on capital, and partly due to the difficulty in measuring institutions.

This study presents a new approach to estimate the return on capital for a large sample of Chinese industrial firms. We then document the cross-sectional relation between the "implied" return on capital and measures of institutions and financial development (e.g., ownership and the regional institutional and financial development). Our empirical strategy is built on a simple economic intuition that in equilibrium the managerial required rate of investment return equals the discount rate (cost of capital). The intuition can be more rigorously modeled in a firm's dynamic value optimization problem, with the resulting first-order condition labeled the investment Euler equation in the literature. The investment Euler equation describes the intertemporal substitution relation of investment spending at firm level, and has been tested in a variety of contexts.[2] Throughout our empirical analysis, we apply the Generalized Method of Moments

[1] E.g., Demirguc-Kunt and Maksimovic (1998) document that the proportion of firms in countries that were growing fast than they could have using only internally generated funds is positively related to financial development and to legal system indicators; Rajan and Zingales (1998) use industry-level data to show that industries that require more external finance grow faster in more developed capital markets; Wurgler (2000) finds that financial development improves capital allocation by increasing the industry-level sensitivity of investment growth to value-added growth.

[2] A large literature has used either the Q-theory or the investment Euler equation model (the two are just different ways of expressing the first order conditions) to examine corporate investment behavior. Recent examples include Whited (1992); Gilchrist and Himmelberg (1999); Chirinko and Schaller (2004); Love (2003); and Whited and Wu (2006) among others. See Hubbard (1998) for a survey of the literature.

(GMM) estimation to the investment Euler equation models. Based on the estimated parameters, we infer the stochastic discount rate ("implied" return on capital) perceived by the managers to decide investment spending.

The "implied" return on capital derived from actual investment has several appealing features. First, this implied return on capital is derived from the actual investment, and reveals the managerial investment propensity. It thus proxies for managerial hurdle rate — the required rate of return actually used by the manager to make investment decision. Second, the conventional methods rely on various asset pricing models to estimate return on capital or cost of capital (see e.g., Fama and French, 1997; Gebhardt et al., 2001). Those methods are subject to several potential problems: (1) difficulty in identifying the right models, and (2) imprecision in the estimates of factor loadings and in the estimates of risk premia. Furthermore, even though those methods generate precise estimates, they at best reflect the discount rate perceived by investors but not managers.[3] Our approach relies on a structural investment model but not asset pricing models, it is thus not subject to the criticism on using asset pricing models to estimate cost of capital. Last but not least, our approach allows for the estimation of the "implied" return on capital for any firms with investment data available. It is not confined to publicly listed firms and also imposes minimal requirement for capital market information. The approach is thus more appropriate for research on emerging markets, where capital markets are under-developed and financial disclosures are less transparent.

We apply the above approach to a large sample of Chinese industrial firms. China is an interesting case to explore how institutions and financial development affect corporate investment efficiency. First, China is an outlier in most cross-country studies of the relation between insinuations and economic performance. Second, investment in fixed assets, which amounts to nearly 50% of China's *GDP* in recent years, has been the primary engine of China's economic growth. China's high investment rate, especially its ever-increasing pattern, has raised the concern that China might have over-invested. Computing firm-level return on capital and studying how institutions and financial development affect it may help us better understand the concerns alike.[4]

[3] The gap between the two could be caused by various imperfections in the capital markets, such as information asymmetry, market irrationalities, and agency problems (See, e.g., Stein, 1996; and Chirinko and Schaller, 2004).

[4] Bai et al. (2006) use the macro-level data from China's national accounts, and estimate China's aggregate return to capital to average at 20% since 1998. Although their estimations challenge the view that China invests too much, using aggregate data cannot directly measure the extent of capital mis-allocation, and link investment inefficiency to

Third, although China has continued to build up institutional infrastructure since its economic reform and economic transition kicked off about twenty-five years ago, significant disparities in institutional and financial development exist cross sectionally (e.g., state owned firms vs. privately owned firms; and coastal provinces vs. inland provinces). The rich cross-sectional variation presents China as an ideal testing ground.

Our empirical analysis is mainly conducted in a setting of cross ownership identifications, in which we take the state-owned enterprises (SOEs) as the benchmark. All else equal, the "implied" return on capital for SOEs might be lower given SOEs' soft budget constraint nature, and preferential treatments received. We assume SOEs' "implied" return on capital to be r^{SOE}, and the "implied" return on capital for other types of firms to be r. We conjecture that in equilibrium, $r = r^{SOE} + \theta$, where θ reflects the premium accrued to other firms due to institutional constraints, and is presumably larger than 0. Our empirical strategy thus centers on exploring the magnitude of θ, and examining its cross-sectional distribution (i.e., by ownership identifications, regions, and industries).[5] In the Chinese context, a positive θ mainly consists of two parts, and is mainly driven by two institutional problems: (1) θ_1 — relative to other firms, SOEs tend to make less efficient investment; and (2) θ_2 — the private sector, facing credit constraints, insecure property rights, and regulatory burdens, requires a higher rate of return to compensate the risks. Note that when institutions and financial intermediation improve, θ_1 and θ_2 tend to move in opposite directions. Thus, the overall effect of institutional improvement on θ remains an empirical question.[6]

Using the actual corporate investment data retrieved from a dataset maintained by the National Bureau of Statistics of China (NBS), we apply the GMM estimation to a panel of 12,607 industrial firms over the period 2000 – 2004. Based on the estimated structural parameter values, we compute the "implied" return on capital at firm level. Our analysis yields several findings. First, we document robust evidence that the derived return on capital varies significantly across ownership identifications. In our benchmark estimation, returns on capital for private firms, Hong Kong

institutional deficiencies.

[5] We note that θ may also capture the distortions in investment due to factors other than institutional deficiencies, e.g., irrationality in managers, managerial agency problems, etc. However, those factors are likely to be individualistic and tend to cancel out each other when we aggregate their impact across ownership identifications or regions.

[6] Although a decomposition of θ is by itself an interesting research question, and warrants careful empirical analysis, it is not the focus of this paper. We do find in this paper some preliminary empirical evidence showing that the magnitude of θ_1 is larger than that of θ_2. We nevertheless want to point out that a more detailed and careful examination of the θ decomposition is an open question for future research.

and Taiwan invested firm (HK/TW firms), foreign firms, mixed firms, and collective firms are respectively 18.9, 18.2, 19.8, 13.7, and 11.9 percentage points higher than that of an average SOE.

The finding is intuitive. Because the state-dominated financial system in China favors the state sector and directs a disproportionate amount of bank lending to the state sector (see, e.g., Brandt and Li, 2003; and Boyreau-Debray and Wei, 2005); also because SOEs are afflicted with investment hunger (see Kornai, 1980; and Huang, 2003, among many others), SOEs managers perceive a relatively lower cost of capital and set a lower investment hurdle rate. The fact that the local governments integrate government activities and business activities further worsens the 'investment hunger problem', because local governments now also actively invest as entrepreneurs do. Managers of private firms however are more likely to perceive a higher cost of capital. Access to bank lending by private firms in China has been plagued by the standard asymmetric information problem, by the poor protection of private properties and the resulting lack of collateral, and by the discriminatory lending policies practiced by the state-dominated banks (Brandt and Li, 2003; and Gordon and Li, 2003). The private firms, in order to obtain external finance, have to either bear higher costs in the formal financial system or resort to alternative informal financing channels by accepting a much higher interest rate.[7]

Although our empirical analysis does not provide a direct estimation of θ_1 and θ_2, we could infer the breakdown of θ from our empirical results. The "implied" returns on capital for private firms and mixed firms are respectively 18.9 and 13.7 percentage points higher than that of SOEs. During China's reform era, SOEs are in most cases the predecessors of mixed firms. We therefore can safely assume that mixed firms are not subject to credit constraints, insecure properties, and regulatory burdens that normally apply to the non-state sector in China (that is, θ_2 for mixed firms is zero). We thus infer that θ_1 is equivalent to the mixed firms' θ. Hence, the gap of θ between mixed firms and private firms, 5.2 percentage points, roughly captures θ_2 in China.

We also document evidence that the values of θ vary significantly across regions in China. The private sectors (including private firms, collective firms, HK/TW firms, and foreign firms) in regions with better institutions and a market-prone financial system, measured by the degree of local marketization and internationalization, outperform their public counterparts. The evidence

[7] Allen et al. (2005) argue that the alternative financing channels play a major role in the private sector's external financing in China.

offers support for the argument that institutions help strengthen corporate investment efficiency from a regional decentralization perspective (see, e.g., Qian and Xu, 1993). We also find evidence that industrial competition has limited effect on the estimated return on capital at firm level.

Besides using the NBS data,[8] we apply the same GMM estimation to the universe of China's listed firms from 1999 to 2005. Although this panel only covers slightly over 600 firms each year and these firms are arguably not representative enough, our estimation results based on the listed firms are largely consistent with those from the NBS data. In the benchmark estimation, all else equal, a state-control listed firm's implied return on capital is about 13.3 percentage points lower than that of other listed firms. We also find that firms with a larger fraction of outside board members, a larger percentage of shares held by the controlling shareholder, and with H– or B–shares traded by foreign investors tend to have a higher estimated return on capital. The results from the alternative population of firms confirm our earlier finding that improvement in institutions helps enhance corporate investment efficiency.

Another novel feature of our study is that we are able to quantify the economic magnitude of capital mis-allocation due to institutional constraints and ineffective financial intermediation. Based on the structural parameter values estimated from our benchmark estimation, we find that if the part of finance directed to the less efficient state sector can be reallocated to the more efficient private sectors, or if the state sector can improve their investment efficiency to the level of private sectors, a 4.5% of GDP growth can be unleashed in China every year. Furthermore, we compute the welfare loss due to mis-allocation of capital resources in the Chinese economy. We find that various institutional distortions cause a deadweight loss of RMB 1.09 trillion, which is about eight percent of China's GDP.

The rest of the paper proceeds as follows. Section 2 discusses the institutional background in China and related literature, and then suggests three conjectures that describe the potential effect of China-specific institutions on corporate investment efficiency. Section 3 provides an investment model and discusses our estimation strategy. Section 4 presents data and variables used in our empirical analysis. The effect of ownership on corporate investment efficiency is discussed in

[8] One may concern that the NNS data, based on which China's GDP is estimated, are potentially inaccurate. In addition, when implementing the GMM estimations, we have to delete from our sample the firms that have changed their ownership identifications during our sample period 2000-2004, which potentially introduces a certain selection bias.

Section 5. The results of regional differences are offered in Section 6. Section 7 discusses caveats of our empirical strategy and reports the results of robustness checks. Most importantly, we apply the GMM estimations to another firm population in China, the listed firms, and find similar results. Section 8 computes the costs of having weak institutions and a failing financial system in China. We conclude the paper in Section 9.

2 Institutional Background and Corporate Investment in China

China's striking economic growth in the past quarter century has been largely driven by fixed asset investments. Three distinct features characterize the fixed asset investments during China's reform era. First, due to a high gross domestic savings rate and success in attracting FDI, the rate of China's fixed asset investments has hovered at a high level. As shown in Table A1, fixed asset investment accounts for nearly 50% of China's GDP in recent years, which from time to time raises the concern that China might have invested too much and the economy is over-heating. Second, more than 50% of fixed asset investment concentrates in the state or quasi-state sector (Table A.2), where productivity and investment efficiency are believed to be considerably low. Third, because the capital markets in China, including both the equity markets and corporate bond markets, are poorly developed, bank lending has been the main funding source of China's investment boom.

While stimulating economic growth, a high fixed asset investment has a flip side. The excessive amount of capital allocated to the state sector results in widespread inefficiency among SOEs, reduced overall productivity of the economy,[9] and a large amount of non-performing loans. Prior literature has identified several sources of inefficiency in corporate investment, and attributes them to insufficient institutions and a low level of financial development. The foremost one is a state-dominated financial system that systematically allocates capital away from more productive sectors/regions towards less effective sectors/regions (see, e.g., Brandt and Li, 2003; Cull and Xu, 2003; Young, 2001; and Boyreau-Debray and Wei, 2005). Due to soft budget constraint, SOEs are afflicted with an "investment hunger" problem and are prone to overinvesting regardless of the market demand for their products (Kornai, 1980). Legally and financially, inefficient SOEs are

[9]During the first half of the 1990s, about $3.30 of investment was needed to produce $1.00 of GDP gorwth. Since 2001, however, each $1.00 of growth has required $4.90 of new investment — 40% more than that amount required in South Korea or Japan during their higher-growth periods (Farrell et al. 2006).

favored at the expense of more efficient non-state sectors (Huang, 2003).

Second, during the reform era, China can be described as the *de facto* federalism. Local governments at the provincial and lower levels have significant autonomy in economic matters (Qian and Xu, 1993). Local bureaucrats are assessed and promoted mainly based on the local economic growth, which primarily comes through investment. Returns generated by their investments help pay for social spending on everything from education to health care — costs that are now their responsibility. The provincial and regional officials thus have strong incentives to approve new projects to stimulate economic growth. A large number of such investments are the so-called "image" projects (projects undertaken by local governments to boost the local image) or "political achievement" projects (projects undertaken to boost local bureaucrats' scores on key performance indicators), and inherently suffer from dim earnings prospects. From time to time, the central government has to take a slew of measures (e.g., raising bank lending rate or bank reserve requirement, sometimes outright administrative methods) to put the brakes on the investment boom because of fears that overheated investment could lead to inflation and a pileup of bad loans.[10]

Despite numerous anecdotes and sound economic intuitions, it remains empirically difficult to map out the dynamics between corporate investment behavior and institutions and financial development in China. Towards this goal, we need to first of all quantify the investment inefficiency at the firm-level, and then plot out its distribution against variables measuring institutions and financial development. Previous studies have used several indirect approaches to unravel such dynamics.[11] In the Chinese context, Cull and Xu (2005) provide empirical evidence that access to external finance in the form of bank loans, expropriation risk, contract enforcement, and ownership structure are significant predictors of firm reinvestment in China. [12] However, to argue that institutions and financial development do enhance investment efficiency at micro-level requires identifying firms that "should" be growing, given their investment opportunities. Few in the

[10] A recent episode however highlights the difficulty the central government faces to control the runaway investment at provincial level. In August 2006, the governor of Inner Mongolia and his two lieutenants were publicly criticized by the State Council for disobeying the central government's call to slow down investment by allowing hundreds of millions of dollars of investments in coal-burning power plants. Such investments boost local economic growth but are also held accountable for the ever-worsening environmental problems in the northern part of China, several fatal accidents, and low efficiency (source: the Wall Street Journal - Asia Edition, August 18, 2006).

[11] See footnote 1 for examples.

[12] For research on how institutions affect corporate investment, also see Besley (1995); Johnson et al. (2002); and McMillan and Woodruff (2002).

literature attempt to control for the growth opportunities available for each firm or each industry at each point in time.

We propose in this paper a new empirical approach and provide direct empirical evidence of corporate investment inefficiency at micro-level. Using the actual corporate investment data obtained from the National Bureau of Statistics of China (NBS), we estimate the investment Euler equation models that characterize the Chinese firms' investment behavior to derive the effective discount rate "perceived" by firm managers in deciding investment spending. The "implied" cost of capital is similar to the managerial hurdle rate, and is potentially a function of variables measuring institutions and financial development.

A large literature has provided evidence that state ownership is less efficient than private ownership (see e.g., Shleifer, 1998; and Dewenter and Malatesta, 2001). We conjecture that SOE managers tend to perceive lower costs of capital because SOEs are favored by the state, and are less subject to regulation burdens, insecure properties rights, and credit constraints. The soft budget constraint nature of SOEs and cheap capital fueled by the state-dominated banking system together reduce the cost of capital SOEs managers perceive. Using the notations we introduced earlier, r^{SOE} is a distorted reflection of the market price of capital and it tends to be lower than the market rate. On the contrary, non-state sectors are more likely to perceive a relatively higher cost of capital (implied return on capital), r. The gap between r^{SOE} and r, θ, is mainly due to two institution details in China. First, non-state sectors likely are able to make better investment decisions, and their require rates of return are higher than r^{SOE}; second, non-state sectors are subject to a variety of institutional constraints, therefore require an external finance premium to compensate additional risks, which further pushes up managerial hurdle rates. To sum up, we have:

Conjecture 1: The "implied" return on capital derived from the investment Euler equation models is the lowest among SOEs; but much higher for non-state firms such as collective firms, private firms, HK/TW firms, and foreign firms.

We expect that significant variations of "implied" return on capital exist across regions as well. There are significant regional differences in the levels of institutions and financial development in China. We expect the regions with healthier institutions and a market-prone financial system to have more firms (especially non-state firms) make sound investment decisions. That is, θ is larger for non-state firms operating in regions with sounder institutions.[13] Using the Italian data, Guiso, Sapienza, and Zingales (2004) document empirical evidence that *local* financial development enhances the probability an individual starts his own business, favors entry of new firms, increases competition, and promote growth. Local financial development is an important determinant of economic success of an area. We conjecture:

Conjecture 2: The gap of "implied" return on capital between non-state firms and SOEs, θ, is higher in regions with healthier institutions and a market-prone financial system.

Finally, we conjecture that the product market competition plays a role as well. Firms in a more competitive market likely face a larger pressure from their rivals and thus are more cautions in making investment decisions. We have:[14]

Conjecture 3: The "implied" return on capital derived from the investment Euler equation models is higher for firms operating in a more competitive market.

3 Investment and Testing Framework

Throughout our empirical analysis, we use a structural investment model to derive the cost of capital (return on capital) "perceived" by managers when making optimal investment decisions. Our model follows closely the literature on the Q-theory and Euler equation models, and explicitly control for future growth opportunities. More importantly, our model provides a theoretical framework for the identification of the "implied" return on capital, which enables us to test the three conjectures laid out in Section 2.

3.1 The Model

We reproduce the dynamic model of the firm value optimization. We start with a standard partial-equilibrium investment model to examine the Chinese firms' investment behavior. Our derivation follows closely the specifications in Whited (1992), Gilchrist and Himmelberg (1999), Love (2003),

[13] The development of institutions and financial system in a region may actually reduce θ_2, the part due to credit constraints and other institutional distortions. But it will increase θ_1. We hypothesize that the overall θ tends to increase, even though it remains an empirical issue to test whether it is the case.

[14] We note that the level of competition in a given industry in China is largely determined by the presence of state ownership due to all kinds of barriers of entry imposed by the government. Therefore, the conventional measures of industry competition may fail to capture this twist. In other words, the impact of competition (or industry) on "implied" return on capital may be camouflaged by the ownership effect.

and Whited and Wu (2006). Note that although both the Q-theory and Euler equation models of investment are derived from the same dynamic optimization problem (the two models are just different ways of rearranging the firs-order conditions), the assumptions required to estimate the Q-model are more stringent.[15] Therefore, we choose to use the investment Euler equation methodology to test the factors that affect a firm's effective discount rate (return on capital).

Here, firm managers maximize the present value of the firm, which is equal to the expected present value of future dividends subject to the capital accumulation and external financing constraints. The firm value is given by

$$V_{it} = \max_{(I_{it+s})_{s=0}^{\infty}} D_{it} + E_{it}[\sum_{s=1}^{\infty} \beta_{it+s-1} D_{it+s}] \tag{1}$$

subject to

$$D_{it} = \Pi(K_{it}, \zeta_{it}) - C(I_{it}, K_{it}) - I_{it}, \tag{2}$$

$$K_{it+1} = (1 - \delta_i) K_{it} + I_{it}, \tag{3}$$

$$D_{it} \geq 0. \tag{4}$$

Here, V_{it} is the time t value of firm i. E_{it} is the expectations operator conditional on firm i's time t information; β_{it+s-1} is a discount factor from the period $t+s$ to period t; D_{it} is the dividend paid to shareholders and is given according to the specification in Equation (2); K_{it} is the beginning of the period capital stock; I_{it} is the investment expenditure during the period t, and δ_i is the deprecation rate. $\Pi(K_{it}, \zeta_{it})$ is the firm's profit function, with $\Pi_K \geq 0$; and ζ_{it} is a shock to the profit function that follows a Markov process and that is observed by the firm at time t. The adjustment cost of investment is given by the function $C(I_{it}, K_{it})$, and is assumed to result in a loss of a portion of investment.

The frictions in financial markets are introduced via a nonnegativity constraint on dividends

[15] The testing frameworks based on the Q-model methodology have recently been subject to extensive criticism due to several concerns. First, since it is virtually impossible to measure marginal Q, most studies use average Q, which only equals marginal Q under very restrictive assumptions such as perfect competition in factor and product markets, perfect capital markets, and constant return to scale in production technology (see Hayashi 1982). Second, observed stock market valuations — a component of Q — may diverge from the manager's valuation of the marginal return on capital, if the stock markets are not efficient. Third, if marginal Q is mis-measured, then the estimated coefficients cannot be properly interpreted. Specially, it is difficult to tell whether the estimated coefficients of effective stochastic discount factor reflect shocks to production opportunities or financing costs.

(see Equation (4)). Let λ_{it} be the Lagrange multiplier associated with (4). This multiplier equals the shadow cost associated with raising new equity, which implies that external (equity) financing is costly relative to internal finance.

The first order conditions to the above maximization problem are rearranged to obtain the Euler equation for K_{it}

$$1+(\frac{\partial C}{\partial I})_{it}=\beta_{it}E_{it}\left[\Theta_{it}\left\{(\frac{\partial \Pi}{\partial K})_{it+1}-(\frac{\partial C}{\partial K})_{it+1}+(1-\delta_{it})(1+(\frac{\partial C}{\partial I})_{it+1})\right\}\right]. \qquad (5)$$

Here $\frac{\partial C}{\partial I}$ is the marginal adjustment cost of investment, which we will specify later. $\frac{\partial \Pi}{\partial K}$ is the marginal profit of capital. $\Theta_{it}=(\frac{1+\lambda_{it+1}}{1+\lambda_{it}})$ is the relative shadow cost of external finance in periods t and t+1. Note that in perfect capital markets, $\lambda_{it}=\lambda_{it+1}$, and β_{it} serves as the only discount factor in the investment equation.

Equation (5) has a simple interpretation. The left side represents the marginal adjustment and purchasing costs of capital goods. The right side represents the expected discounted cost of waiting to investment tomorrow, which consists of the marginal product of capital and the marginal reduction in adjustment costs from an increment to the capital stock. Optimal investment implies that on the margin the firm must be indifferent between investing today and transferring those resources to tomorrow, as long as appropriate *discount rate* is identified to discount the payoff in the next period.

The firm's intertemporal allocation of investment depends on its effective discount factor, which is given by the product of β_{it} (the internal discount factor), and Θ_{it} (the discount factor associated with the external finance premium). Let $\Gamma_{it}=\beta_{it}\Theta_{it}$. Then Γ_{it} measures the effective discount factor facing firm i in period t. Suppose that the investment decision is optimal, then the cost of capital "implied" or "perceived" by the firm managers, r_{it}, is given by

$$r_{it}=\frac{1}{\Gamma_{it}}-1 \qquad (6)$$

In (6), a high level of Γ_{it} corresponds to a low level of cost of capital for firm i in period t and vice versa. When Γ_{it} (r_{it}) is low (high), the firm may defer investment to next period.

Γ_{it} can be viewed as the effective stochastic discount factor that guides the managers' investment decision. Similarly, r_{it} derived from (6) is the "perceived" cost of capital by managers that corresponds to an optimal investment decision. Although we argue that Γ_{it} corresponds to the effective discount factor at optimality, we do not assume away frictions causes by institutional distortions and poor financial development. Those distortions could be incorporated and reflected in the specifications of Γ_{it}, and can be tested empirically.

3.2 Estimation

To estimate the model we replace the expectation operator in (5) with an expectational error, e_{it+1}, where we assume that $E_{it}(e_{it+1}) = 0$ and $E_{it}(e_{it+1}) = \sigma^2_{it}$. The former condition implies that e_{it+1} is uncorrelated with any time t information, and the latter suggests that the error can be heteroscedastic. We thus rewrite Equation (5) as follows:

$$\Gamma_{it}\left\{\Pi_K(K_{it+1},\zeta_{it+1}) - C_K(I_{it+1},K_{i,t+1}) - (1-\delta_{it})(1+C_I(I_{it+1},K_{it+1})\right\} = 1 + C_I(I_{it},K_{it}) + e_{it+1}. \tag{7}$$

To parameterize the marginal product of capital, we assume that firms are imperfectly competitive and set out price as a constant mark-up, μ, over marginal cost.[16] In this case constant return to scale implies:

$$\Pi_k(K_{it},\zeta_{it}) = \frac{Y_{it} - \mu VC_{it}}{K_{it}}, \tag{8}$$

where Y_{it} is output and VC_{it} is variable cost, which is defined as the sum of "costs of goods sold" and "selling, general, and administrative expenses".

We parameterize the investment adjustment cost function, $C(i_{it}, K_{it})$ as follows:

$$C(I_{it},K_{it}) = (\alpha_0 + \sum_{m=2}^{M} \frac{1}{m}\alpha_m(\frac{I_{it}}{K_{it}})^m)K_{it}, \tag{9}$$

where $\alpha_m, m = 2, ..., M$ are coefficients to be estimated, and M is a truncation parameter that sets the highest power of $\frac{I_{it}}{K_{it}}$ in the expansion. When $M = 2$, Equation (9) reduces to the standard quadratic adjustment cost function. We follow Whited and Wu (2006) and use the test developed in Newey and West (1987) to determine the value of M. We are able to achieve the best estimation results (the corresponding Chi-square values are minimal) for most of our model specifications when

[16] Here we follow the assumptions in Whited and Wu (2006).

we set $M = 3$. In what follows we set $M = 3$ for all.[17]

We obtain the estimating equation by substituting (8) into (7), differentiating (9) with respect to I_{it} and K_{it} respectively, and substituting the derivatives into (7), which results in the following estimating equation:

$$\Gamma_{it}\left[\frac{Y_{it+1}-\mu VC_{it+1}}{K_{it+1}}-(\alpha_0-\sum_{m=2}^{M}\frac{m-1}{m}\alpha_m(\frac{I_{it+1}}{K_{it+1}})^m)+(1-\delta_{it})(\sum_{m=2}^{M}\alpha_m(\frac{I_{it+1}}{K_{it+1}})^{m-1}+1)\right] = \sum_{m=2}^{M}\alpha_m(\frac{I_{it}}{K_{it}})^{m-1}+1+e_{it+1}. \quad (10)$$

To estimate Equation (10), we need to specify the firm-level discount factor, Γ_{it}. In our model, Γ_{it} consists of two parts — the internal discount factor denoted by β_{it} and a part associated with external finance premium, Θ_{it}. Based on our empirical design, institutional distortions and inefficient financial intermediation, if any, will be reflected in Γ_{it}. Because the investment Euler equation models do not provide a formula for Γ_{it}, prior research relies mainly on ad hoc parameterization of the factor with observable firm-level indicators of a firm's financial health and other firm-specific variables.[18] This approach, although ad hoc, does provide a certain empirical flexibility in specifying the firm-level discount factor function.

We adopt a reduced-form specification for the effective discount factor, Γ_{it}. Besides the usual firm-level variables, our specification of Γ_{it} also incorporates the variables measuring institutions and financial development. We assume:[19]

$$\Gamma_{it} = l_0 + l_1 OWN_{it} + l_2 LNLABOR_{it} + l_3 AGE_{it} + l_4 CFK_{it} + l_5 HIND_{it}. \quad (11)$$

Here OWN_{it} is a set of dummy variables that specify a firm's ownership identification (private, collective, mixed firm, foreign invested firm, HW/TW firm, or SOE); $LNLABOR_{it}$ is the natural

[17] As detailed in Newey and West (1987) and Whited and Wu (2006), the test can be described as a GMM analog to a standard likelihood-ratio test. We start with a "high" value for M and estimate the model. We then use the same optimal weighting matrix to estimate a sequence of restricted models for lower values of M, in which the corresponding coefficient, α_{M+1}, is set to be zero. The appropriate maximum value for M will be the highest one for which the exclusion restriction on the parameter α_{M+1} is not rejected.

[18] See, e.g., Whited (1992); Love (2003); Whited and Wu (2006); and Forbes (2007).

[19] One caveat of our specification is that it does not model traditional risk factors such as β, book-to-market ratio, momentum, etc. due to the data limitations. However, we are not much concerned here because (1) our estimations, as we will explain later, are based on a two-year investment data (2003 and 2004), our results thus are largely driven by cross-sectional variations rather than the time-series effects; and (2) we include in the specification a rich set of firm-specific variables, which likely pick up these traditional risk factors.

log of the number of employees, which captures firm size; AGE_{it} is firm age; CFK_{it} is the ratio of cash flow to total assets, in which cash flow is defined as the sum of net income and depreciation; $HIND_{it}$ is the industry Herfindahl index, which is the sum of squares of the market shares (by sales) by the ten largest firms in an given industry (based on the two-digit industry code designated by NBS). It is designed to capture the level of competition in a given industry.[20] Besides the above variables, we also define several other firm-specific variables. We defer the discussion of their impact on the discount factor to Section 4.

The parameterization in Equation (11) does not allow for an explicit error term, which is a strong assumption. However, this assumption can be tested with the over-identification test, which provides an important check on the validity of the model. If the test does not indicate a rejection of the model, the omitted error term is not empirically important.

In order to test the various conjectures laid out in Section 2, we need to know the signs and significance levels of the estimated coefficients of the ownership variables, competition variables, and regional variables. Note that in our benchmark specification (11), we do not include regional dummies or any variables measuring the regional disparities in institutions and financial development. This choice stems from the evidence that ownership dummies in our sample are significantly correlated with regional dummies.[21] Including regional dummies or other variables measuring regional disparities may pick up the effect of ownership and industrial competition. We devote a separate section, Section 6, to analyzing the impact of regional institutions and financial development on "implied" return on capital. By the same logic, we do not include industry dummies in the benchmark specification, in stead we include $HIND$. We do not include Tobin's q in (11). The majority of our sample firms are non-listed firms, and their market values are not available.

We estimate Equation (10) in first differences to eliminate possible fixed firm effects. That is, we use GMM to estimate conditional moments of the following form:

$$E_{t-1}(z_{it-1} \otimes (e_{it+1} - e_{it})), \tag{12}$$

where z_{it-1} are a set of instruments which use the two-period lags of all variables, including all

[20] As a robustness check, we also calculate the Herfindahl index by total assets, which yields similar results.

[21] Both ownership and industry distributions of the Chinese firms demonstrate significant regional pattern. For example, foreign firms and HK/TW firms tend to concentrate in the coastal areas; the costal areas also boast of a larger number of export-oriented industries (firms).

variables appeared in the Euler equation model, plus inventories, income taxes, total liabilities, depreciation, current assets, and net income. All of these variables are scaled by total assets.

4 Sample Overview and Variable Definition

4.1 Data Source

We use a database developed and maintained by the National Bureau of Statistics of China (NBS) to conduct our empirical analysis. The NBS database is in fact census data. NBS surveys all industrial firms in China with sales above RMB5 million (approximately US$600,000). The data cover close to 190,000 firms in thirty seven 2-digit manufacturing industries and from 31 provinces or province-equivalent municipal cities. The NBS database is quite representative and represents literally all of China's industrial value added and 22% of China's *urban* employment in 2004.

The NBS database is constructed based on the annual accounting briefing reports filed by the industrial firms in China with NBS. NBS designates every firm in the database a legal identification number and specifies its ownership type. Firms are classified into one of the following six primary categories: SOEs, collective firms, private firms, mixed-ownership firms (mainly joint stock companies), foreign invested firms, and Hong Kong, Macao, and Taiwan invested firms. NBS does not treat publicly listed companies in China separately. It is difficult to track them as their legal identification numbers were changed when they went public. But they all belong to the mixed category. By the end of 2004, there are about 1,300 publicly listed companies in China's two stock exchanges. However, only slightly over 700 of them are manufacturing firms.

The NBS data contain detailed enough information that allow us to construct variables required for the GMM estimation of the investment Euler equation models. All monetary terms are in 2000 constant Renminbi (RMB) Yuan.

Our empirical analysis is mainly conducted against the NBS data. In Section 7, we apply the same GMM estimation on the listed firms in China as a robustness check. The listed firms' financial data are collected from the CSMAR Financial Databases developed by the Shenzhen GTA Information Technology Co. We study the universe of Chinese listed companies for the period from 1999 to 2005. The sample contains 5977 firm year observations, and represents 1009 unique listed firms in China.

4.2 Sampling

We need to have a balanced panel of firm-year observations to conduct our empirical analysis. The NBS data however have several weaknesses. First, the enterprises included in the NBS survey each year are not always the same. About 20% of firms enter or exit the database each year as a result of changes in their size classification or changes in their identification numbers due to mergers and acquisitions, privatization, bankruptcy and reorganization. Although the original NBS database contains industrial firms with the numbers ranging from 162,883 to 279,092 from year to year, only 49,171 firms appear in all five years.

Second, many firms in the NBS database are fairly small.[22] One may wonder whether those small firms are representative. Also, data quality is always a concern for smaller firms. We thus have to impose several size restrictions on the NBS data.

Finally, the NBS data do not have information on capital expenditures or the firm-level fixed asset investments. We have to compute the fixed asset investment, I_{it}, based on the investment accounting identity. However, not all information required to calculate I_{it} is available for all firms in the data.

To obtain a balanced panel and a relatively cleaner sample to estimate the investment Euler equation models, we screen the original firm-level data and delete the problematic firms. Firms satisfying all of the following criteria are retained: (i) the total value of fixed assets in any single year is above RMB 10 million; (ii) the total sales in any single year in our sample is above RMB 10 million; (iii) the firm does not change its ownership identification throughout our sample period (2000-2004); (iv) there is adequate information to calculate the firm's fixed asset investment; (v) the total number of employees has to be above 30; (vi) the computed fixed asset investment during our sample period has to be non-negative; and finally (vii) the total assets minus liquid assets, the total assets minus total fixed assets, the total assets minus net value of fixed assets, and the accumulated depreciation minus current depreciation are all positive.

We delete from the original data the firms that violate any of the above selection criteria. We are left with slightly over 13,000 firms for our sample period. We delete firms with variable values (the variables will be defined below) either below the 1 percentile or above the 99 percentile. Our

[22] To offer a sense of the size distribution of the NBS firms, when we truncate the data by total sales at RMB 10 million, the number of firms quickly drops to below 40,000 each year.

final sample contains 12,607 firms from 2000 to 2004. In 2004, they account for about 23% of total industrial value added and 5% of urbane employment in China.

Table 1 reports the breakdown of our sample firms by ownership and by industry. As shown in Panel A, SOEs, collective firms, mixed firms, private firms, HK/TW firms, and foreign firms respectively account for 12.29%, 14.43%, 22.06%, 13.56%, 19.62%, and 18.04% of our sample. Panel B shows the distribution of the sample firms by industry. Textile (17), electrical machinery and equipment (39), and ordinary machinery (35) are the top three industries with the most firms in the sample, while petroleum and natural gas extraction (7) and ferrous mining (8) are the least covered industries.[23] Table 2 presents the breakdown of our sample firms by region. Not surprisingly, Guangdong, Zhejian, and Jiangsu are the three provinces with the largest numbers of firms in our final sample, while Hainan, Tibet, Qinghai and Ningxia have the fewest.

One may concern with the potential 'selection bias' or 'survival bias' in our sample. While we are fully aware of their impact, we argue that such impact might be limited. The breakdowns of our sample firms by region, industry, and ownership (Tables 1-2) are largely consistent with those in the original NBS database. During the sampling process, we do not observe any significant cross-ownership, cross-industry, or cross-region patterns in the probability of an observation being dropped, suggesting that the "bad data" problem has been random. In addition, to offer a robustness check, we also estimate another firm population, the listed firms in China, in Section 7. We find similar empirical results, which suggests that our NBS sample is able to reflect the dynamics of Chinese industrial firms.

4.3 Variables

Based on the information provided in the NBS database, we first construct six dummy variables to capture a firm's ownership status: D^{SOE}, $D^{private}$, $D^{foreign}$, $D^{HK/TW}$, D^{mixed}, and $D^{collective}$. These binary variables take the value of one if a firm falls into a corresponding ownership category and zero otherwise. Note that all firms in our sample have the same ownership identifications throughout our sample period, 2000 − 2004.

We define $Sale_{it}$ as the sales in year t for firm i. Cost, VC_{it}, is the variable costs, which is defined as the sum of costs of good sold and administrative costs. We denote total assets as TA_{it}.

[23]Numbers in the brackets are the 2-digit industry codes designated by NBS.

The depreciation rate $DRATE_{it}$ is computed as the ratio of DEP_{it} (current year depreciations) to the beginning of year fixed assets K_{it-1}.[24] The cash flow CFK_{it} is defined as earnings before depreciations and amortizations plus depreciations. We retrieve total liabilities TL_{it} and current assets CA_{it} from the NBS data. Besides the above variables, we use $INVEN_{it}$ to denote firm i's total inventories in year t. The firm's after tax income is defined as $INCOME_{it}$ and its effective tax rate TAX_{it} is calculated as the ratio of total income tax to total before-tax profit. We use the natural log of the number of employees to measure firm size. It is labeled $LNLABOR_{it}$. Except for $INCOME_{it}$, $DRATE_{it}$, and TA_{it}, all of the variables are scaled by total assets (TA_{it}). Note that we have defined firm age AGE_{it}, and the industry Herfindahl index, $HIND_{it}$, in Section 3.2.

Although the NBS data do not have information on capital expenditures or fixed asset investment, I_{it}, the key variable of our analysis, we compute I_{it} by following the investment accounting identity below:

$$I_{it} = K_{it} - K_{it-1} + DEP_{it}. \tag{13}$$

We only have investment data available for the period from 2001 to 2004. Meanwhile, to apply the GMM estimations, we have to use variable values lagged by two periods as the instruments. We can only estimate the investment Euler equation models in 2003 and 2004. Panel A of Table 3 presents firms' investment rate (I_{it}/TA_{it}) by ownership in 2003 and 2004. If judging by investment rate, it seems that private firms in China have the highest investment rates among all firms, while SOEs' investment rate only averages at 14.2%. The numbers reported in Panel A however could be misleading in the sense that they do not take into account the impact of firm size and diverse investment opportunities facing firms. Especially, SOEs in China have relatively longer history and usually are much larger than private firms and collective firms.

To provide a better motivation that corporate investment behavior in China varies across ownership, we regress the firm-level investment rate on ownership dummies and firm size. Panel B of Table 3 reports the OLS regression results. In Model 1, only ownership dummies are included as the explanatory variables. The results certify the findings in Panel A. That is, compared to SOEs, non-state sectors in China tend to have higher investment rates. In Model 2, we add the firm size

[24] We delete firms with $DRATE_{it}$ larger than one from our sample. About 0.4% of firms are thus dropped. Such a screening rule is consistent with our previously discussed guideline that firms with variables values either above the 99 percentile or below 1 percentile would be dropped.

(measured by $LNLABOR$), we find similar results. Interestingly, firm size enters the regression positively, implying that larger firms in our sample tend to invest more. We wonder whether ownership influences corporate investment decision through firm size. We interact ownership dummies with $LNLABOR$ and add them into the regression. We report the results in Column 3. After controlling for the interactions of ownership and firm size, we find that the estimated coefficients of private dummy, foreign dummy, HK/TW dummy and even collective dummy (not significant though) become significantly negative. Such a finding seems to suggest that controlling for firm size, non-state sectors in China appear to invest less. The results in panel B of Table 3 thus suggest that using investment rate to understand Chinese firms' investment behavior is inappropriate.

Table 4 provide the summary statistics of the variables used in our analysis. We truncate the sample at the 1 percentile and 99 percentile, the variables display nice statistical properties. During 2003 –2004, the fixed investment on average accounts for 18.3% of total assets; the average depreciation rate is 11.6%; cash flow is about 2.5% of total asset. Surprisingly, the mean of ST (total sales/total assets) is 1.094, indicating that in our sample firms tend to have sales larger than total assets. The sales costs (VC) also amount to 91.5% of total assets, and the profit margin (INCOME) is 5%. The average firm age is 16.3 years.

5 The Ownership Effect

5.1 Does ownership matter?

We apply the GMM estimation to various Euler equation models with the baseline model specified as Equations (10) and (11). Although the NBS database contains firm-level information from 2000 to 2004, it does not have fixed asset investment data. We calculate I_{it} according to Equation (13), we therefore lose the data in 2000. Also, we need to use the values of firm-level variables lagged by two periods as the instrument variables (see Equation (12)) in order to conduct the GMM analysis. Thus we can only estimate the investment Euler equation models for 2003 – 2004.

We first examine the ownership effect and start with the most general model. The stochastic discount factor is specified in Equation (11), in which all ten variables are used to parameterize Γ_{it}. We include in the specification of the stochastic discount factor *six* ownership dummy variables.

Together with three unknown parameters in the production function and investment adjustment function (μ, α_1, and α_2), we have in total 12 parameters to estimate (the coefficient of SOE dummy is set to be zero). Our instruments include all of the Euler equation variables lagged by two periods such as $Sale_{it-2}$, VC_{it-2}, $DRATE_{it-2}$, and I_{it-2}, as well as inventories ($INVEN_{it-2}$), total liabilities (TL_{it-2}), current assets (CA_{it-2}), depreciations (DEP_{it-2}), tax rate (TAX_{it-2}), net income ($INCOME_{it-2}$), firm age (AGE_{it-2}), industry-level Hirfindahl index measure ($HIND_{it-2}$), ownership dummies, and finally the constant. There are in total 20 instrument variables.

Table 5 presents the investment Euler-equation estimation results. Column (1) contains estimates from the most general model, where the discount factor is specified according to Equation (11). We do not include time dummies here since we only estimate the model for 2003 – 2004. Adding time dummies does not change the results qualitatively.[25] Each subsequent column contains estimates from a model in which we have dropped from the the discount factor equation the variable with the smallest t-statistic. We examine the difference in the minimized GMM objective functions for the most general and for subsequently more parsimonious models. Each of these differences will have a χ-squared distribution with degree of freedom equal to the number of variables excluded from the model. That is, if a variable belongs in the Euler equation, its omission should produce a small p-value. Following Whited and Wu (2006), we call this test of exclusion restriction an "L-test".

First of all, we note that for all of our models, the J-test of over-identifying restrictions does not produce a rejection, suggesting that our models and corresponding assumptions are not misspecified. The p-values of L-test suggest that dropping AGE and $HIND$ from the stochastic discount factor specification do not affect the model efficiency. That is, firm age and industrial competition level are not significant determinants of the discount factor perceived by the managers.

The estimation results in Table 5 reveal several findings. The coefficients of $D^{private}$, $D^{collective}$, D^{mixed}, $D^{foreign}$, and $D^{HK/TW}$ are all negative, but only those of $D_{private}$ and $D_{collective}$ are significant at conventional levels in all models. The estimated coefficients of other ownership dummies are only marginally significant in some specifications (e.g., $D^{foreign}$ and $D^{HK/TW}$ in

[25] We actually start with more general models in which all relevant firm-specific variables are included as determinants of discount factors. However, it turns out the majority of them are not significant at all. Also, including more variables into the discount factor function increases the demand for more instrument variables and also greatly reduces the stability of estimating results.

Column 3). The results suggest that the investment behavior of private and collective firms in China is distinctively different from that of SOEs. Meanwhile, the difference in investment behavior between SOEs and mixed firms, foreign and HK/TW firms is not distinct in most specifications in Table 5. All else equal, private firms and collective firms in China perceive lower "implied" discount factors. In other words, they face higher "implied" costs of capital and have higher "implied" returns on capital.

The estimated coefficient of $LNLABOR$ — the proxy for firm size — is significantly negative in all models, implying that larger firms tend to have lower (higher) discount factor ("implied" return on capital) than smaller firms do. We can interpret the evidence as that in equilibrium larger firms tend to make more efficient investment decisions after controlling for investment opportunities, competition effect, and the impact of other firm-specific attributes. As shown in Columns 1 and 2, the proxy for the industrial competition, $HIND$, is not statistically significant at any conventional levels. The result, although counterintuitive, implies that the explanatory power of competition may have been picked up by ownership variables.

The cash flows variable, CFK, is not significant except in Model 3. The result seems to suggest that cash flows have limited impact on Chinese firms' investment behavior in equilibrium. The positive sign of CFK in Column 3 however indicates that firms with more free cash flows tend to face lower "implied" return on capital, which seems to support Jensen's (1986) "free cash flow" argument. However, we do not intend to overstate the result here because CFK is only marginally significant in one of our four reported model specifications.

5.2 The magnitude of ownership effect

The results in Tables 5 strongly suggest that firm size — measured by $LNLABOR$ — has significant impact on firms' investment decisions. One possibility is that large firms have better corporate governance system and are more accessible to good management, face a lesser extent of information asymmetry problem, and are also likely to be favored by the government's preferential policies. One may wonder whether the firm size effect may offset ownership effect to a certain extent. We thus specify the discount factor function Γ_{it} as follows:

$$\Gamma_{it} = l_0 + l_1 OWN_{it} + l_2 LNLABOR_{it} + l_3 AGE_{it} + l_4 CFK_{it} + l_5 HIND_{it} + bOWN_{it} * LNLABOR_{it}, \tag{14}$$

where the marginal impact of ownership on Γ_{it} is given by

$$\frac{\partial \Gamma_{it}}{\partial OWN_{it}} = l_1 + bLNLABOR_{it}. \tag{15}$$

In Equation (15), l_1 captures the standard impact of ownership on the discount factor, and the latter, $b \times LNLABOR$, measures ownership's impact through firm size. Plugging Γ_{it} as in Equation (14) into Equation (12) and using GMM to estimate the Euler investment equation models, we expect the estimated coefficients of l_1 and b to be negative and positive respectively — firm size effect offsets the ownership effect.

We report the estimation results in Table 6. Since firm age has been consistently insignificant in all of our previous models, we exclude it from the estimations in Table 6. Again, from Columns (1) to (3), we sequentially exclude discount factor variables based on their t-statistics. We use the L-test to check which model is more parsimonious. None model actually produces a rejection of the exclusion restrictions. Model 3, in which $HIND$ and CFK are both excluded from the discount factor function, emerges as the model we accept.

Our primary interest is in the magnitude of the ownership impact. To illustrate it, we examine the economic significance of the results in Model 3. The impact of ownership is given by Equation (15). In our sample, the mean of $LNLABOR$ is 5.94. Everything else being equal, a private firm's effective discount rate is 18.9 percentage points lower than that of a typical SOE.[26]

Similarly, we can compute the magnitude of the ownership effect for mixed firms, collective firms, foreign firms, and HK/TW firms. Our computation results indicate that the "perceived" or "implied" return on capital for collective firms, mixed firms, HK/TW firms, and foreign firms are approximately 11.9, 13.7, 18.2, and 19.8 percentage points higher than that of an average SOE.

[26] The estimate coefficients of private firm dummies and its interaction with $LNLABOR$ are -1.562 and 0.231 respectively. The aggregate impact of private firm dummy on effective discount factor is thus given by $-1.562 + 0.231 \times 5.94 = -0.189$.

We note that the “implied” return on capital for mixed firms is higher than SOEs, although almost all of the mixed firms in China are partly owned by the state, and they can be viewed as *de facto* SOEs. The result is intuitive since mixed firms can be viewed as the end product of China’s SOEs reforms. Their operating efficiency tends to improve after the reforms kick off. The difference in “implied” return on capital between mixed firms and SOEs could be viewed as θ_1, if we assume that the SOEs reform in China is successful and mixed firms are less subject to soft budget constraint.

5.3 Evidence from the domestic firms only

Foreign firms and Hong Kong/Taiwan invested firms operating in China use different financing channels. Plus, their investment decision making mechanisms might also be different from domestic firms. Pooling domestic firms and foreign and HK/TW firms thus might lead to spurious results. Also, as shown in Table 5, both $D^{foreign}$ and $D^{HK/TW}$ are not statistically significant in some of our models. To better serve our goal of examining how institutions and financial development affect Chinese firms’ investment decisions and also offer a robustness check, we apply the GMM estimations to a sub-sample that only contains the domestic firms. Deleting foreign firms and HK/TW firms, we obtain a smaller sample with 7,860 domestic firms in each year.

Applying the GMM estimation to the domestic firms only, we first replicate the estimations in Table 5 and report the results in Table A3. The estimated coefficients of private, collective, and mixed firms dummies again are all significantly negative. Firms’ investment behaviors are largely consistent with those revealed in Table 5 when the GMM estimations are applied to the whole sample.

We then replicate the estimations by adding the interactions of ownership dummies with firm size. We report the results in Table A4. Again, the results in Table A4 are qualitatively similar to those in Table 6. We thus draw the conclusion that our empirical results are not driven by foreign firms and HK/TW firms.

6 The Impact of Regional Institutions and Financial Development

China is a large and diversified country with significant cross-regional differences in the institutions and the level of financial development(Demurger et al., 2002). China can be described as the *de facto* federalism, involving a decentralized economic system in which each region can be considered as autonomous economic entity (Qian and Xu, 1993). Differentiated regional development policies adopted by the central government and local governments since 1978 have created better investment environment in coastal provinces and some special economic zones.[27] As a result, domestic financial markets in China are severely segmented. Compared to the developed markets, cross-regional bank lending has been relatively rare (Boyreau-Debray and Wei, 2005).

In this section, we conduct an inter-region study to understand how regional disparities in China affect firms' investment efficiency. The advantage of inter-region studies within one country is that we can capture the effect of institutions on firm-level investment decisions without contamination due to differences in accounting rules, bankruptcy laws, etc. We predict that the provinces or metropolises, in which economically preferential policies and better institutions prevail, would see more efficient firm-level investment decisions (Conjecture 2 in Section 2).

We use the measures compiled in Demurger et al. (2002) and Fan and Wang (2004) to capture the regional financial development and institutions. Demurger et al. (2002) compile the open-door and deregulation policies adopted in different regions and use the so called preferential policy index (PPI hereafter) to capture the amount of preferential policies granted to each region by the central government. PPI captures the extent of marketization and internationalization of a local economy.

We use $NERI$ complied in Fan and Wang (2004) as our second measure. Fan and Wang examine the extent of marketization in each region by focusing on the following five aspects: (1) the relations between the local government and local markets; (2) the significance of non-state sector in the local economy; (3) the development level of product markets; (4) the development level of factor markets; and (5) legal environment, law enforcement, and the development of market intermediaries. The weighted average of scores on the five aspects is computed and used to capture the market and legal conditions of China's diverse regions.

[27]For example, in east China approval processes for new investment projects as well as import and export rights were easier and faster than the other regions. Demurger et al. (2002) detail different preferential policies adopted in China and discuss their implications on regional disparity. They find that preferential policies have a large impact on the regional economic development.

Panel A of Table 7 presents the PPI and $NERI$ indexes for each province or province-equivalent municipal city. To conduct GMM estimation in each region, we combine several provinces with few firms in our sample. We combine Tibet, Qinghai, Ningxia, Gansu, and Xingjiang to form a large region. We also pool Chongqin and Sichuan, Guizhou and Yunnan, and lastly, Hainan and Guangxi. By doing so, we end up with 24 regions. It is not surprising that several coastal provinces (e.g., Zhejiang, Guangdong, Fujiang, and Jiangsu), Beijing, and Tianjin score high along both indexes.

Panel B of Table 7 reports the summary statistics of the two indexes. We note that the standard deviations of both $NERI$ and PPI are large enough for us to conduct meaningful cross-sectional analysis. The two indexes are also highly correlated with the correlation coefficient 0.84.

To examine the corporate investment efficiency across the regions, we first estimate the investment Euler equation model based on Equations (10) and (11) for each region.[28] We obtain the region-level estimated coefficients of the ownership dummies, $\hat{l_1}$. $\hat{l_1}$ is a 5×1 vector with its elements capturing the estimated coefficients of the five different ownership dummies (the coefficient of the SOEs dummy is set to be zero). They measures the investment efficiency of the five different types of non-state firms relative to SOEs in that region. That is, they capture θ in each region.

The five sets of coefficients are then regressed on the index of the regional financial development and institutions, IFD. IFD is either PPI or $NERI$ in our setting. We have

$$\hat{l_{1i}} = b_0 + b_1 IFD_i + e_i, \tag{16}$$

where $\hat{l_{1i}}$ measures the ownership dummy estimates for region i, and IFD_i measures the level of institutions and financial development in region i.

Our hypothesis is that $b_1 < 0$. That is, the non-SOE firms in a region with a higher level of institutions and financial development tend to have a lower discount factor (a higher "implied" return on capital). Put it in another way, non-state sectors in the regions with sound institutions and well-developed financial system are more likely to make efficient investment decisions and enjoy

[28]It is worth noting that the single-region estimations are not as efficient as the estimations conducted against the panel because they require to estimate more coefficients (eleven per region for twenty-four regions rather than only eleven coefficients for the whole nation in the earlier analysis) by using the same set of information. As a result, some of the individual coefficient estimates are not significant at the conventional levels. However, our main interest here is to examine how those estimated coefficients vary across institutions and levels of financial development. The loss in modeling efficiency might not be a big concern. The results of the first-stage GMM analysis are available upon request.

higher investment returns relative to the state sector.

We report the second-stage regression results in Table 8. As shown in Models 1-10, all of the institutional variables are negative and significant at conventional levels except for PPI in model 2, where it is used to explain the regional difference in private firms' discount factor. The two institutional variables individually explain about 10 to 20 percent of the regional variations in the corporate investment efficiency.

To get a better sense of the economic significance of regional institutions and financial development, we take the results from Model 1 of Table 8 as an example. The OLS regression results in a coefficient of -0.061, significant at the 10% level, when the estimated coefficient of $D^{private}$ is used as the dependent variable and NERI is used as the explanatory variable. The result suggests that a one unit increase in a region's institutional and financial development level will lead to a 6.1 percentage points decrease (increase) in its private firms' managerial discount factor ("implied" return on capital). That is, θ will increase by 6.1 percentage points.[29] Using PPI as the measure of institutions in general yields similar albeit larger economic effect. Take the results in Model 4, where PPI is used to account for the estimated coefficient of collective dummy, as the example. The estimated coefficient of PPI is -0.128. It implies that if Heilongjiang or Jilin ($PPI = 0.67$) could improve their institutional infrastructure and the efficiency of financial system to the level of Shanghai ($PPI = 1.76$), then their collective firms' investment efficiency can improve by 12.8 percentage points. The disparities in institutional and economic development across regions matter in Chinese firms' investment efficiency.

The regression results in Table 8 also shed some light on the breakdown of θ_1 and θ_2. As shown in Table 8, the improvement in institutions and financial development results in a larger impact on mixed firms than private firms. The evidence seems to suggest that θ_1 and θ_2 tend to move in opposite directions when $NERI$ and PPI increase. In regions with better institutions and a market-prone financial system, non-state sectors make more efficient investment decisions relative to SOEs (a larger θ_1); they require a smaller premium to compensate the additional risks due to institutional distortions (a smaller θ_2). The overall effect (the sum of θ_1 and θ_2) is positive.

[29] For example, as shown in Panel A of Table 7, the average NERI for Shangdong Province is 7.1, while the average $NERI$ for Jiangsu Province is about 8.1. If Shangdong can improve its institutions and financial development to the level of Jiangsu, then an average private firm in Shangdong can harvest a 6.1 percentage points increase in its investment return.

7 Additional Analysis

7.1 Caveats and Robustness Checks

Our empirical analysis is conducted based on the estimation of the investment Euler equation models. We examine the impact of institutions and financial development on corporate investment efficiency by studying the cross-ownership and cross-region distribution of the the "implied" return on capital derived from corporate investment data. Such a testing strategy however suffers from several shortcomings. First, it requires imposing a high degree of structure on the estimating equations, such as our various specifications of the effective discount factor equation (see Equation (11)). The estimation results thus can be sensitive to the model specification. A rejection of "no ownership effect" or "no regional difference" hypothesis can occur for reasons other than institutional deficiencies. To overcome this concern, we experiment with many different specifications of the discount factor function. Our results, especially the ones related to ownership identifications and regional disparities, turn out to be quite robust.

Second, the testing strategy based on the Euler equation models relies on period-by-period restrictions derived from the firm's first-order conditions, so that it may not capture the impact of institutions and financial development across periods. However, due to data limitations, we are only able to estimate the investment equations for 2003 and 2004. The changes in institutions and financial development cannot be that significant in these two years. Our identification is thus mainly driven by cross-sectional variations. Third, the tests based on the Euler-equation methodology have poor small sample properties. It is however not a big concern here since our sample is reasonably large.

We need to be cautious with the potential 'selection bias' and 'survival bias' in our sampling process as well. We require the firms to have both their fixed assets and total sales above RMB 10 million. Such a restriction turns out to be quite stringent since our final sample only contains 12,607 firms. A large number of small- and medium-sized firms are deleted from the sample. Such an exercise however can be justified on several grounds. First, the cross-ownership, cross-region, and cross-industry distributions of our sample firms are largely consistent with the original NBS database. Second, we offer a robustness check by relaxing the size restriction. When we lower the size threshold level to RMB 7 million (for both fixed assets and total sales), we end up with a panel with 27,698 firms in each year. Such a sample represents 35% of total industrial output and 7% of urban employment in China, both of which have been significantly improved compared to the previously used sample. We use GMM to estimate the investment Euler equation models and find quite similar results. Table A5 presents the results of using various versions of Equation (14) to specify the effective discount factor.[30]

Another concern with our sampling process is that we have to drop from our sample the firms that have changed their ownership identifications within the sample period (2000-2004), which might introduce another dimension of sample selection bias. However, almost all of such changes occur in one direction — from the SOEs to the mixed. The changes likely only affect the relative investment efficiency of SOEs and mixed firms, while our main argument is built upon the comparisons between SOEs and other types of non-state firms such as private, collective firms, HK/TW, and foreign firms.

7.2 Estimating another population — the listed firms in China

To offer a more direct cross-check on our empirical results, we apply the same testing strategy to another population of the Chinese firms — the universe of China's listed firms. Such analysis has several advantages. First, the information on the listed firms is more transparent and arguably more reliable; second, listed firms contain more publicly accessible information, so we can construct more variables to capture the potential impact of institutions. Third, the listed firm sample allows us to carry out the GMM estimation over a relatively longer time period (1999–2005). The tradeoffs however are also obvious. There are only slightly over 1000 listed firms in China, the representativeness is always a concern. Second, focusing on the listed firms makes cross-region analysis less applicable since some provinces have few listed firms.

We study the universe of China's listed firms for the period from 1999 to 2005.[31] The listed firms' financial data are collected from the CSMAR Financial Databases developed by the Shenzhen GTA Information Technology Co. We obtain a sample with 5977 firm year observations for our

[30]We are not using this enlarged sample to carry out all of our empirical analysis due to two considerations. First, several regions are over-represented in the sample (e.g., Zhejiang and Fujian). Also, the share of collective firms increases dramatically. Second, the NBS data are quite noisy, especially for small and medium-sized firms. Focusing on relatively large firms helps strengthen the rigor of our empirical analysis.

[31]The Chinese listed firms' corporate governance variables are not available until 1999. In our tests, we need to use the corporate governance variables to capture the impact of institutions.

sample period, which represents 1009 unique listed firms in China. To conduct the GMM analysis, we need a balanced sample. To make the estimation results comparable, we also exclude financial firms. Finally, we delete the firms with extreme variable values (one percent at both tails). We finally get a panel with 646 firms each year for the period 1999–2005.

We specify the discount factor function Γ_{it} as follows:

$$\begin{aligned}\Gamma_{it} &= l_0 + l_1 SOE_{it} + l_2 LNLABOR_{it} + l_3 OUTSIDE_{it} + l_4 CFK_{it} + l_5 HIND_{it} \\ &\quad + l_6 PARENT_{it} + l_7 HBSHARE_{it} + l_8 TOPSHARE + l_9 CEOCHAIR + l_{10}\beta,\end{aligned} \tag{17}$$

where SOE is a binary variable that takes the value of 1 if a listed firms is controlled by the government; $OUTSIDE$ is the ratio of outside board members to total board members; $PARENT$ is a binary variable with the value of 1 if a listed firm belongs to a group firm; $HBSHARE$ is a binary variable with value of 1 if a listed firm has either H- or B-shares traded by foreign investors; $TOPSHARE$ is the percentage of shares held by the controlling shareholder; $CEOCHAIR$ is a binary variable with the value of 1 if the CEO is also the chairman of the board; and β is estimated based on the CAPM model annually and used to capture systematic risk. Other firm-specific variables have been defined earlier.

Unlike the NBS data, the list firms in China have more firm-level information available for us to construct institution (corporate governance) variables. However, almost all of China's listed firms are domestic firms, therefore, we cannot analyze the investment behavior of foreign firms and HK/TW firms by using this sample.

We apply the GMM estimation on the listed firm sample and report the results in Table 9. The p-value of the J – test is 0.151, which rejects the hypothesis that our model is misspecified. The estimated coefficients of the production function and investment adjustment cost function (α_1, α_2, and μ) are in line with previous results in which the GMM estimations are applied to the NBS data.

Our focus is on the various corporate governance variables that measures the impact of institutions on corporate investment decisions. The results in Table 9 yield several interesting findings. First, the estimated coefficient of SOE is significantly positive with its value equal to 0.133. It suggests that all else equal, an SOE's "implied" discount factor is higher than that other listed firms. Approximately, an SOE's "implied" return on capital is 13.3 percentage points lower than that of non-SOE firms. The result is consistent with that from the NBS data. Second, we find that other corporate governance variables have the expected signs and are statistically significant in most cases. Everything else equal, the listed firms with H- or B- shares traded by foreign investors, more outside board members, and a larger percentage of shares owned by the controlling shareholder have a higher "implied" return on capital. We also find that CEO being board chairman and belonging to a group firm affects a listed firm's investment efficiency negatively, although they are not statistically significant. β is negative, but it is not significant in our listed firm sample. Its impact on the discount rate may have been picked up by other firm-level variables.

To sum up, the estimation results based on China's listed firms generate consistent findings — improving institutions helps enhance firms' investment efficiency in China.

8 The Costs of Weak Institutions and Failing Financial System

China's fast growing economy has been largely built upon weak institutions and an ineffective financial system. Although the financial system in China is doing an outstanding job of mobilizing savings, it only directs a relatively small share of the country's savings to the economy's most productive enterprises. Such a model of development presents China as a counterexample to the well-accepted argument that finance is important to economic growth.[32] Bearing the parameters estimated from our structural model in mind, we examine below the implications of our results for the Chinese model of development, and estimate the welfare loss due the misallocation of capital in the Chinese economy.

8.1 Implications for the Chinese model of economic growth

China's economic growth has been largely driven by fixed asset investments and FDI. However, as shown in Table A2, in 2004 the fixed asset investments of SOEs and mixed firms account for more than 60% of total fixed asset investment, RMB 7,047.7 billion. Such a significant amount of

[32]Two views related to the Chinese economy and its relation with financial system thus come along. Allen et al. (2005) suggest that Chins's financial system is actually quite effective because a sufficient amount of alternative, informal financial mechanisms are working in a quite efficient manner. Young (2001 and 2003) however argue that given the institutional deficiencies and the failing financial system, the economic growth in China is neither unprecedented nor spectacular. The sustainability of the Chinese model of growth is thus questioned by him.

investment concentrating in the less efficient SOEs and mixed firms indicates a widespread mis-allocation of capital, for which poor institutions and failing financial systems are held accountable. It thus raises a valid concern that if China does not change its development model and still heavily relies on fixed asset investment, whether its economic growth can be sustained?

By deriving the "implied" return on capital based on the firm-level investment data, we identify significant gaps in investment efficiency between the state sector and non-state sectors in China. Based on our calculation, all else given, an average private firm, collective firms, mixed firms, HK/TW firm, and foreign firms have the rates of investment return that are respectively 18.9, 11.9, 13.7, 18.2, and 19.8 percentage points higher than that of an average SOE. However, the allocation of capital resources has be disproportionate by ownership identifications. Farrell et al. (2006) estimate that SOEs, mixed firms, collective firms, and private and foreign firms (include both HK/TW and foreign firms in our context) respectively account for 35% (23%), 27% (19%), 11% (6%), and 27% (52%) of the total corporate loans outstanding.[33] Because China's weak institutions and failing financial system fail to channel scarce capital resources to relatively more profitable sectors, the sectors that are efficient and contribute the most to the Chinese economy however are not receiving the bulk of bank loans.

Based on our model estimation, the costs of the resource mis-allocation are significant. According to the statistics released by China's central bank, the People's Bank of China (PBOC), by the end of 2005, the total medium- and long-term corporate loans amount to RMB 9,311.6 billion in China, among which about 35%, that is, RMB 3,259 billion, are allocated to SOEs. If this part of financing can be reallocated to more efficient private firms, or if SOEs in China can improve their investment efficiency to the level of that of private firms, then the additional value added would amount to RMB 615.9 billion (it is computed as $3,259 \times 18.9\%$; he investment return of a typical private firm is 18.9 precentage points higher than that of an SOE.) The gains from improving institutions and enhancing the efficiency of financial system are economically significant (about 4.5% of the GDP based on the data in 2004).

[33]The numbers in bracket is the share of total industrial value added contributed by each category of firms.

8.2 Welfare loss due to the mis-allocation of capital

Our estimates, together with the actual distribution of financial assets among different firms and several mild assumptions, allow for an assessment of the welfare loss due to the mis-allocation of capital in the Chinese economy. Figure 1 illustrates the deadweight loss in the bank lending market for SOEs.

By the end of 2005, the total value of financial assets in the Chinese banking sector is RMB 34.14 trillion,[34] 35% of which have been allocated to the SOEs (sources: PBOC; and Farrell et al. 2006). Since the interest rates have been regulated throughout China's reform era, we assume that the interest rate applied to SOEs is set to be at r, which is lower than market rate, r^*. Because the private sector in China has been discriminated, the private firms can only access to the bank lending through formal channels at a much higher rate, or resort to alternative financing channels for external finance. In either case, the interest rate they are facing is higher than market rate r^*. Our analysis could be simplified if we assume that the "implied" return on capital for mixed firms captures the marginal cost of capital in China. That is, we assume r^* is 13.7% higher than r.

Instead of accepting the market rate, r^*, the state sector can borrow money at r, which has been intentionally designated to them at a lower level. Their excess demand for bank lending by the state sector thus is given by $K^* - K$. The deadweight loss is given by area A in figure 1, which can be computed as:

$$Deadweight\ Loss = \frac{1}{2}(K^* - K)(r^* - r). \tag{18}$$

To compute the size of deadweight loss, we need to estimate the slopes of the demand and supply curves for capital as shown in Figure 1, which is non-trivial. Our analysis could be greatly simplified if we assume that the optimal amount of bank loans assigned to SOEs (K in figure 1) is proportional to SOEs' contribution to the total industrial value added in China. That is, K should be 23% instead of 35%. The excess part, captured by $K^* - K$, is thus 12% of total banking assets. Because $r^* - r = 0.137$, $K^* - K = 0.12$, and the total banking assets in China is RMB 34.14 trillion, plugging those numbers into Equation (18), we compute the deadweight loss in the financial market for SOEs due to the mis-allocation of capital to be RMB 280.6 billion, which is about US$ 34.9 billion.

Similarly, we use Figure 2 to illustrate the deadweight loss in the bank lending market for

[34] We do not include corporate equity market and corporate bond market, and the assets in the insurance industry.

private firms, area B. Instead of getting 52% of bank lending (K^*), this sector only gets 27% of total bank lending in China. Because $r^{private} - r = 0.189$, we can compute the deadweight loss in the credit market for private firms to be RMB 806.6 billion. We sum up the deadweight losses in all the markets and obtain the total deadweight loss in the economy, which amounts to RMB 1087.2 billion, 8% of China's GDP in 2004.

9 Concluding Remarks

In this paper, we propose an innovative empirical approach to examine the Chinese firms' investment efficiency. Based on the firm-level investment data, we derive the *equilibrium* cost of capital perceived and used by the managers to discount future payoffs. Such an "implied" cost of capital is equivalent to the marginal investment return in equilibrium, thus serves as a good proxy for investment efficiency. Using such a measure, we find that corporate investment efficiency varies dramatically across ownership and regions. In particular, non-state firms in China in general enjoy higher investment returns than SOEs do. We also find that regions with sound institutions and a high level of financial development tend to see more non-state firms under their jurisdictions make better investment decisions. We attribute the gaps in investment inefficiency to several features that capture institutions and financial development in China. Our analysis further demonstrates that the welfare loss due to the mis-allocation of capital amounts to 8% of China's GDP. We also find that redirecting the capital from SOEs to more profitable non-state sectors can unleash 4.5% GDP growth each year. These findings suggest that institutions and financial development are crucial for the sustainability of China's economic growth.

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Table 1 The breakdown of the sample firms by ownership and industry

The data source is a database compiled by the National Bureau of Statistics in China (NBS) that covers all industrial firms in China with total sales above RMB 5 million for the period 2000-2004. We include in our sample the firms that satisfy several threshold conditions specified in the text. We eventually obtain a balanced panel of 12,607 firms for 2000-2004. In Panel A, SOE stands for state-owned enterprises; Collective stands for collective firms; Private refers to privately owned firms; Mixed refers to the joint-stock companies; Foreign stands for foreign firms operating in China; and HK/TW stands for the Hong Kong or Taiwan invested firms.

Panel A: By ownership

	# of Firms	% of the whole sample
SOE	1,549	12.29
Collective	1,820	14.43
Mixed	2,782	22.06
Private	1,709	13.56
HK/TW	2,473	19.62
Foreign	2,274	18.04
Total	12,607	100

Table 1 continued

Panel B: by industry (based on the 2-digit industry codes designated by NBS)

Industry Code	Industry	# of firms	Percent
6	Coal Mining	167	1.32
7	Petroleum and Natural Gas Extraction	20	0.15
8	Ferrous Mining	24	0.19
9	Nonferrous Mining	26	0.21
10	Nonmetal Mining	48	0.38
13	Timber Logging	374	2.97
14	Food Production	237	1.88
15	Beverage	196	1.55
16	Tobacco	56	0.44
17	Textile	928	7.36
18	Textile wearing apparel , Footwear and caps	450	3.57
19	Leather	234	1.86
20	Timber	90	0.72
21	Furniture	91	0.72
22	Papermaking	372	2.95
23	Printing	286	2.27
24	Cultural	215	1.70
25	Petroleum Processing	75	0.59
26	Raw Chemical	886	7.03
27	Medical	449	3.56
28	Chemical Fiber	72	0.57
29	Rubber	164	1.3
30	Plastic	550	4.36
31	Nonmetal Products	860	6.82
32	Pressing Ferrous	244	1.93
33	Pressing of Nonferrous	172	1.37
34	Metal Products	536	4.25
35	Ordinary Machinery	906	7.19
36	Special Equipment	444	3.52
37	Transport Equipment	691	5.48
39	Electrical machinery and equipment	914	7.25
40	Communication equipment computers and other electronic equipment	643	5.10
41	Measuring instruments and machinery for cultural activity and office work	224	1.77
42	Artwork and other manufacturing	163	1.29
44	Electric power and heat power	656	5.20
45	Gas Production	26	0.21
46	Water Production	123	0.98
Total		12607	100

Table 2 The breakdown of sample firms by region

Code	Region	# of firms	Percent
11	Beijing	330	2.62
12	Tianjin	321	2.55
13	Hebei	451	3.58
14	Shanxi	193	1.53
15	Inner Mongolia	115	0.91
21	Liaoning	404	3.2
22	Jilin	107	0.85
23	Heilongjiang	123	0.98
31	Shanghai	1190	9.44
32	Jiangsu	1601	12.7
33	Zhejiang	1856	14.72
34	Anhui	211	1.67
35	Fujian	756	6
36	Jiangxi	85	0.67
37	Shandong	1003	7.96
41	Henan	424	3.36
42	Hubei	164	1.3
43	Hunan	97	0.77
44	Guangdong	1959	15.54
45	Guangxi	136	1.08
46	Hainan	19	0.15
50	Chongqing+Sichuan	479	3.8
52	Guizhou	90	0.71
53	Yunnan	191	1.52
54	Tibet+Qinghai+Ningxia	34	0.27
61	Shan^xi	159	1.26
62	Gansu	43	0.34
65	Xinjiang	66	0.52
Total		12607	100

Table 3 The corporate investment rate by ownership

The investment rate is defined as the ratio of fixed asset investment (I_{it}) to total assets (K_{it}). Due to data limitations, we can only estimate the investment Euler equation models for 2003-2004. We therefore only report corporate investment rates in these two years.

Panel A: The distribution of corporate investment rates by ownership

	2003	2004	average
SOE	0.156	0.132	0.142
Collective	0.193	0.175	0.189
Mixed	0.194	0.176	0.189
Private	0.230	0.215	0.227
HK/TW	0.180	0.160	0.174
Foreign	0.173	0.173	0.173

Panel B: OLS regressions investment rates on ownership dummies and firm size, 2003-2004

The dependent variable is $(I/K)_{it}$, the coefficient of SOEs dummy is set to be zero. Firm size is measured by the natural log of the number of employees. t-statistics with robust standard errors reported in parentheses. *, **, and *** represent the significance levels at the 10%, 5%, and 1% respectively.

	(1)	(2)	(3)
$D^{private}$	0.0851***	0.0936***	-0.0940***
	(24.52)	(26.47)	(-4.11)
$D^{collective}$	0.0465***	0.0555***	-0.0209
	(13.60)	(15.88)	(-0.97)
D^{mixed}	0.0475***	0.0497***	0.0219
	(15.15)	(15.84)	(1.18)
$D^{foreign}$	0.0319***	0.0386***	-0.0774***
	(9.79)	(11.68)	(-3.92)
$D^{HK/TW}$	0.0316***	0.0375***	-0.0865***
	(9.85)	(11.58)	(-4.40)
LNLABOR		0.0106***	-0.0018
		(12.02)	(-0.74)
$D^{private}$*LNLABOR			0.0315***
			(8.33)
$D^{collective}$*LNLABOR			0.0118***
			(3.31)
D^{mixed}*LNLABOR			0.0040
			(1.41)
$D^{foreign}$*LNLABOR			0.0186***
			(5.90)
$D^{HK/TW}$*LNLABOR			0.01999***
			(6.37)
Adj. R-squared	0.013	0.016	0.018
# of obs.	25,214	25,214	25,214

Table 4 Summary statistics, 2001-2004

The table reports the summary statistics of the variables used in our empirical analysis for the period from 2001 to 2004 (year 2000 is not included since the investment data is missing). We drop from our sample the firms with extreme variable values (one percent at both tails). We obtain a panel with 12,607 firms in each year. The definition of variables can be found in the variable column. Specifically, LNLABOR is the natural log of the number of the employees, CFK is the ratio of cash flow to total assets; HIND measures the industry-level Hirfindahl index; AGE refers to firm age.

Variable	Obs	Mean	Std. Dev.	Min	Max
Long term liabilities / total assets (TL)	50428	0.074	0.135	0.000	1.000
Cash flow / total assets (CFK)	50428	0.025	0.112	-0.450	0.483
Depreciation Rate (DRATE)	50428	0.116	0.089	0.000	0.700
Total sales /total assets (ST)	50428	1.094	0.651	0.120	4.560
Inventories / total assets (INVEN)	50428	0.181	0.142	0.000	0.965
Income tax / total assets (TAX)	50428	0.010	0.017	0.000	0.934
Sales costs / total assets (VC)	50428	0.915	0.606	0.087	3.693
Current assets /total assets (CA)	50428	0.555	0.199	0.000	0.999
Profits/total sales (INCOME)	50428	0.050	0.085	-0.765	1.000
Sales growth rate (SG)	50428	0.179	0.317	-0.908	1.000
Investment Rate (I_{it}/K_{it})	50428	0.183	0.199	0.000	2.827
Industry Hirfindahl index (HIND)	50428	0.020	0.019	0.002	0.190
Firm size (LNLABOR)	50428	5.942	1.038	3.932	11.635
Current liabilities / total assets (CL)	50428	0.484	0.221	0.000	1.000
Firm Age	50428	16.319	14.683	1	103

Table 5 Euler equation estimation – the full sample

We estimate the investment Euler equation models based on a sample of industrial firms from a database maintained by the National Bureau of Statistics of China (NBS). The sample period is 2000-2004. After cleaning up the data, we obtain a balanced panel consisting of 12,607 firms for the period from 2001 to 2004. Our most general model is given by Equations (10) and (11). Nonlinear GMM estimation is done on the model in first differences with twice lagged instruments. α_1 and α_2 are adjustment cost parameters, and μ is a mark-up. $D^{private}$, $D^{collective}$, D^{mixed}, $D^{foreign}$, $D^{HK/TW}$, and D^{SOE} are dummy variables indicating a firm's ownership type. The estimated coefficient of D^{SOE} is set to be zero. LNLABOR is the natural log of the number of the employees, CFK is the ratio of cash flow to total assets; HIND measures the industry-level Hirfindahl index; AGE refers to firm age. Standard errors are reported in parentheses. The p-values of the J-Test and L-Test on model specification are reported in the last two rows.

	(1)	(2)	(3)	(4)
α_1	-0.027	-0.027	-0.027	-0.037
	(0.036)	(0.031)	(0.029)	(0.029)
α_2	0.024	0.024	0.025	0.030
	(0.056)	(0.049)	(0.046)	(0.047)
μ	1.066	1.066	1.064	1.067
	(0.033)	(0.024)	(0.023)	(0.022)
$D^{private}$	-0.377	-0.377	-0.357	-0.323
	(0.128)	(0.127)	(0.106)	(0.108)
$D^{collective}$	-0.527	-0.528	-0.490	-0.474
	(0.184)	(0.163)	(0.105)	(0.111)
D^{mixed}	-0.169	-0.169	-0.151	-0.056
	(0.165)	(0.149)	(0.131)	(0.126)
$D^{foreign}$	-0.325	-0.327	-0.294	-0.186
	(0.257)	(0.186)	(0.145)	(0.136)
$D^{HK/TW}$	-0.310	-0.311	-0.281	-0.213
	(0.234)	(0.187)	(0.151)	(0.153)
LNLABOR	-0.116	-0.116	-0.122	-0.131
	(0.038)	(0.027)	(0.018)	(0.017)
CFK	0.343	0.344	0.274	
	(0.307)	(0.276)	(0.133)	
HIND	-0.581	-0.575		
	(2.312)	(1.949)		
AGE	0.000			
	(0.006)			
Chi-squared	6.318	6.327	6.959	10.630
J-Test	0.612	0.708	0.729	0.475
L-Test	---	0.911	0.726	0.230

Table 6 Euler equation estimation considering size impact – the full sample

We estimate the Euler equation model based on a sample of industrial firms from a database maintained by the National Bureau of Statistics of China (NBS). The sample period is 2000-2004. After cleaning up the data, we obtain a balanced panel consisting of 12,607 firms for the period from 2001 to 2004. Nonlinear GMM estimation is done on the model in first differences with twice lagged instruments. α_1 and α_2 are adjustment cost parameters, and μ is a mark-up. $D^{private}$, $D^{collective}$, D^{mixed}, $D^{foreign}$, $D^{HK/TW}$ and D^{SOE} are dummy variables indicating a firm's ownership type. The estimated coefficients of D^{SOE}, and D^{SOE}*LNLABOR are set to be zero. LNLABOR is the natural log of the number of the employees, CFK is the ratio of cash flow to total assets; HIND measures the industry-level Hirfindahl index; AGE refers to firm age. Standard errors are reported in parentheses. The p-values of the J-Test and L-Test on model specification are reported in the last two rows.

	(1)	(2)	(3)
α_1	0.037	0.032	0.032
	(0.026)	(0.023)	(0.022)
α_2	-0.055	-0.039	-0.039
	(0.038)	(0.033)	(0.030)
μ	1.013	0.988	0.988
	(0.057)	(0.081)	(0.077)
$D^{private}$	-1.589	-1.561	-1.562
	(0.379)	(0.350)	(0.323)
$D^{collective}$	-1.269	-1.265	-1.265
	(0.416)	(0.365)	(0.356)
D^{mixed}	-0.873	-1.059	-1.058
	(0.301)	(0.235)	(0.234)
$D^{foreign}$	-0.972	-1.091	-1.091
	(0.325)	(0.281)	(0.279)
$D^{HK/TW}$	-1.254	-1.391	-1.392
	(0.464)	(0.429)	(0.394)
LNLABOR	-0.150	-0.140	-0.140
	(0.016)	(0.012)	(0.012)
$D^{private}$*LNLABOR	0.239	0.230	0.231
	(0.064)	(0.057)	(0.053)
$D^{collective}$*LNLABOR	0.212	0.193	0.193
	(0.080)	(0.073)	(0.070)
D^{mixed}*LNLABOR	0.132	0.155	0.155
	(0.040)	(0.030)	(0.030)
$D^{foreign}$*LNLABOR	0.146	0.153	0.153
	(0.049)	(0.043)	(0.042)
$D^{HK/TW}$*LNLABOR	0.183	0.201	0.201
	(0.065)	(0.059)	(0.053)
CFK	-0.140	0.001	
	(0.150)	(0.086)	
HIND	1.370		
	(1.108)		
Chi-squared	2.633	4.646	4.638
J-Test	0.621	0.461	0.591
L-Test	---	0.156	0.367

Table 7 The NERI and PPI indexes

PPI index is compiled by Demurger et al. (2002) to measure the degree of marketization and internationalization of a local economy. NERI is designed by Fan and Wang (2004) to examine the extent of marketization in each region. We combine various provinces into one large region so as to have a sizeable sample to carry out GMM analysis in each region.

Panel A: The NERI and PPI indexes by region

Region	NERI	PPI
Tibet+Qianghai+Ningxia+Xinjiang+Gansu	3.91	0.44
Guizhou+Yunnan	4.37	0.5
Shannxi	4.59	0.33
Inner Mongolia	4.64	0.67
Shanxi	4.95	0.33
Heilongjiang	4.98	0.67
Jiling	5.14	0.67
Jiangxi	5.36	0.33
Henan	5.53	0.33
Hubei	5.57	0.62
Hunan	5.6	0.33
Anhui	5.89	0.62
Guangxi+Hainan	5.92	1.41
Chongqing+Sichuan	6.2	0.62
Hebei	6.37	1.24
Liaoning	6.61	1.24
Tianjin	7.02	1.43
Shangdong	7.1	1.43
Beijing	7.54	0.67
Shanghai	8.13	1.76
Jiangsu	8.13	1.43
Fujiang	8.67	2.71
Zhejiang	9.1	1.43
Guangdong	9.74	2.86

Panel B: Summary statistics of the NERI and PPI indexes

Variable	Obs	Mean	Std. Dev.	Min	Max
NERI	24	6.294167	1.582974	3.91	9.74
PPI	24	1.002917	0.712036	0.33	2.86

Table 8 The Level of Regional Institutions and Financial Development and the Derived Discount Factors based on the Euler Equation Estimations

We estimate the baseline Euler equation model (see model 2 in Table 5) for each region in our sample. The estimated coefficients of the five ownership dummies for each region are dependent variables. We use the NERI and PPI indexes as the measures of the level of regional institutions and financial development. There are in total 24 observations. T-statistics based on heteroscedasticity adjusted standard errors are in parentheses.

***, **, and * represent significance at 1%, 5%, and 10% respectively.

Model	Dependent Variable	Institution Measure: NERI	Institution Measure: PPI	Adjusted R square
(1)	Estimate of $D^{private}$	-0.061* (-2.04)		0.121
(2)	Estimate of $D^{collect}$		-0.096 (-1.39)	0.039
(3)	Estimate of $D^{collective}$	-0.076** (-2.62)		0.237
(4)	Estimate of $D^{collective}$		-0.128* (-1.86)	0.135
(5)	Estimate of D^{mixed}	-0.069*** (-2.81)		0.263
(6)	Estimate of D^{mixed}		-0.108* (-1.79)	0.087
(7)	Estimate of $D^{HK/TW}$	-0.111*** (-2.94)		0.282
(8)	Estimate of $D^{HK/TW}$		-0.188** (-2.08)	0.126
(9)	Estimate of $D^{foreign}$	-0.065* (-1.79)		0.087
(10)	Estimate of $D^{foreign}$		-0.143* (-1.77)	0.085

Table 9 Euler equation estimation – the universe of China's listed firms, 1999-2005

We estimate the investment Euler equation model against another firm population --- the listed firms in China. We exclude financial firms and firms with missing variables, and obtain a balanced sample with 646 listed firms. We construct several corporate governance variables to capture the impact of institutions on the discount factor perceived by firm managers. The detailed definition is in the first column of the table. LNLABOR is the natural log of the number of the employees, CFK is the ratio of cash flow to total assets; HIND measures the industry-level Hirfindahl index; AGE refers to firm age. Standard errors are reported in parentheses.

The p-value of the J-Test on the model specification is reported in the last row.

	GMM estimated coefficients
α_1	-0.226
	(0.275)
α_2	0.245
	(0.349)
μ	1.057
	(0.057)
SOE dummy	0.133
	(0.041)
H- or B- share dummy	-0.355
	(0.169)
Is CEO also the Board Chairman?	0.029
	(0.038)
Percentage of Shares held by controlling shareholder	-1.168
	(0.521)
Outside board members / total board members	-0.117
	(0.054)
Is the listed firm one part of a group?	0.081
	(0.062)
LNLABOR	-0.094
	(0.014)
CFK	0.062
	(0.054)
HIND	0.042
	(0.073)
β – measure of systematic risk	-0.721
	(1.019)
Chi-squared	14.387
J-Test	0.151

Table A1 GDP, Fixed asset investment, and FDI in China 1990-2004
Source: China Statistical Yearbook
Exchange rate: 1 US$ = RMB 8.026

Year	Gross Domestic Product (RMB 100 million)	Fixed asset investment(RMB 100 million)	Percent of GDP	Foreign Direct Investments (USD 100million)	Percent of GDP
1990	18547.9	4516.9	24.35%	34.87	1.51%
1991	21617.8	5594.5	25.88%	43.66	1.62%
1992	26638.1	8080.1	30.33%	110.07	3.31%
1993	34634.4	13072.3	37.74%	275.15	6.37%
1994	46759.4	17042.9	36.45%	337.67	5.79%
1995	58478.1	20019.3	34.23%	375.21	5.15%
1996	67884.6	22913.5	33.75%	417.26	4.93%
1997	74462.6	24941.1	33.49%	452.57	4.88%
1998	78345.2	28406.2	36.26%	454.63	4.66%
1999	82067.5	29854.7	36.38%	403.19	3.94%
2000	89468.1	32917.7	36.79%	407.15	3.65%
2001	97314.8	37213.5	38.24%	468.78	3.86%
2002	105172.3	43499.9	41.36%	527.43	4.02%
2003	117390.2	55566.6	47.33%	535.05	3.66%
2004	136875.9	70477.4	51.49%	606.3	3.55%

Table A2 Fixed asset investment by corporate ownership 2000-2004
Source: China Statistical Yearbook
Unit: RMB 100 million

Fixed Asset Investment					
	2000	2001	2002	2003	2004
SOE	16504.4	17607	18877.4	21661	25027.6
	50.14%	47.31%	43.40%	38.98%	35.51%
Collective	4896.2	5373.1	6125.6	8197.5	10183.2
	14.87%	14.44%	14.08%	14.75%	14.45%
Mixed	4061.9	5663.5	8328.8	12733.6	17697.9
	12.34%	15.22%	19.15%	22.92%	25.11%
Private	4709.4	5429.6	6519.2	7720.1	9880.6
	14.31%	14.59%	14.99%	13.89%	14.02%
HK/TW	1293.1	1583.3	1765.3	2375.1	3113.5
	3.93%	4.25%	4.06%	4.27%	4.42%
Foreign	1313.2	1415.4	1685.4	2533.7	3854
	3.99%	3.80%	3.87%	4.56%	5.47%
Others	139.6	141.7	198.2	345.7	720.6
	0.42%	0.38%	0.46%	0.62%	1.02%
Total	32917.7	37213.5	43499.9	55566.6	70477.4
	100%	100%	100%	100%	100%

Table A3 Euler equation estimation – domestic firms only

We estimate the Euler equation model based on a sample of industrial firms from a database maintained by the National Bureau of Statistics of China (NBS). The sample period is 2000-2004. After cleaning up the data and deleting foreign invested firms and Hong Kong /Taiwan invested firms, we obtain a balanced panel consisting of 7,860 firms for the period from 2001 to 2004. Our model is given by equations (10) and (11). Nonlinear GMM estimation is done on the model in first differences with twice lagged instruments. α_1 and α_2 are adjustment cost parameters, and μ is a mark-up. $D^{private}$, $D^{collective}$, D^{mixed}, $D^{foreign}$, and D^{SOE} are dummy variables indicating a firm's ownership type. The estimated coefficient of ^{DSOE} is set to be zero. LNLABOR is the natural log of the number of the employees, CFK is the ratio of cash flow to total assets; HIND measures the industry-level Hirfindahl index; AGE refers to firm age. Standard errors are reported in parentheses. The p-values of the J-Test and L-Test on model specification are reported in the last two rows.

	(1)	(2)	(3)	(4)
α_1	0.109	-0.025	-0.022	-0.059
	(0.104)	(0.063)	(0.059)	(0.066)
α_2	-0.170	0.021	0.015	0.045
	(0.159)	(0.098)	(0.092)	(0.097)
μ	0.971	0.978	0.979	1.272
	(0.022)	(0.008)	(0.010)	(0.037)
$D^{private}$	-0.311	-0.324	-0.303	-0.626
	(0.132)	(0.100)	(0.091)	(0.136)
$D^{collective}$	-0.175	-0.262	-0.268	-0.657
	(0.117)	(0.085)	(0.081)	(0.126)
D^{mixed}	-0.006	-0.062	-0.081	-0.704
	(0.137)	(0.109)	(0.103)	(0.078)
LNLABOR	-0.172	-0.151	-0.149	-0.070
	(0.019)	(0.013)	(0.012)	(0.018)
CFK	-0.206	-0.202		
	(0.300)	(0.231)		
HIND	-0.171	1.626	1.191	
	(1.414)	(0.901)	(0.716)	
AGE	0.009			
	(0.004)			
Chi-squared	7.185	21.489	25.694	14.793
J-Test	0.517	0.011	0.004	0.192
L-Test	---	0.000	0.000	0.055

Table A4 Euler equation estimation considering size impact – domestic firms only

We estimate the Euler equation model based on a sample of industrial firms from a database maintained by the National Bureau of Statistics of China (NBS). The sample period is 2000-2004. After cleaning up the data and deleting foreign invested firms and Hong Kong /Taiwan invested firms, we obtain a balanced panel consisting of 7,860 firms for the period from 2001 to 2004. Nonlinear GMM estimation is done on the model in first differences with twice lagged instruments. α_1 and α_2 are adjustment cost parameters, and μ is a mark-up. $D^{private}$, $D^{collective}$, D^{mixed}, $D^{foreign}$, and D^{SOE} are dummy variables indicating a firm's ownership type. The estimated coefficient of ^{DSOE} is set to be zero. LNLABOR is the natural log of the number of the employees, CFK is the ratio of cash flow to total assets; HIND measures the industry-level Hirfindahl index; AGE refers to firm age. Standard errors are reported in parentheses. The p-values of the J-Test and L-Test on model specification are reported in the last two rows.

	(1)	(2)	(3)	(4)
α_1	-0.011	-0.023	-0.028	-0.037
	(0.048)	(0.041)	(0.038)	(0.039)
α_2	0.017	0.035	0.043	0.060
	(0.073)	(0.063)	(0.058)	(0.060)
μ	0.954	0.952	0.943	0.931
	(0.024)	(0.022)	(0.033)	(0.039)
$D^{private}$	-0.698	-0.676	-0.729	-0.746
	(0.229)	(0.244)	(0.204)	(0.203)
$D^{collective}$	-1.068	-1.096	-1.120	-1.136
	(0.201)	(0.200)	(0.174)	(0.173)
D^{mixed}	-1.276	-1.382	-1.282	-1.253
	(0.324)	(0.259)	(0.186)	(0.181)
LNLABOR	-0.146	-0.141	-0.145	-0.145
	(0.036)	(0.011)	(0.008)	(0.008)
$D^{private}$*LNLABOR	0.083	0.079	0.087	0.092
	(0.043)	(0.046)	(0.039)	(0.039)
$D^{collective}$*LNLABOR	0.149	0.150	0.159	0.162
	(0.036)	(0.039)	(0.033)	(0.033)
D^{mixed}*LNLABOR	0.190	0.205	0.190	0.189
	(0.044)	(0.034)	(0.023)	(0.022)
CFK	0.158	0.187	0.118	
	(0.162)	(0.166)	(0.117)	
HIND	-0.497	-0.478		
	(0.602)	(0.632)		
AGE	0.001			
	(0.002)			
Chi-squared	1.085	1.084	2.252	3.347
J-Test	0.955	0.982	0.945	0.911
L-Test	---	-1.000	0.558	0.520

Table A5 Euler equation estimation considering size impact – the enlarged sample

We estimate the Euler equation model based on a sample of industrial firms from a database maintained by the National Bureau of Statistics of China (NBS). The sample period is 2000-2004. After cleaning up the data, we obtain a balanced panel consisting of 27,689 firms for the period from 2001 to 2004. Nonlinear GMM estimation is done on the model in first differences with twice lagged instruments. α_1 and α_2 are adjustment cost parameters, and μ is a mark-up. $D^{private}$, $D^{collective}$, D^{mixed}, $D^{foreign}$, $D^{HK/TW}$ and D^{SOE} are dummy variables indicating a firm's ownership type. The estimated coefficient of ^{DSOE} is set to be zero. LNLABOR is the natural log of the number of the employees, CFK is the ratio of cash flow to total assets; HIND measures the industry-level Hirfindahl index; AGE refers to firm age. Standard errors are reported in parentheses. The p-values of the J-Test and L-Test on model specification are reported in the last two rows.

	1	2	3
α_1	0.015	-0.005	0.001
	0.052	0.035	0.028
α_2	-0.034	0.001	-0.007
	0.091	0.06	0.047
μ	0.997	0.998	0.994
	0.01	0.009	0.01
$D^{collective}$	-0.639	-0.924	-0.923
	0.519	0.238	0.193
D^{mixed}	-1.28	-1.315	-1.187
	0.348	0.295	0.185
$D^{private}$	-1.175	-1.074	-1.049
	0.367	0.284	0.224
$D^{HK/TW}$	-1.275	-1.237	-1.115
	0.253	0.214	0.11
$D^{foreign}$	-0.917	-0.995	-1.028
	0.185	0.114	0.08
LNLABOR	-0.17	-0.174	-0.172
	0.015	0.011	0.009
$D^{collective}$*LNLABOR	0.09	0.153	0.158
	0.112	0.048	0.04
D^{mixed}*LNLABOR	0.208	0.218	0.199
	0.06	0.049	0.034
$D^{private}$*LNLABOR	0.202	0.181	0.177
	0.071	0.054	0.042
$D^{HK/TW}$*LNLABOR	0.242	0.234	0.206
	0.06	0.05	0.028
$D^{foreign}$*LNLABOR	0.161	0.172	0.18
	0.036	0.026	0.018
CFK	0.034	0.023	
	0.034	0.025	
HIND	-1.339		
	2.097		
Chi-squred	1.208	2.219	4.633
J-test	0.877	0.818	0.592
L-test		0.315	0.180

Figure 1 The market of bank lending for SOEs

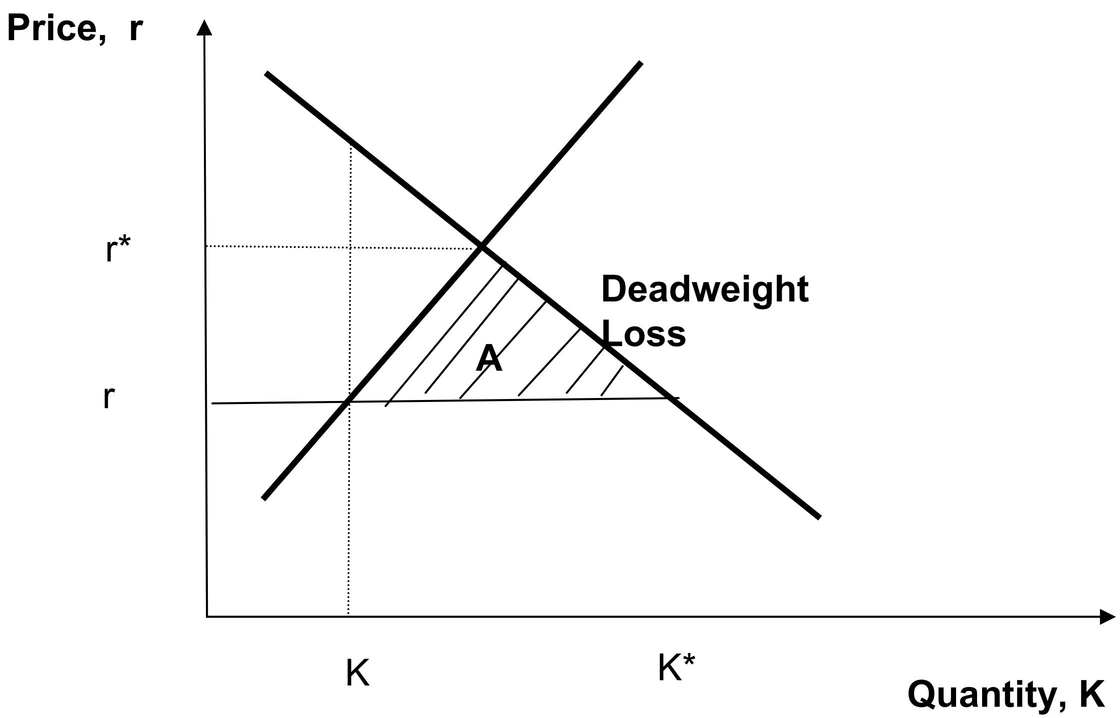

Figure 2 The market of bank lending for the private firms