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What Drives Fixed Asset Holding and Risk-Adjusted Performance of Corporates in China? An Empirical Analysis

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This paper attempts to shed light on the over-investment debate by investigating listed firms in China. Firms with a higher level of fixed asset holding and overhead expenses, and covered by preferential tax policies in China are found to be associated with lower risk-adjusted performance. In addition, the preferential tax policies encourage fixed asset investment. In contrast to some of the previous literature, state-ownership of firms, dividend policies, and ownership concentration are not robust predictors of risk-adjusted performance, and debt level, managerial shareholding, and profit per unit of asset are not robust predictors of fixed asset investments.

Keywords

Fixed asset holding; Corporate real estate; Over-investment theory; State-ownership; Tax-favor policy

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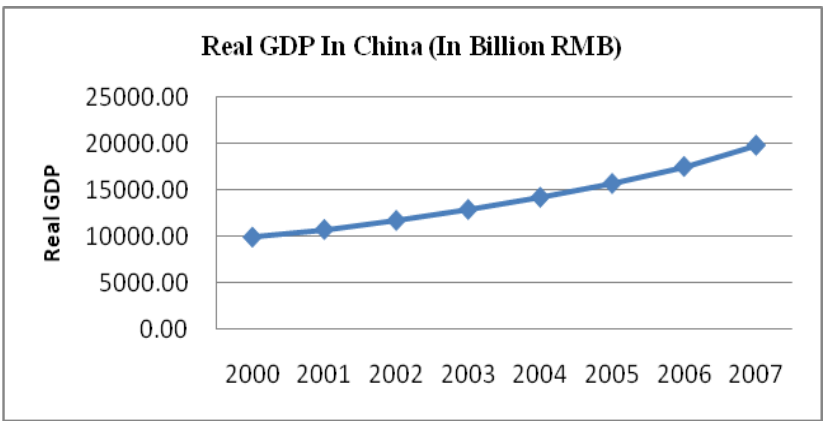
1. Introduction

This study is motivated by several strands of the literature. First, it is related to the phenomenal economic growth of China. Figure 1 demonstrates that after accounting for inflation, the real GDP of China has increased by almost 100% in less than a decade. Among the many explanations that have been suggested, the over-investment theory is among the few that has received attention in the media and academic circle.[1] For instance, several authors have mainly studied the issue from the domestic side, including Aziz and Cui (2007), Chinn (2006), Kuijs (2006), Liang (2006), and Makin (2006), among others. It would be fair to say that a consensus has yet to be reached.

Figure 1 Real GDP in China from 2000 to 2007 (in billion RMB)



Note: Year 2000 is calculated as the base year.
Data Source: China Statistical Yearbook 2009, compiled by the National Bureau of Statistics of China

The over-investment theory can also be approached from the firm side. The concept is very simple: if Chinese firms do indeed over-invest, then the corresponding rates of return on capital would be low. Bai et al. (2006) provide a careful empirical study on the return of capital in China and find that the return is not actually low, which seems to suggest that China may not be over-investing. Cooper (2006, pp. 97-98) argues that, among other factors, "China contains millions of people on the move and other millions who desire and are able to upgrade significantly the quality of their housing … agriculture still accounts for nearly half of the labor force. China still has a relatively low capital-labor ratio in the productive sectors and ample unskilled labor; *thus the investment boom may continue for some years without pushing*

[1] Clearly, it is beyond the scope of this paper to review the literature. Among others, see Chow (2002), and the references therein.

down rates of return". Blanchard (2006, p. 92), however, finds that "*private firms have much higher rates of return than state firms,*" which suggests that the over-investment theory might receive more support when the ownership structure of firms is taken into consideration. This paper will indirectly test these statements.

Many researchers in China have also joined the over-investment debate by studying the fixed asset investment behavior of companies listed on the Chinese stock market, as fixed asset investments arguably have more reliable data at the firm level. Wei (1999) and Zhao and Wang (1999) believe that there is no effective supervision in Chinese firms, which could result in over-investment in fixed assets. Yuan et al. (1999) suggest that because the cost of raising capital is relatively low, Chinese firms tend to over-invest in fixed assets. He and Ding (2001) have analyzed the fixed asset investment strategies of companies listed on the Shanghai stock market. They find that this decision is positively related to the cash flow volumes in these companies, instead of the volume of capital that firms can raise in the financial market. The analysis by Wei and Liu (2004) finds the same relationship between cash flow and fixed asset investment. In contrast, Quan, Jiang and Chen (2004) show that fixed asset investment in large and listed firms is less sensitive to cash flow. The empirical work of Jiang and Sheng (2005) suggests that company debt will not constrain the asset investments of firms in most cases.

In light of these contributions, this paper attempts to complement the literature by focusing on fixed asset investments in China at the firm level. From casual observations and our private correspondence with industry participants, it seems that corporate real estate (CRE) constitutes a major share of the fixed assets. The reasons are easy to envisage. As documented by Gordon (1990), and Greenwood, Hercowitz and Krusell (1997), the real price of capital goods (adjusted for efficient units) has a clear downward trend. This means that the value of capital goods (such as machines and equipment) experience both physical depreciation (due to wear and tear) and economic depreciation (due to price drops). In contrast, land and property values in China have displayed an upward trend in recent years. In addition, the composition of fixed assets (CRE versus equipment) is itself endogenous, and the real estate boom in China seems to encourage corporations to shift more resources to CRE instead of equipment. In fact, the issue is so serious that the Chinese government recently ordered 78 state-owned enterprises, whose core business is not in the real estate sector, to withdraw from the real estate market (Hong Kong Economic Journal, 2010). Thus, throughout this paper, we will use "fixed asset investment" and CRE interchangeably, although conceptually, they are clearly different subjects.[2]

[2] An anonymous referee correctly pointed out that machinery and corporate real estate are different subjects. On the other hand, from a theoretical point of view, the two share several common features. They are "inputs" of the production process. They can serve as "collateral," at least for bank borrowing. They can be resold to other firms

This paper attempts to shed light on several research questions. First, do fixed asset investments enhance (or damage) the performance of firms? For instance, if a higher share of fixed asset investments is found to be associated with a lower level of performance or with efficiency measures, then it would be consistent with the "over-investing" theory. Second, this paper will study the determinants of fixed asset investments in Chinese firms. For instance, is the behavior of Chinese firms consistent with the pattern previously reported in the literature, based on data from the United States? Does a particular institutional setting (such as state-ownership) or policy (such as tax policy) play a role? This paper attempts to shed light on these questions.

There are several additional benefits for studying fixed asset investments. First, relative to investment in research and development, investment in fixed assets is easier to measure. It is also easier to compare across firms from different sectors. While Cooper (2006), among others, suggests that China will continue to experience an investment boom, our firm-level approach should help us to assess whether particular kinds of firms tend to invest more than others. Moreover, fixed asset investments also seem to be a very important component of the total investments in a typical firm in China.

In addition, it may be related to the macroeconomic activities. As CRE typically constitutes a significant share of "fixed asset investments," and real estate can serve as collateral for bank lending, the fluctuation of real estate prices have the potential to influence the lending capacity of corporates and hence, macroeconomic activities, as demonstrated recently by Jin et al. (2010). Thus, this study of CRE may also contribute to our understanding of the borrowing behavior of Chinese firms. Even though investment data are not accessible to us, as China has not yet adopted the "mark-to-the-market" principle in accounting, the asset holding data could well reflect the investment pattern of different firms, thus analysis of these data would still shed light on the relevant issues.

2. Why Hold Fixed Assets?

A standard economic theory would suggest that whether a person rents or owns does not matter, as long as the capital market is perfect. However, if the

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through the secondary market. And, as we argue in the paper, since corporate real estate tend to appreciate in value (especially in China), and machines tend to depreciate over time, the importance of corporate real estate in the "fixed asset holding" will increase over time. Recently, Jin et al. (2010) also use "corporate real estate" as a proxy for "fixed asset holding" and find that it is very important in explaining both the business cycle dynamics as well as housing market dynamics. Thus, interchangeably using CRE and "fixed asset holding" may be a compromise given the data limitation.

capital market is imperfect, which may indeed be the case in China, firms may prefer to rent rather than own a fixed asset because they may prefer to maintain some level of cash flow to self-insure against possible liquidity risks in the future.[3] Thus, firms with growth opportunities or facing severe financial constraints may prefer to rent rather than own fixed assets.

On the other hand, there are also reasons why companies may prefer to hold fixed assets. First, a rental market may not yet be established, hence firms are forced to own certain assets (for instance, special machinery) if they need to employ them. In addition, there is a tax advantage. Investment in fixed assets can be tax-exempted. To encourage economic growth, the Chinese government published "The contemporary law for tax adjustment of the fixed-asset investment in different industries in China" in 1999. This law gives a lower value-added tax rate for certain industries (such as manufacturing, petroleum, cars, agriculture, technology innovation, shipping, metallurgy, etc.) that are perceived to play an important role in economic growth. Some fixed-asset investment items from these industries are subject to only a 5% tax, or even no tax, while comparable investments in other industries would be subject to a 50% tax.

The demand for fixed asset holding may also be driven by the production mode. Some industries, such as manufacturing, may prefer to hold more fixed assets. Moreover, very few Chinese listed companies distribute dividends, which enable them to invest even more. Finally, in the Chinese stock market, many listed companies have high state-ownership. Historically, state-owned firms are perceived to be more likely to acquire fixed assets. This perception is consistent with the results of Blanchard (2006). Later on, we will examine whether this impression is still true in our data.

Another reason may be related to the recent boom in the real estate market in China. For instance, Peng et al. (2008) find that "the property price index for Shanghai increased by an average of about 13% per annum in 2001–2004". Figure 2 displays the ratio of house prices relative to the GDP. It shows that, at the national level, house prices have increased at least as fast as the GDP. In other words, real estate investment can be a good "hedge." Thus, some firms may have an incentive to acquire real estate as part of their fixed asset investment.[4, 5]

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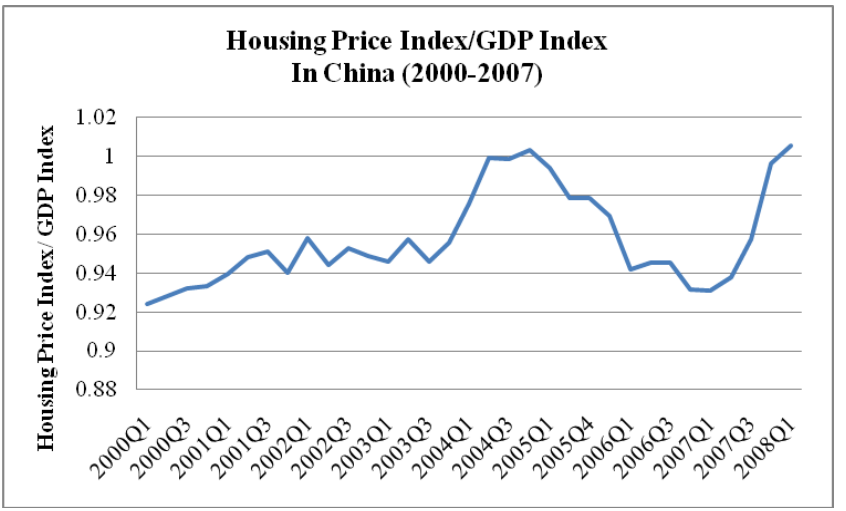
[3] Among others, see Gorton (2010) for more discussion on this issue.

[4] Throughout this paper, we will interchangeably use the term "properties" and "real estate". Henceforth, we will also abuse the vocabulary slightly to assume that "real estate" includes both "buildings" and "land."

[5] Needless to say, if most firms attempt to buy real estate now to hedge the risk of even higher prices in the future, it may lead to a self-fulfilling price increase in real estate. This paper focuses on the firm level analysis and leaves this question for future research. For an analysis of the China housing markets, see Leung and Wang (2007), Leung et al. (2010), and Wu, Gyourko and Deng (2010), among others.

Figure 2 Housing Price Index/ GDP Index in China from 2000 to 2007



Note: Both the Housing Price Index and GDP index are nominal indexes.
Data Source: Online dataset of the National Bureau of Statistics of China: http://www.stats.gov.cn/tjsj/

3. Data and Empirical Strategy

Following recent Chinese research which focuses on micro data, this paper also concentrates on the efforts of corporate level data.[6] The data used in this study were collected from the China Stock Market and Accounting Research Database (CSMAR), which is based on annual reports and employed by several recent researchers. Our sample consists of companies listed on the Shanghai and Shenzhen stock exchanges throughout the years 2003 to 2007. Because the annual reports of listed firms are usually audited by world-renowned accounting agencies, the data used in this paper carry some credibility.[7] Missing annual reports and observations in the CSMAR reduce the sample size. Also, one firm with negative assets is dropped from the sample. Therefore, our full sample consists of 1218 companies and 5512 firm-year observations. Subsample 1 contains 4625 observations, which are firms with positive profits only, and Subsample 2 contains 3978 observations,

[6] Allen et al. (2005), Calomiris et al. (2010), Cull and Xu (2005), Fan et al. (2007), Firth et al. (2006), Gul et al. (2010), and Jiang et al. (201), among others. The data source of our paper and theirs are very similar, and in some cases, exactly identical.
[7] The accounting year for listed firms in China is from January 1 to December 31. Foreign firms are not subject to this rule, and excluded from our sample. Thus, all firms in our sample have the same accounting year, which facilitates the comparison.

which are firms with positive efficiency only. The detailed definitions are provided in Table 1. It is clear that by construction, firms with positive efficiency will have positive profit in the first place.

Table 1 List of Variables

Variable Name	Explanation
CDs	Cash dividend (dummy variable 0=no dividend, 1=dividend)
CR	Percent of shares held by top 10 shareholders/total shares
DEBT	Debt/total asset
DUAL	1= CEO and chairman are the same person; otherwise 0.
EFFICIENCY	(profit-depreciation-tax + interest payment)/ (fixed asset holding + inventory)
EPS	Net profit divided by total shares
FAH	Fixed assets/total assets
JENSEN ALFA	Jensen's alpha = Portfolio Return - [Risk Free Rate + Portfolio Beta * (Market Return - Risk Free Rate)]
LNPAY	LNPAY = Ln (total annual remuneration of current board of directors and senior managers)
MSR	Managerial shares/total shares
OE	Overhead expenses
ROA	Return of asset = profit/total asset
SH	SH=1 if the firm is listed on the Shanghai Stock Exchange SH=0 if the firm is listed on the Shenzhen Stock Exchange
SIZE	Size = Ln (asset)
STO	State owned shares/total shares
TAXFAVOR	TAXFAVOR=1 if this industry has received a special preferential tax treatment on investment, 0 otherwise. The preferential tax scheme is applied to industries such as manufacturing, petroleum, cars, agriculture, technology innovation, shipping, and metallurgy.

We have collected information on fixed asset holding, debt ratio, sales (income), profit/total assets, state-ownership, salaries of senior managers/ incomes, dividends, CEOs/chairmen, industries, etc. These variables are included for sound economic reasons. As Du et al. (2007) explain in detail, managers may not invest to maximize returns for investors, but might instead use investments for private benefits, including "empire building" or other private motives. Thus, it is necessary to include some corporate governance variables in firm-level empirical analyses. The rationale is simple. If the senior management has only minor share ownership, the private cost of their inefficient investment may be small. Similarly, if firms are cash-constrained or

reserving cash for other investments, they may be less willing to buy CRE. However, firms may be able to finance their real estate investment through long-term debt, as the real estate can be used as collateral. As a result, we would expect a positive association between the holding of CRE and long-term debt holding. Due to space limitations, we refer interested readers to Du et al. for a more extensive discussion and literature review.

We will first present some summary statistics to provide an overview of the dataset; these are shown in Table 2a.[8] To establish the robustness of our results, note that we have three samples: the full sample, Sub-sample 1, and Sub-sample 2. For most variables, such as the CDs, CDR, debt, dual, Jensen's alpha, etc., there are very few changes across different samples. Needless to say, there are exceptions. For the efficiency variable, once we restrict our attention to firms with positive efficiency, the mean is much closer to zero, and the standard deviation shrinks dramatically from 776 (full sample) to 53 (Sub-sample 2). The earnings per share (EPS) variable (net profit per share) increases from about 0.23 (full sample) to about 0.46 (Sub-sample 2). Table 2b also summarizes the expected sign of different variables in the Jensen's alpha regression.

It may be instructive to recall our research questions.

(1) Do firms in China "over-invest" in their fixed asset investments (FAH)? Are the risk-adjusted performances of firms affected by the FAH?

(2) Do preferential tax policies lead to more FAH in the targeted industries?

(3) What are the other determinants of FAH in Chinese firms?

To approach the CRE problem, as Du et al. (2007) explain, some econometric issues need to be resolved. Clearly, since this dataset includes all listed firms in the Chinese stock market over a period with significant economic development in China, serious heterogeneity issues may arise. In particular, firm-fixed and time-specific effects may be present in the dataset. Ignoring their presence may lead to significant bias, as explained by Hsiao (2003). Recently, Hsiao and Tahmiscioglu (2008) show that through data transformation, it is possible to "eliminate" both the firm-fixed and time-specific effects, and obtain an unbiased estimator. To our knowledge, this is the first study which employs this new technique in the panel data method. Therefore, some additional details are presented in Appendix I. We will present econometric data based on the original data and the "adjusted data."

[8] In the original sample, there is one firm which shows negative assets. Because it is not clear on how we should interpret this issue, we simply removed the firm from the sample and find that the summary statistics are virtually unchanged.

Table 2a Summary Statistics

	Full Sample	(No. of Obs.=5512)	Subsample 1 (Firms with Positive Profit)	(No. of Obs.=4625)	Subsample 2 (Firms with Positive Efficiency)	(No. of Obs. = 3978)
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
CDS	.3512337	.4773991	.3496216	.476902	.3944193	.488787
CR	58.03741	13.92745	57.93693	13.91901	58.3164	13.9843
DEBT	.0724802	.1138099	.0724066	.1077405	.0727111	.0962747
DUAL	.1139332	.3177599	.1161081	.3203892	.1128708	.3164746
EFFICI-ENCY	-10.28485	776.8082	-12.2621	848.026	1.077584	53.14381
EPS	.2278429	3.212522	.2714032	2.458388	.4588386	2.412534
FAH	.3145689	.1878599	.3163736	.1885543	.3147734	.1894271
JENSENALPHA	-.0235673	.0265477	-.0233436	.0246684	-.0228784	.0260667
LNPAY	14.005	.8578241	14.00087	.8586776	14.08471	.8351003
MSR	.0001087	.0013332	.0001185	.0014522	.0001287	.0015637
OE	18.10016	1.078647	18.09175	1.067724	18.08334	1.065607
ROA	-.3739496	28.91251	-.4475944	31.56331	.0529499	.5772647
SIZE	21.3172	1.07632	21.30929	1.066255	21.40118	1.031131
SH	.6139332	.4868904	.6004324	.4898624	.6136249	.4869795
STO	.3255011	.246879	.3241886	.2463527	.3298115	.2469107
TAXFAVOR	.6373367	.4808124	.6402162	.4799888	.6420312	.4794632

Table 2b Expected Sign of Different Variables on Jensen's Alpha Regression

Variables	Expected Sign
FAH	Negative if firms over-invest; Positive if tax-advantage effect dominates
STO	Negative if state-owned firms are inefficient; Positive if state-owned firms have competitive advantage
CDS	Positive if dividend-paying signals firm profitability; Negative if non-dividend-paying signals good growth opportunities and there is a significant external finance premium
DUAL	Positive if un-monitored managers tend to over-invest
MSR	Positive if managers have private incentive to over-invest
OE	Negative if managers over-compensate themselves
CR	Positive if the major shareholders solve the free-rider problem in corporate governance
SIZE	Negative if the firm exhibits diminishing marginal returns to scale; Insignificant if the firm exhibits constant returns to scale
TAXFAVOR	Positive if the preferential tax policies enhance performance; Negative if the preferential tax policies encourage over-investment
_CONS	(theories do not provide any predictions on the intercept term)

Another issue is endogeneity and causality. It may be that firms that are inefficient, or managers who are uncompetitive, choose to heavily invest in real estate, as their opportunity costs are arguably lower. It may also be the other way around: previous heavy investment in CRE may constrain firms to make more profitable investments. Because the real estate market is relatively illiquid, firms may be "trapped" in past "mistakes" with over-investment in real estate. However, as the time span of our data is relatively short, it is unlikely that our data set would be able to resolve this causality question. To remain neutral on this issue, we adopt a probit model, which only indicates the likelihood of the occurrence of certain phenomena, given a particular set of variables. As a comparison, we also ran an ordinary least squares (OLS) regression; however, as the results are similar, and OLS may be subject to more econometric doubts, we will present only the results from the probit model. In the text, we will mainly present the results with all firms included. In Appendix II, which will be available upon request, we have removed all "real estate firms" and re-run all the regressions.[9] We find that the results are

[9] The full version of this paper will be available from IDEAS, http://ideas.repec.org/

indeed very similar. Thus, we will focus on the discussion on the "all firm case" in the text.

Except for "data adjustment," our econometric strategy is fairly standard, to facilitate comparison with the literature. To address research questions (1) and (2), we follow the finance literature in using Jensen's alpha as a risk-adjusted measure of performance. Table 3 presents the probit model for the firm-level Jensen's alpha across different samples. Clearly, other things being equal, a higher share of FAH in the total asset is associated with a *lower* value of Jensen's alpha (statistically significant in 5 of the 6 cases considered). In other words, it seems that investment in more fixed assets does adversely affect the performance of corporations in China. Moreover, we find that the dummy variable for industrial preferential tax treatment is associated with a *lower* value of Jensen's alpha (statistically significant in 5 of the 6 cases considered). Thus, the tax policy does not seem to bring any immediate benefits to the shareholders. Furthermore, in 4 out of the 6 cases, a higher level of overhead expenses (OE) is associated with a *lower* level of Jensen's alpha, which seems to be consistent with the agency theory, as higher levels of OE often means higher levels of subsidy to the senior management.[10]

While these variables show a consistent pattern in their relationship with corporate performance, this is not the case for some other variables. For instance, with the original data, a higher level of state-ownership is *always* associated with a *higher* Jensen's alpha, which makes state-ownership a *positive* factor. However, after the firm-fixed and specific- time effects are taken into consideration, a higher level of state-ownership is *always* associated with a *lower* Jensen's alpha, which makes state-ownership a *negative* factor. Similarly, the coefficients of the cash dividend dummy are always statistically significantly and *positive* in the Jensen's alpha regression with the original data. However, it is consistently statistically significant and *negative* after the firm-fixed and time-specific effects are taken into consideration. The same phenomenon also occurs in the case of CR, which measures ownership concentration by the proportion of shares held by the top 10 shareholders. With the original data, the coefficients are always statistically significant and *positive*, which suggest that a higher concentration of ownership will enhance the risk-adjusted measure of performance of corporations. However, after adjusting for the firm-fixed and time-specific effects, the coefficients are always statistically significantly and *negative*, which suggest that a higher concentration of ownership actually depresses the risk-adjusted performance for firms in China.

[10] Senior managers in China, especially in state-owned enterprises, usually do not receive high salaries. Nonetheless, their private expenses, such as meals, transportation, holidays, and shopping, can be covered by company expenses. Thus, OE can be interpreted as the hidden income of senior managers. In Chinese academic circles, it is often regarded as a proxy for management costs. A high OE will lead to a lower level of efficiency.

Table 3a Jensen's Alpha and FAH[11] (All Firms Included)

	Full Sample	Sub-Sample1 (Firms with Positive Profit)	Sub-Sample2 (Firms with Positive Efficiency)	Full Sample Adjusted	Sub-Sample1 Adjusted (Firms with Positive Profit)	Sub-Sample2 Adjusted (Firms with Positive Efficiency)
JENSEN ALPHA	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
FAH	-.163898*	-.1778505*	-.0537834	-4.61e-08***	-4.13e-08***	-4.16e-08***
STO	.3557752***	.319256***	.3114815***	-.012302***	-.0100149***	-.0101054***
CDS	.5520284***	.5244555***	.4379631***	-.4192785***	-.406408***	-.4684545***
DUAL	-.0119715	.0037015	.0522378	-.2009325***	-.1793014***	-.2206937***
MSR	14.16026	13.43497	10.34369	-.7778318***	-.8047145***	-.6931924***
OE	-.0489703**	-.0582657**	.0441247	-.0343929**	-.0313704**	.0079563
CR	.0137678***	.0131211***	.0132469***	-.0069947***	-.0056688***	-.006745***
SIZE	.0015995	.0135847	-.0695877**	.0341305*	.0268192	.013374
TAXFAVOR	-.0954043***	-.1321726***	-.1698788***	-.0406806	-.0756741*	-.0990798**
_CONS	-.0481067	-.0727276*	-.1658069	-.639573**	-.4747125	-.7852838**
R^2	0.0613	0.0561	0.0495	0.0310	0.0293	0.0309
Number of Obs.	5512	4625	3978	5512	4625	3978

Notes*:** "Coeff." Stands for coefficient, "CONS" stands for the intercept term in the regression. "Sample" means the original data. "Sample adjusted" means that both the firm-fixed and time-specific effects are removed through data-transformation."" significant at the 1% level; "**" significant at the 5% level; "*" significant at the 10% level.

[11] This table provides the results for whether a higher level of fixed asset holding leads to a lower level of risk-adjusted performances of firms.

To provide a tentative summary, these results seem to suggest that, while the level of state-ownership, dividend policies of firms, and concentration of ownership are all important factors, their effects may not be as robust as some previous authors had thought. This may also be related to our interpretation of the firm-fixed and time-specific effects. Nonetheless, these results may also justify why we should focus on the holdings of fixed asset investments and the preferential tax policies, which seem to give more robust results. As the main focus of this paper is on fixed asset investments, we simply present these results and leave further exploration to future research.

Thus far, we have followed the literature and pooled the firms listed on the Shanghai and Shenzhen markets together. However, it is possible that the firms listed on the two markets are different. For instance, very large Chinese firms tend to be listed on the Shanghai rather than Shenzhen market. Some people argue that the liquidity in the Shanghai market is higher, while others argue that firms are listed on the Shanghai market only if they have certain connections. For our purposes, it is sufficient to test whether the listing decision may affect the risk-adjusted performances of firms. Therefore, we introduce one more dummy variable, SH, which takes the value of one if the firm is listed in Shanghai, and zero if it is listed in Shenzhen. We re-run the regression and the results can be found in Appendix II, which will be available upon request. Most results are preserved with a few notable differences. First, after controlling for the firm-fixed and time-specific effects, the coefficients for DUAL (which takes the value of one when the chairman of the company and the CEO are the same person, and zero otherwise) are statistically significant and *negative*. This is consistent with Du et al. (2008), who find that better corporate governance (which in this case means that the chairman and the CEO are different people) will improve the risk-adjusted performances of firms. In addition, other things being equal, the coefficients of the Shanghai dummy are always statistically significant and *negative*. This is consistent with the conjecture that the Shanghai market provides a higher level of liquidity, and hence investors would accept a lower return. It is also possible that being listed on the Shanghai market may incur additional costs to the firm (such as a financial contribution from the firm to Shanghai city, or the need to provide more subsidies to senior managers in the form of "overhead expenses", etc.), which lead to a lower Jensen's alpha value. Since our focus is on fixed asset holding, it is sufficient for us to know that the introduction of the Shanghai dummy does not affect our principal results, and we will leave the explanation of the negative coefficient for future research.

It may be argued that Jensen's alpha is the not the most appropriate measure. Jensen's alpha is a risk-adjusted measure of firm performance, but we are more interested in the investment risk, which is measured by "beta." To address this concern, we repeat our analysis, with Jensen's alpha replaced by "beta risk." Table 3b reports the results of the baseline cases. The results when the Shanghai-listing dummy is included can be found in Appendix II. It is

clear that FAH is statistically and negatively related to beta, meaning that an increase in the proportion of fixed assets to total assets is associated with a decrease in the systematic risk (which is beta). However, after controlling for the time-specific and firm-fixed effects, the statistical significance disappears. It seems that there are important idiosyncratic factors which affect firm performance.

To address research question (3), we run another probit regression and present the results in Table 4. As real estate and other fixed assets are typically illiquid, it is not surprising that the FAH for the previous period is a very consistent predictor of the FAH for the current period. The statistical significance and positivity of the coefficients across all six samples are in some ways expected. Once again, the coefficients of the dummy variable for the preferential tax policies are statistically significant and positive across all six samples. Combined with the results from the previous table, this means that the preferential tax policy encourages those industries to invest more in fixed assets, which on its own, tends to be associated with lower levels of risk-adjusted measures of firm performance. In addition, even controlling for the effect of FAH, the preferential tax policy exerts a direct and negative effect on Jensen's alpha. Thus, the *preferential tax policy* both directly and indirectly *suppresses firm performance*.

For other variables, the results do not seem to be as clear. For instance, the coefficients of DEBT are statistically significant and *positive* for the original data, which mean that a higher debt ratio relative to total assets is associated with a higher ratio of fixed asset investments relative to the total assets. However, after the firm-fixed and time-specific effects are taken into consideration, the coefficients become *negative* and statistically significant. Similarly, the coefficients of STO are statistically significant and *positive* for the original data, which mean that a higher level of state ownership is associated with a higher proportion of fixed asset investments relative to the total assets. However, once the firm-fixed and time-specific effects are adjusted for, the coefficients become *negative* and the statistical significance is unfortunately lost. Other variables that fail to deliver robust results include the ROA (the amount of profit for each unit of asset), managerial shares/total shares (MSR), and the cash dividend dummy (CD). In the appendix, we provide supplementary regressions and the qualitative results seem to be unaffected. The most consistent (and positive) factors to explain fixed asset investments are the previous FAH (which only confirms the persistence of FAH) and tax preferential policies. Other variables are still subject to changing signs or even the disappearance of statistical significance. It suffices to say that further research is needed to gain a better understanding of the determinants of FAH

Table 3b Beta Risk and FAH[12] (All Firms Included)

	Full Sample	Sub-Sample1 (Firms with Positive Profit)	Sub-Sample2 (Firms with Positive Efficiency)	Full Sample Adjusted	Sub-Sample1 Adjusted (Firms with Positive Profit)	Sub-Sample2 Adjusted (Firms with Positive Efficiency)
BETA	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
FAH	-.4255677***	-.3642361***	-.392987***	2.18e-09	1.14e-10	-3.25e-09
CDS	.4993897***	.5193864***	.5541423***	-.0087488***	-.0076805***	-.0058359***
CR	.1176989***	.1438711***	.1873342***	-.2682122***	-.2777139***	-.278463***
DUAL	-.1614423***	-.1687806***	-.1711631***	-.2421135***	-.2788603***	-.3128901***
MSR	-4.304198	-4.823651	-1.683752	-.1645115**	-.1647322**	-.2811378***
OE	.0067303	.0120698	-.0795636***	.0055014	.0031437	-.0213946
SIZE	.0055279***	.0048857***	.0043481***	-.0099774***	-.0095362***	-.0083438***
STO	-.0341947	-.0573121**	.0132534	.0404164**	.027638	.0364093
TAXFAVOR	.0161199	.0069503	.0425231	.0416346	.0441332	.0688012
_CONS	.3169	.7394963	.8314517	-.9243672***	-.5598455*	-.3545901
R^2	0.0183	0.0187	0.0222	0.0121	0.0119	0.0122
Number of Obs.	5512	4625	3978	5512	4625	3978

Notes*:** "Coeff." Stands for coefficient, "CONS" stands for the intercept term in the regression. "Sample" means the original data. "Sample adjusted" means that both the firm-fixed and time-specific effects are removed through data-transformation. "" significant at the 1% level, "**" significant at the 5% level, "*" significant at the 10% level.

[12] This table provides the results for whether a higher level of fixed asset holding leads to a lower level of beta risk for firms.

Table 4 Determinants of FAH[13] (All Firms Included)

	Full Sample	Sub-Sample1 (Firms with Positive Profit)	Sub-Sample2 (Firms with Positive Efficiency)	Full Sample Adjusted	Sub-Sample1 Adjusted (Firms with Positive Profit)	Sub-Sample2 Adjusted (Firms with Positive Efficiency)
FAH	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
L.FAH	2.363007***	2.37265***	2.480684***	2.386947***	2.387394***	2.471456***
DEBT	2.779517***	2.824479***	3.332848***	-.0771508***	-.1034453***	-.1235553***
ROA	.0015126	.0016081	-1.898716*	.0323866	.0428799*	.0771072**
MSR	-11.40781	38.62567	44.88193*	-.062224	.11021	.0352122
CDS	.097039*	.0900744	.2251664***	-.0714108	.0093584	.0554001
CR	.0000812	.0001766	.0002307	-.0046531	-.0039951	-.0044184
TAXFAVOR	.2856874***	.2713558***	.2750976***	.2952355***	.2905104***	.3006526***
STO	.589395***	.6358339***	.5885134***	-.0065187	-.005776	-.0047251
_CONS	-1.894962***	-1.916912***	-2.036388***	-3.27983***	-3.78276***	-4.279727***
R^2	0.5174	0.5162	0.5505	0.4951	0.4936	0.5218
Number of Obs.	3907	2763	2132	3907	2763	2132

Notes: "Coeff." Stands for coefficient, "CONS" stands for the intercept term in the regression. "Sample" means the original data. "Sample adjusted" means that both the firm-fixed and time-specific effects are removed through data-transformation. "***" significant at the 1% level, "**" significant at the 5% level, "*" significant at the 10% level.

[13] This table provides the results for how the level of fixed asset holding of firms are related to some corporate level variables, such as whether the firm pays dividends, the amount of debt, whether the firm belongs to industries that receive preferential tax treatment, etc.

To examine the possibility that the firms listed in Shanghai are intrinsically different from those listed in Shenzhen, we again introduce the Shanghai dummy and re-run the regression. As shown in Appendix II, the qualitative results are the same as in Table 4 (without the Shanghai dummy). In fact, the Shanghai dummy is never statistically significant. This suggests that listing in Shanghai per se does not affect fixed asset investment behavior. If the risk-adjusted measure of firm performance is indeed affected, it must be through some other channel. Again, we contend that the listing decision does not affect fixed asset holding and leave other issues for future research.

4. Conclusion

This paper is motivated by the over-investment theory (or over-investment debate), which attempts to explain the phenomenal economic growth of China. Our data set spans the period 2003 to 2007, and covers more than 1,000 listed firms in China. Our principal findings are that: (1) a higher proportion of fixed asset investments is associated with a lower level of Jensen's alpha, which suggests that CRE and other types of FAH may not enhance firm performance in the stock market after adjusting for risk; (2) the industries that are favored by "The contemporary law for tax adjustment of the fixed-asset investment in different industries in China" issued in 1999, are associated with a lower Jensen's alpha, which suggest that the law may potentially damage firm performances (after adjusting for risk); (3) the previous FAH period and the dummy variable for industrial preferential tax treatment are the only robust determinants of the current period fixed asset holding (FAH), which indicate that industries are favored by the law mentioned previously. Clearly, (1) is consistent with the findings of Du et al. (2008), which were based on U.S. data, while (2) and (3) together seem to confirm the conventional wisdom in the public finance literature that tax favors may do more harm than good, at least in the financial market. The law does encourage fixed asset investments, but an increase in such does not deliver better performance at the firm level (after adjusting for risk).

The result reported in the previous literature, which suggests that state-ownership of firms may encourage FAH and dampen risk-adjusted firm performance, is only partially confirmed in this updated dataset. It seems that whether or not the firm-fixed and time-specific effects are corrected for, will crucially affect the results. Other variables, including the dividend policy of firms, concentration of ownership, and the managerial proportion of share holdings, all suffer from the same issue. In other words, an increase in the proportion of fixed asset investments need not be associated with a decrease in risk-adjusted firm performances. We are aware that our results are at odds with some of the earlier literature on Chinese corporate investment. This may be because we are using more up-to-date data. It may

also be due to the fact that our econometric strategy, which is based on the recent work of Hsiao and Tahmiscioglu (2008), allows us to take into consideration both the firm-fixed and time-specific effects simultaneously. Clearly, more research is needed to clarify these points.

To deepen our understanding of corporate investment, it would be helpful to conduct a cross-country comparison. Theoretical work would also be instructive. Some of these ideas are currently being pursued.

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Appendix IA Data Transformation to Overcome both the Firm-Fixed and the Time-Specific Effects

The exposition here mainly follows Hsiao and Tahmiscioglu (2008).

Suppose that the data-generating process is captured by the following equation (*)

$$y_{it} = \alpha_i + \lambda_t + \rho y_{i,t-1} + X_{it}\beta + \varepsilon_{it}$$

where X_{it} is a vector of explanatory variables, α_i and λ_t are the (unobservable) firm-fixed and the time-specific effects, respectively.

Now we need a few definitions. For any variable z_{it}, the time-average of z_{it} is defined as $\bar{z}_i = \left(\sum_{t=1}^{T} z_{it}\right)/T$, and the cross-sectional average of z_{it} as $\bar{z}_t = \left(\sum_{t=1}^{N} z_{it}\right)/N$.

From (*), we can take the cross-sectional average of the whole equation and get (*1)

$$\bar{y}_t \equiv \left(\frac{1}{N}\sum_{i=1}^{N} y_{it}\right) = \bar{\alpha} + \lambda_t + \rho\bar{y}_{t-1} + \bar{X}_t\beta + \bar{\varepsilon}_t$$

where $\bar{\alpha} \equiv \frac{1}{N}\sum_{i=1}^{N}\alpha_i$, $\bar{y}_{t-1} \equiv \frac{1}{N}\sum_{i=1}^{N} y_{i,t-1}$, $\bar{X}_t = \frac{1}{N}\sum_{i=1}^{N} X_{it}$, $\bar{\varepsilon}_t \equiv \frac{1}{N}\sum_{i=1}^{N}\varepsilon_{it}$

Similarly, we can take the time average of the whole equation and get (*2)

$$\bar{y}_i \equiv \left(\frac{1}{T}\sum_{i=1}^{T} y_{it}\right) = \alpha_i + \bar{\lambda} + \rho\bar{y}_{i,-1} + \bar{X}_i\beta + \bar{\varepsilon}_i$$

where $\bar{\lambda} \equiv \frac{1}{T}\sum_{t=1}^{T}\lambda_t$, $\bar{y}_{i,-1} = \frac{1}{T}\sum_{t=1}^{T-1} y_{i,t}$, $\bar{X}_i = \frac{1}{T}\sum_{t=1}^{T} X_{it}$, $\bar{\varepsilon}_i \equiv \frac{1}{T}\sum_{t=1}^{T}\varepsilon_{it}$

Finally, we can take both the time and cross-sectional average of the equation (*) and get (*3)

$$\bar{y} \equiv \left(\frac{1}{NT} \sum_{i=1}^{N} \sum_{t=1}^{T} y_{it} \right) = \frac{1}{N} \sum_{i=1}^{N} \bar{y}_i = \frac{1}{T} \sum_{t=1}^{T} \bar{y}_t = \bar{\alpha} + \lambda + \rho \bar{y}_{-1} + \bar{X}\beta + \bar{\varepsilon}$$

where $\bar{y}_{-1} = \frac{1}{N} \sum_{i=1}^{N} \bar{y}_{i,-1}$, $\bar{X} = \frac{1}{N} \sum_{i=1}^{N} \bar{X}_i$, $\bar{\varepsilon} = \frac{1}{N} \sum_{i=1}^{N} \bar{\varepsilon}_i$.

Then, if we subtract (*1) and (*2) from (*), and add back (*3), we get (**).

$$(y_{it} - \bar{y}_i - \bar{y}_t + \bar{y}) = \rho(y_{i,t-1} - \bar{y}_{i,-1} - \bar{y}_{t-1} + \bar{y}_{-1}) + (X_{it} - \bar{X}_i - \bar{X}_t + \bar{X})\beta + (\varepsilon_{it} - \bar{\varepsilon}_i - \bar{\varepsilon}_t + \bar{\varepsilon}),$$

which is in the form

$$\Theta_t = \rho \Theta_{t-1} + \Omega_t \beta + \Xi_t .$$

Notice that ***both*** the firm-fixed effect α_i, and the time-specific effect λ_t are eliminated.

Moreover, we observe that Θ_t, Ω_t, Ξ_t are all serially correlated, and

$$E(\Theta_t \Xi_t) \neq 0, \quad E(\Omega_t \Xi_t) \neq 0,$$

which implies that the OLS estimate of (**) will be biased. We will instead use GLS for (**) and the probit model.

Appendix IB Summary Statistics by Industry

	No. of Firms	Avg. Size (Real Value)	Skewness of Size	Avg.FAH	Avg. State Ownership	Jensen's Alpha
X1 Agriculture	120	1.64e+09	1.200635	0.255079	.3360117	-0.02391
X2 Mining Industry	81	3.50e+10	3.828829	0.461056	.4792746	-0.01892
X3 Manufacture	3182	2.99e+09	12.19938	0.320415	.3407569	-0.02252
X4 Energy	249	7.40e+09	4.550773	0.525603	.4120958	-0.02448
X5 Construction	107	3.75e+09	2.196678	0.196786	.4252596	-0.02456
X6 Transportation, Warehousing	241	6.82e+09	3.690077	0.504383	.4105065	-0.02229
X7 Communication	346	3.11e+09	9.63609	0.171273	.2201142	-0.02437
X8 Whole Sale and Retail Business	403	2.29e+09	4.931087	0.327243	.2956939	-0.02513
X9 Financial Firms	18	1.02e+09	1.468129	0.329371	.383003	0.027178
X10 Real Estate	236	3.75e+09	9.447016	0.105312	.2610726	-0.02148
X11 Service	165	2.75e+09	1.483072	0.389084	.3491345	-0.02264
X12 IT and Entertaining	43	1.54e+09	1.38333	0.326644	.2083465	-0.02329