Negative investment in China: restructuring and financing constraints versus growth

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Abstract This paper attempts to address the seemingly puzzle of China's investment pattern: despite the high aggregate investment, a high rate of negative investment is found at the microeconomic level. Using a large firm-level dataset, we test three hypotheses of negative investment among various ownership groups: the financing explanation, the efficiency explanation, and the growth explanation. Our panel data Probit estimation shows that the negative investment by state-owned firms can be explained mainly by inefficiency: owing to over-investment or mis-investment in the past, these firms need to restructure and get rid of obsolete capital in the face of increasing competition and hardening budgets. The financing explanation holds for private firms, which may have to divest in order to raise capital. Rapid economic growth counterweighs both effects in all types of firms, with a bigger impact for firms in the private and foreign sectors. Lastly, a Tobit model is estimated to examine the determinants of the amount of negative investment in China.

Key words: China; Negative fixed asset investment; Financing explanation; Efficiency explanation; Growth explanation

JEL: G3; O16; O53

1. Introduction

China's investment has been remarkably high in the past three decades. Gross capital formation has averaged a fairly steady 39 percent of GDP over the entire reform period, among which the rate of fixed capital formation has increased significantly in recent years, rising from an average of 29 percent between 1978 and 1993 to an average of 37 percent thereafter. The high investment rate and dramatic investment-generated improvements in productivity and technology have been seen as the main driving forces behind China's rapid economic growth over the last three decades (Ding and Knight, 2009). Interestingly, using a comprehensive national-wide economic census dataset of more than 120,000 Chinese manufacturing firms over the period 1998-2007, we find that about one third of the firm-year observations in our sample actually divest! This presents a puzzle of China's investment pattern: so much investment has been carried out at the aggregate level; nevertheless, microeconomic evidence reveals a high rate of negative fixed asset investment among firms. In this paper, we attempt to address this interesting issue which, to the best of knowledge, has been ignored in the literature.

China is not alone in terms of having high rate of negative investment. Based on the firm-level data from Bureau Van Dijk, we observe extensive divestment among many transition economies, for instance, 8.98% in Poland, 8.9% in Czech Republic, 13.34% in Bulgaria, and 33.4% in Romania. Lots of negative investment observations can be found in the UK FAME dataset, i.e. about 22% of firm-year observations are characterized by negative investment. This phenomenon deserves to be understood. This is particularly the case for China, a country with extraordinary growth performance but still in the process of transition towards a market economy.

Using a comprehensive firm-level dataset, we attempt to provide explanations for two broad research questions. First, why Chinese firms divest? In other words, what determines the probability of negative investment? Second, why some firms divest more than others? This relates to the determinants of the amount of negative investment among various types of firms. To achieve these goals, a random-effect Probit model is firstly estimated and then followed by a Tobit estimation. Three theoretical hypotheses of firm divestment are tested for different ownership groups, namely, the financing explanation, the efficiency explanation and the growth explanation. We find that the state-owned enterprises (SOEs) divest mainly for the inefficiency or restructuring reasons, for example, the need to restructure obsolete capital in the face of rising competition. The negative investment by private firms is mainly due to external financial constraints. The fact that firms are growing fast offsets the above two incentives

for negative investment, which is particularly the case for the most dynamic private and foreign firms.

The paper is organized as follows. Section 2 briefly reviews the relevant theories and empirical evidence on negative investment. Section 3 specifies our three hypotheses based on the background of China's institutional reform and also discusses the empirical methodology. Section 4 describes the data and provides the descriptive statistics of variables of interests. Section 5 interprets the estimation results of the Probit model, including both the baseline regression and the robustness tests for each hypothesis. Section 6 reports the results of the Tobit model. Section 7 draws conclusions.

2. Literature review on negative investment

Compared with the enormous literature on corporate investment, the topic of negative investment (or divestment) is relatively under-researched and the limited existing literature focuses mainly on the mature financial markets in developed countries. According to Gadad *et al.* (2004), divestment can take many forms: the sell-off, the spin-off, the equity carve-out, and management buyout (MBO)[1]. Given the fact that most firms in our sample are not listed in the stock market, we focus on the first type of divestment, the sell-off, in this literature survey.

The finance literature has identified several motives for negative investment, among which the following five hypotheses are most prominent, i.e. the *efficiency* explanation, whereby assets are transferred to those who can operate them most productively (Maksimovic and Phillips, 2001); the *focus* explanation, according to which divestment may allow concentration on core activities (John and Ofek, 1995); the *financing* explanation, whereby divestment can raise capital without recourse to the capital market, which may be unwilling to supply capital (Lang *et al.*, 1995); the *liquidity* explanation, which justifies the important role of liquidity of the market for corporate assets in firm divestment process in addition to the fundamental reasons (Schlingemann *et al.*, 2002); and the *defensive restructuring* explanation, according to which asset divestment is a response to rapid economic transition (Carlin *et al.*, 2001). All these arguments are potentially important for understanding the coexistence of widespread negative investment and huge positive investment among Chinese firms.

2.1 The efficiency explanation

[1] A sell-off occurs when a firm sells a part of its assets to another firm. A spin-off occurs when ownership of the divested asset is transferred to a new company formed by a pro-rata distribution of equity shares in the new company to current shareholders. An equity carve-out occurs when ownership of the divested assets is transferred to a new company formed by the issue of equity shares in the new company to the public. Lastly, a MBO occurs when the incumbent management team buy all the equity shares of either a firm or a subsidiary from current shareholders.

Hite *et al*. (1987) provide an explicit theoretical explanation for the motivation behind asset sales: managers only retain assets for which they have a comparative advantage and sell assets if another party can manage them more efficiently irrespective of their financial situation. Using the event-time methods, they investigate the cases for both partial sell-offs and total liquidations[2] in the US and find that asset sales are associated with the movement of resources to higher-valued uses and sellers capture some of the resulting gains.

Maksimovic and Phillips (1998) examine whether the incentives to divest are different between bankrupt and nonbankrupt firms in the US using detailed plant-level data from 1977 to 1990. Their logistic-limited dependent variable model results show that growth in industry output positively affects both the frequency of asset sales and the productivity gain from asset sales, both outside and inside bankruptcy. Besides, the asset sales are more frequent in industries with high R&D. Consistent with the importance of demand on asset sales, plant-level cash flows are highly significantly and positively related to the probability of selling a plant. Lastly, although firms that go bankrupt sell assets at a higher rate before bankruptcy, there is no evidence that bankruptcy either increases or decreases asset sales. Hence, their evidence is in line with a higher value of asset reallocations for all firms, both bankrupt and nonbankrupt, in high-growth industries.

Maksimovic and Phillips (2001) analyze the market for corporate assets (plants, divisions, and whole firms) in manufacturing industries and examine how seller characteristics and firm organization influence asset sales based on a large US firm-level database over the period of 1974 to 1992. Using a panel Probit approach, they find that assets are more likely to be sold when the assets are less productive than their industry benchmarks, when the selling division is less productive, when the selling firm has more productive divisions in other industries, and when the economy is undergoing positive demand shocks. There are *ex post* productivity changes for assets transacted, which are associated with buyer and seller's initial productivity and firm organization. The timing of sales and the pattern of efficiency gains suggests that the divestments tend to improve the allocation of resources, which is consistent with profit-maximizing behaviour.

Warusawitharana (2008) presents a theoretical model in which asset sales and purchases enable the transfer of capital from less productive to more productive firms. The empirical analysis employs logit regressions and finds that return on assets and size strongly influence the choice of a firm to purchase or sell existing assets, i.e. highly profitable firms engage in asset purchases, and less profitable

[2] A partial sell-off is defined as the sale of a subsidy, division, or other operating assets to a buyer for cash, securities, and/or other future consideration. Liquidation occurs when a firm sells all its assets to various buyers.

firms find it optimal to downsize and sell existing assets; moreover, large firms engage in asset sales and purchases much more than small firms.

2.2 The focus explanation

John and Ofek (1995) emphasize 'focus' as an important motive for divestment, i.e. selling an unrelated asset leads to an increase in focus and more efficient operation of the core business. The improvement in performance may be due to various reasons, such as elimination of negative synergies with the divested asset or increased efficiency arising from better allocation of management time and other resources in a more focused firm. Using a US sample of divestment from 1986 through 1988, they find that asset sales lead to an improvement in the operating performance of the seller's remaining assets in each of the three years following the asset sale. This improvement is found only for the firms that increase focus. The results support their hypothesis that divestments are undertaken to make the seller a more focused operation, and thus enhancing the firm's performance.

Berger and Ofek (1995) adopt segment-level US data to estimate the valuation effect of diversification and to examine the potential sources of value gains or losses during 1986-91. They find that diversified firms have values that average 13% to 15% below the sum of the imputed values of their segments, indicating that diversification reduces value. Overinvesment is associated with lower value for diversified firms, and segments of diversified firms overinvest more than single-line business do. This result supports the view that one source of the value loss is the greater propensity of multi-segment firms to overinvest and provides justification for the focus explanation for negative investment.

2.3 The financing explanation

Shleifer and Vishny (1992) closely link asset sales to firm's debt capacity in a market equilibrium model. Compared with debt rescheduling and new security issues, selling asset is argued to be the most attractive and perhaps the cheapest way for firms to raise funds in order to meet their debt obligations. In many cases, asset sales can lessen conflicts between creditors, reduce the asset substitution problem, control agency costs, and alleviate the informational asymmetry between the firm and outsiders. They also analyze the adverse effect of asset illiquidity on asset sales and on firm's debt capacity, i.e. asset illiquidity reduces proceeds from asset sales below previously expected levels, making debt repayment more difficult.

Lang *et al*. (1995) argue that rather than for operating efficiency reasons alone, management sells assets to obtain funds to pursue its objectives when alternative funding is either too expensive or unavailable. In theory, highly-

leveraged or poorly-performed firms may find it expensive to use the capital markets due to the adverse selection costs (Myers and Majluf, 1984) or the agency costs of managerial discretion (Jensen, 1988; Stulz, 1990). Asset sales, instead, may provide a source of funds that managers find preferable to capital markets. Based on a sample of 93 asset sales over the period of 1984-89 in the US, they find that firms selling assets have high leverage or poor performance, suggesting that the typical firm selling assets is motivated by its financial situation rather than by the discovery that some other firm has a comparative advantage in operating the assets. The stock-price reaction to asset sales is found to be strongly related to the use of the proceeds, i.e. significantly positive for those firms expected to use the proceeds to pay down debt, but negative and insignificant for firms which are expected to keep the proceeds within the firm.

Hovakimian and Titman (2006) examine the relationship between proceeds from voluntary asset sales and investment expenditure using a dataset of 1474 US firms from 1980 to 1999. Their first-differenced regressions show that cash obtained from asset sales is a significant determinant of corporate investment and that the sensitivity of investment to proceeds from asset sales is significantly stronger for firms that are likely to be financially constrained. Hence, funds from voluntary divestment provide an important financing source for financially constrained firms.

2.4 The liquidity explanation

Schlingemann *et al*. (2002) agree with the above views that firms divest in order to accomplish operating, strategic or funding objectives, however, they emphasize the role of asset liquidity in determining which asset is divested. They argue that when firms seek to divest assets but have a choice of assets to sell, assets that are relatively more liquid are more likely to be divested. Since asset liquidity *per se* does not give rise to divestment, they control for the fundamental factors that initiate the divestment process by selecting focusing firms[3] only for their sample. Their logit regressions show that along with the efficiency, focusing and financing explanations for divestments, the probability that a segment is divested is higher if the asset is in an industry with a liquid market for assets, suggesting the important role of asset liquidity in explaining the divestment decision. Their empirical finding is in line with the theoretical prediction of Shleifer and Vishny (1992) that asset illiquidity impedes asset sales and worsens financial distress of firms.

2.5 Defensive restructuring explanation

[3] Focusing firms are defined as firms that reduce their number of reported segments.

The phenomenon of negative investment has also been noticed in several transition economies with an alternative interpretation. When survival is threatened, asset divestment can be made as a logical response to rapid and uncertain environment changes that have occurred during transition. According to Carlin *et al*. (2001), divestment may indicate 'defensive restructuring' and downsizing in firms that are less efficient in active adaptation to the market environment. Using a World Bank survey dataset of 3,300 firms in 25 transition countries, they examine the determinants of restructuring and performance of firms, with a particular interest in the impact of ownership, competition, soft budget constraints and the general business environment. They find that SOEs and old firms are significantly more likely to have engaged in defensive restructuring through, for instance, labour shedding or plant closures; and firms with market power are much less likely to do so. They conclude that the unchallenged monopoly has impeded restructuring and has been a drain on firm performance in these transition economies.

This defensive restructuring argument is closely linked to the financing explanation for divestment by Filatotchev *et al*. (2007). Based on a survey dataset of 157 large and private Hungarian and Polish companies, they investigate how managers' choice of financing sources may be affected by a number of strategic and governance factors such as the divestment strategy, ownership concentration, presence of domestic and foreign institutional investors, and the relationship links to banks. They hypothesize that the intention to divest may arise as a means to raise funds when firms become financially distressed during the period of transition. They find a negative relationship between divestment and bank finance in the Bayesian estimation. Their explanation is that for firms undergoing restructuring and seeking access to fresh finance in order to stay in business, divestment may be taken as a negative signal by external providers of finance making it more difficult to obtain.

In brief, the prior literature provides various motivations for corporate divestment. For financially healthy firms, the voluntary asset sales allow firms to restructure operations and to achieve higher operating efficiencies by selling assets to more productive users or by selling assets unrelated to the core business. For financially constrained firms, asset sales, which are privately negotiated transactions, may allow firms to raise capital in situations where debt and equity markets are unattractive. Besides these fundamental reasons for divestment, asset liquidity plays a role in determining which asset is divested. In the economies of transition, asset divestment may also occur in the process of defensive restructuring or to overcome financial distress.

3. Hypotheses and methodology

3.1 Background of Chinese economy and our hypotheses

China was a central planned economy and the economic reform starting from 1978 has been described by Deng Xiaoping as a process of 'crossing the river by groping for the stepping stones'. The reforms were incremental but hardly slow: huge changes have occurred in less than three decades, as China has moved from central planning towards a market economy.

One distinguishing feature of China's institutional reform is the emergence of new forms of ownership. Before 1978, the Chinese industrial sector was dominated by SOEs, whose objective was to fulfil production quotas and to provide life-long employment. In the 1980s and early 1990s, the collectively-owned 'township and village enterprises' (TVEs) experienced a significant expansion and played a catalytic role in pushing China towards a market economy. Several factors contributed to the rapid development of rural industry in China, the most important of which were access to previously protected or empty markets, their competitive advantage from low wages, and local government support. Jefferson *et al*. (1998) found empirical evidence that TVEs had institutional advantages over SOEs. Unlike SOEs, TVEs faced relatively hard budget constraints, so generating profit incentives. The entry of TVEs also provided competition for SOEs. However, when restrictions on the private sector were gradually relaxed and when the urban reforms provided SOEs with more incentives to seek out profitable opportunities and to compete successfully against them, TVEs began to lose their profitability; many were transformed into private businesses after the mid-1990s.

Deng Xiaoping's 'southern tour' of 1992 formally gave the green light for capitalist development. The Company Law adopted in 1994 provided a uniform legal framework into which all of the ownership forms fit, signalling the introduction of more clearly defined property rights and the start of dramatic institutional change implied by the rapid downsizing of the state sector. Many SOEs and urban collective enterprises (UCEs) were shut down, and employment in SOEs and UCEs shrank by over 40 percent and 75 percent respectively between 1995 and 2006[4]. A large number of SOEs and UCEs were either privatized or turned into shareholding entities that are increasingly dominated by private owners (Lin and Zhu, 2001; Garnaut *et al*., 2005). However, SOEs remain dominant in energy, natural resources and a few strategic or monopolistic sectors that are controlled and protected by central government.

Figure 1 shows the pattern of different ownership in investment in fixed assets over the period of 1980-2006. SOEs accounted for the bulk of fixed investment until the early 1990s, and then the structure of investment altered dramatically after Deng Xiaoping's southern tour in 1992. In the next 14 years, the share of SOEs fell from two-thirds to one-third, whereas the share of individual and other types of ownership climbed from 15 percent to 64 percent. The decline in SOEs' share in fixed investment has been viewed as a significant and positive development, given the widespread belief that the return on investment in the

[4] Data come from *China Statistical Yearbook 2007*: 128.

SOEs was far below that in the private sector (Dougherty and Herd, 2005; Blanchard, 2006).

However, there is evidence that the profitability of the state sector has improved since 1998: the measures taken from the mid-1990s to make SOEs more accountable for their profits and losses seem to have been effective (Riedel *et al*., 2007; Lu *et al*., 2008; Knight and Ding, forthcoming). The SOEs that survived the massive downsizing and reform are assumed to be more efficient and profitable on average. Our comprehensive firm-level dataset, spanning from 1998 to 2007, provides a valuable opportunity to test this argument. Our **first hypothesis** is therefore whether some Chinese firms, SOEs in particular, divest for efficiency or restructuring purposes? In other words, are some firms still much less efficient than others so that they find it optimal to divest and downsize themselves?

The differences in the behaviour of different ownership types can be attributable partly to the inefficient financial system. China can be said to have a 'repressed' financial system, and the degree of government intervention in bank lending decisions has been remarkably high (Riedel *et al*., 2007). Despite the 15-year reform of banking sector, bank loans constitute a major share of investment financing only for the SOEs, while private firms, the engine of growth in the Chinese economy, are generally discriminated against by the formal financial system and have to rely predominantly on internal funds to finance their investment (Allen *at al*., 2005; Guariglia *et al*., 2008; Knight and Ding, forthcoming). There is evidence that these problems have become less severe since 2000 (Guariglia and Poncet, 2008), but others believe that private investment has remained constrained although the state-owned banks have become more profit-oriented over the decade (Haggard and Huang, 2008). Hence our **second hypothesis** is whether some firms, especially those in the private sector, divest in order to generate funds to pursue their objectives when other external source of finance is limited or constrained?

One distinguishing feature of Chinese economy is its rapid economic growth since 1978: the growth rate of GDP per capita has averaged 8.6 percent per annum over the last three decades. This remarkable growth performance not only contributes to the poverty reduction in China, i.e. over 300 million people have been lifted out of one-dollar-a-day poverty since 1978[5], but also creates vast opportunities for investment. In the literature, Blomström *et al*. (1996) argue that growth induces subsequent capital formation more than capital formation induces subsequent growth. Thus our **third hypothesis** is whether the rapid growth of firms reduces the probability and the amount of divestment in China? This is referred to as the growth hypothesis for negative investment in this paper, which has not been mentioned in the existing literature, but is important in the context of China.

In brief, to answer the question of why Chinese firms divest, we attempt to investigate how the restructuring or efficiency explanation, financing

[5] The figure is calculated from Ravallion and Chen (2007).

explanation, and growth explanation help to understand the widespread negative investment among various types of Chinese firms. Given the absence of segment-level data, we are unable to test the focus and liquidity hypotheses of divestment for China in this paper.

3.2 Empirical methodology

In order to test the three hypotheses, we adopt a two-step approach: first, a random-effects Probit model is estimated to examine the factors that determine the probability of negative investment in various types of ownership; second, we use a Tobit model to investigate the determinants of the amount of negative investment in divesting firms.

Probit model estimates a limited dependent variable system and focuses on the determinants of the probability p of the occurrence of one outcome rather than an alternative outcome that occurs with a probability of $1-p$. It is fitted by maximum likelihood. We prefer the random effects Probit model to fixed effects in respect that the conditional likelihood approach does not yield computational simplifications for the latter. In particular, the fixed effects cannot be swept away and maximizing the likelihood over all the parameters including the fixed effects will in general lead to inconsistent estimates for large N and fixed T (Heckman, 1981). The random effects Probit model is based on multivariate normal distribution and controls for error correlations, i.e. with random effects, the composite error term is correlated across cross-section units even if errors are independent and identically-distributed (IID). In contrast, the standard Probit estimator with no correction for autocorrelation leads to incorrect results as the coefficient standard errors are badly biased (Guilkey and Murphy, 1993). The dependent variable in our Probit models is a binary variable takes a value of one if the firm divests and zero otherwise.

Tobit model is referred to as a censored or truncated regression model, and is relevant when the dependant variable of a linear regression is constrained in some way, for instance, being observed only over some interval of its support. The estimation method is also maximum likelihood. Given the fact that Tobit estimator is inconsistent if the errors are not normally distributed or if they are heteroskedastic, we will test for normality and homoskedasticity before estimating the model. In order to test how firms that divest differ from those without any negative investment, the dependent variable of our Tobit regressions is a censored variable which is equal to zero if firm does not divest, and takes the value of actual amount of divestment otherwise.

Our independent variables can be classified into the four categories, i.e. financing variables, efficiency variables, growth variables and other conditioning variables (see Table A1 in Appendix for detailed definition of each variable).

(1) Financing variables

i. Cash flow ratio

Theoretical models of imperfections in capital markets imply that external financing is more costly than internal financing for many firms (for instance, Myers, 1984; Hubbard, 1998). For given levels of investment opportunities, information costs, and market interest rates, firms with higher net worth should invest more, and therefore less probability or amount of negative investment. We therefore hypothesize a negative coefficient of the cash flow term in the divestment equations.

Cash flow, however, is an imperfect proxy for changes in net worth, i.e. it may contain information about expected future profitability or demand which might be relevant for investment decisions even under the null hypothesis of perfect capital markets. This is especially the case when investment opportunities are omitted or mismeasured by standard measures, particularly Tobin's Q (Bond *et al*., 2003; Carpenter and Guariglia, 2008). Therefore, many researchers criticize on the influential work of Fazzari *et al*. (1998) and argue that the finding of a significant coefficient on cash flow cannot be interpreted directly as evidence of financing constraints (see, Kaplan and Zingales, 1997; 2000).

To deal with this problem, we adopt a relatively new method proposed by Brown and Peterson (2009) that the interactions of time dummies and industry dummies can be used to capture investment opportunity or more general demand factors in an indirect way. They find evidence that these dummies can effectively account for time-varying demand shocks at the industry level.

ii. Net profit ratio

One important component of the cash flow measure is depreciation. However there is no consensus regarding whether depreciation is a source of funds, i.e. some believe that depreciation is a source of capital replacement, whereas others argue that depreciation is only one of the adjustments needed to convert the accrual net income to the cash provided from operating activities. Hence as a robustness check, we deduct deprecation from cash flow, which leads to a measure of net profit.

iii. Liquidity ratio

As a further robustness test, we construct a liquidity measure, which is the difference between current assets and current liabilities, to examine the role of internal liquidity in firms' divestment decision. We hypothesize that all three measures of cash flow, net profit and liquidity display similar pattern in our equations.

iv. Leverage ratio

Leverage ratio is a measure of firm's financial position and an important determinant of external financing decisions. Leverage can affect investment in a number of ways. In theory, excess leverage may impair a firm's ability to raise additional capital and may reduce the amount of cash that can be used for investment. According to Myers (1977), managers of highly leveraged firms may be induced to forego positive net present value (NPV) projects because some or

all of the benefits from the investment may accrue to debt-holders. Jensen (1986) and Stulz (1990) argue that high leverage in low growth firms can be used to discourage management from undertaking non-profitable investments, i.e. debt commitments in low growth firms can reduce managerial discretion over free cash flows that may have otherwise been allocated to negative NPV projects. These theories predict a negative relationship between leverage and investment, and therefore the probability or amount of negative investment may rise with a higher leverage ratio.

On the other hand, high leverage for a certain group of firms may also be interpreted as high debt capacity or lower external financial constraints (Hovakimian, 2009). Under these circumstances, a positive relationship between leverage and investment can be perceived, and thus the probability or amount of negative investment may decline as the leverage ratio increases.

Most empirical literature supports the former view. For instance, using the US or Canadian data, Lang *et al.* (1996), Aivazian *et al.* (2005) and Ahn *et al.* (2006) all report a negative relation between investment and leverage and the correlation is much stronger for firms with low growth. Firth *et al.* (2008) also find a negative leverage-investment nexus among listed firms in China, but the connection is weaker in firms with low growth opportunities, poor operating performance, and high level of state shareholding. In this paper, our focus is on the connection between leverage and negative investment in a large sample of mainly unlisted Chinese firms.

v. Collateral ratio

Collateral is a measure of asset tangibility, and is defined as a ratio of tangible fixed assets over total assets of firms. In theory, collateral is important in raising financing in the presence of incentive problems and asymmetric information between the firm and capital markets (Wette, 1983). Hence, firms with lower tangibility of assets are more likely to have difficulties in borrowing and to be forced to cut back on investment. On the other hand, some recent research suggests that collateral may not always be optimal within the *ex ante* private information framework (Carlier and Renou, 2006). Hovakimian (2009) also find that firms with lower asset tangibility are more likely to operate in industries with higher growth opportunities. So it would be interesting to examine empirically the role of collateral in firms' divestment decision in China.

(2) Efficiency variables

Our primary measure of firm efficiency is the total factor productivity (TFP), which is defined as a residual from a translog production function plus the plant-level fixed effects. According to Levinsohn and Petrin (2003), when estimating production functions, researchers have to account for the correlation between input levels and productivity, i.e. profit-maximizing firms respond to increases in productivity by increasing their usage of factor inputs. Ignoring this endogeneity issue could provide inconsistent estimates of the parameters of the production function. We therefore follow the method of Levinsohn and Petrin (2003) and

introduce intermediate inputs as a proxy for unobserved shocks in the estimation of production function parameters (see appendix for details of the construction of our TFP measure).

In addition, we also compute two widely-used proxies for firm-level productivity. First, following McGuckin and Nguyen (1995) and Maksimovic and Phillips (2001), we calculate the value added per worker, which is defined as total sales less materials cost of goods sold, divided by the number of workers. Second, we construct the average labour productivity, which is the total real sales divided by the number of workers. Neither of these measures has the desirable theoretical properties of TFP. But they may have desirable statistical properties since they are not computed from a regression. The efficiency explanation of negative investment predicts a negative relationship between firm efficiency and divestment. We will test this hypothesis using our comprehensive dataset.

(3) Growth variables

For our growth indicators, we use two measures to capture the growth of output among firms, i.e. the growth rates of value added and of real sales. Besides, we are interested in various sources of output growth, i.e. the rate of factor accumulation (proxied by the growth rates of total assets and of employment), and the rate of improvements in firm productivity (the growth rate of TFP).

TFP growth in the industrial sector has widely been used to assess the outcome of SOE reform in China. Using either industry- or firm-level data, many researchers find that there was a significant improvement in the productivity of SOEs in the late 1970s and 1980s, i.e. the estimates of annual TFP growth range from 2% to 5% in these studies, compared with almost 0% growth prior to reforms (Chen *et al*., 1988; Dollar, 1990; Jefferson *et al*., 1992; and Gorden and Li, 1995). Some recent research shows that the trend of productivity improvement in SOEs has continued until the late 1990s (Zhang *et al*., 2002). It would therefore be interesting to examine whether our large firm-level dataset is consistent with this story.

(4) Other conditioning variables

i. Firm size

Firm size is an important factor explaining financing choices of corporate investment. Size may serve as an inverse proxy for the extent of informational asymmetries between the firm's insiders and external finance providers, i.e. smaller firms are expected to face higher hurdles when raising external capital due to, for instance, adverse selection problems (Myers and Majluf, 1984), whereas large firms, which are assumed to be more diversified and less prone to bankruptcy, are able to raise debt more easily. Using a dataset of over 4000 firms in 54 countries, Beck *et al.* (2005) find that small and medium-sized enterprises face greater financial, legal, and corruption obstacles compared to large firms,

and it is the small firms that stand to benefit the most from improvements in financial development and a reduction in corruption. On the contrary, some research shows that there exists a trade-off between firm size and performance, i.e. increases (decreases) in firm size reduce (raise) the performance of the firm (Power and Reid, 2003).

In the case of China, we hypothesize that the role of firm size in firms' divestment decision varies across different ownership groups. In particular, whether firm size plays a more important role in the non-state sectors than in the SOEs given the presence of soft-budget constraints in the latter? The answer might present some evidence of the outcome of financial reforms in China.

ii. Firm age

Similar to firm size, firm age may proxy for the wedge between the costs of external and internal capital (see, Oliner and Rudebusch, 1992). Younger firms are more likely to face problems of asymmetric information and therefore more financially constrained, as their short track record makes it more difficult for creditors and stock markets to judge their quality. On the other hand, younger firms are generally found to be more dynamic and efficient than old ones. In the context of China, it is very likely that, on average, old firms are less efficient and may divest for more restructuring reasons, whereas younger firms may divest for more funding problems.

iii. Exporting behaviour

There is microeconomic evidence that efficiency and exports are positively correlated in China. Kraay (1999), using a panel of Chinese industrial enterprises over the period 1988-92, examined whether firms learn from exporting, and found that past exports led to significant improvements in firm performance, and that the learning effects were more pronounced for established exporters. Park *et al*. (forthcoming), using panel data on Chinese manufacturers and firm-specific exchange rate shocks as instruments for exports, found that exporting increases TFP, total sales and return on assets, so providing evidence in favour of the 'learning-by-doing' hypothesis. These China-specific findings are in contrast to the general argument made by Bernard *et al*. (2007) in a survey article that exporters are more productive, not as a result of exporting, but because only productive firms are able to overcome the costs of entering export markets.

In this paper, we use an export dummy or export-sales ratio to capture the expected performance-enhancing efforts of export activities among Chinese firms. We hypothesize that firms that conducting export business are less likely to divest or divest less.

iv. Regional dummies

China's economic reform has generated an across-the-nation rapid growth (Ding and Knight, 2008a; 2008b). However, there are disparities across regions and provinces in terms of income, growth and well-being. Despite the labour cost

advantage of central and inner provinces, coastal region benefits from lower-cost access to markets and is the growth engine of the Chinese economy. A geographical distinction is made among coastal, central and inner provinces in this paper (see Table A1 in Appendix for details), and we hypothesize that firms in the inner and central regions have more incentive to divest than those in the coastal areas.

v. Time dummies, industry dummies, and their interactions

Lastly, we include time dummies to account for macroeconomic fluctuations or business cycle effects; industry dummies to capture industry-specific effects; and the interactions of time and industry dummies to account for industry-specific shifts in investment demand or expectations.

4. Data and descriptive statistics

4.1 Data and ownership definition

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

We use the data drawn from the annual accounting reports filed by industrial firms with the National Bureau of Statistics (NBS) over the period of 1998-2007. The original sample size is more than 532,000 firms, including all SOEs and other types of enterprises with annual sales of five million yuan (about $650,000) or more. These firms operate in manufacturing and mining sectors and come from 31 provinces or province-equivalent municipal cities. We deleted observations with negative sales; as well as observations with negative total assets minus total fixed assets; total assets minus liquid assets; and accumulated depreciation minus current depreciation. Firms that do not have complete records on our main regression variables are dropped. To control for the potential influence of outliers, we excluded observations in the one percent tails of each of the regression variables. Finally, we removed all firms with less than 5 years of consecutive observations.

Our final dataset covers 120,197 mainly unlisted firms, which corresponds to 821,166 firm-year observations[6]. Our sample is unbalanced, and the structure of

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

the panel can be observed from Table A2 in Appendix. The number of observations ranges from a minimum of 55,106 in 1998 to a maximum of 104,591 in 2003. There are also entry and exit of firms during our sample period, i.e. only less than 20 percent of firms have the full 10-year accounting information. The active entry and exit of firms are the consequence of enterprise restructuring starting from mid-1990s and are generally viewed as a potentially important driver of the dynamism in the manufacturing sector in China (see, for instance, Brandt *et al*., 2009).

The NBS data contains a continuous measure of ownership, which is based on the fraction of paid-in-capital contributed by six different types of investors, namely the state; foreign investors (excluding those from Hong Kong, Macao, and Taiwan); investors from Hong Kong, Macao, and Taiwan; legal entities; individuals; and collective investors. The rationale for dividing foreign investors into those from Hong Kong, Macao, and Taiwan, and those from other parts of the world is that the former capture the so-called 'round-tripping' foreign direct investment, whereby domestic firms may register as foreign invested firms from nearby regions to take advantage of the benefits (such as tax and legal benefits) granted to foreign invested firms (Huang, 2003). Ownership by legal persons is a mixture of ownership by state legal persons and private legal persons[7], which represents a form of corporate ownership. Finally, collective firms are typically owned collectively by communities in urban or rural areas (the latter are known as TVEs).

We group all foreign firms (from Hong Kong, Macao, Taiwan, and other parts of the world) into a single category (which are labelled *foreign*); and all firms owned by legal entities and individuals into a single category (labelled *private*)[8]. Thus our firms fall into the following four broad categories, i.e. state-owned, collective, private and foreign, based on the shares of paid-in-capital contributed by our four types of investors each year.

We then adopt two methods to classify firms by ownership. First, we group firms according to the majority average ownership shares. For instance, if the average

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

[8] Within this category, firms owned by individuals represent 69% of the total. As firms owned by legal persons include firms owned by state legal persons, one could question their inclusion in the *private* category. One reason for including them is that while the state's primary interests is mainly political (i.e. aimed at maintaining employment levels or control over certain strategic industries), legal persons are profit-oriented (Wei *et al*., 2005). Since our dataset does not allow us to discriminate between state and non-state legal persons, we are unable to exclude the former from our *private* category. All our results are, however, robust to excluding all firms owned by legal persons from the *private* category.

shares of paid-in-capital owned by private investors over the period 1998-2007 are greater than 50%, then the firm is classified as privately owned. One potential problem with this method is that the size of the private ownership is likely to be exaggerated. According to Haggard and Huang (2008), defining China's private sector is difficult and the genuinely private domestic firms are different from the government-controlled corporate firms. They argued that the former sector has remained relatively small and subject to many controls and permissions, for instance with regard to the provision of finance and the requirement of official approval of investment projects above a certain size. To take into account of this phenomenon, our second approach of ownership classification is based on a 100% rule. For instance, a firm is classified as privately-owned when all the paid-in-capital is contributed by private investors. This method allows us to focus on the *de jure* private firms which are more likely to represent the true private sector in China. The cost of the second approach is that a significant number of firms are left in a residual category, which is referred to as the mixed ownership group in which firms do not have a dominant investor (by the majority rule) or a single-type investor (by the 100% rule).

Table A3 in Appendix presents the distribution of observations by ownership using both methods. Our sample is dominated by private firms, i.e. about 58.2% firms are classified as privately-owned by the majority rule and 33.6% by the 100% rule. SOEs, collective firms and foreign firms represent 10.2%, 10.2% and 16.9% of our sample respectively based on the majority rule, and 5.4%, 3.7% and 9.5% respectively using the 100% rule. The second approach leads to a decrease of the number of firms in all four types of ownership groups, and an increase of firms in the mixed ownership group, i.e. about 47.9% of our observations are classified as mixed ownership. Since it is unclear about the composition of investors in this residual group, the second method of ownership classification involves a significant loss of observations despite its potentially more accurate measure of the private ownership. We therefore mainly rely on the majority rule to divide firms into different ownership groups, and use the 100% rule of classification as a robustness check.

Table A3 also reveals an interesting pattern of the evolution of ownership of Chinese firms from 1998 to 2007. Taking the majority rule of classification as an example, we find that the proportion of SOEs in our sample declines dramatically from 17.1% in 1998 to 5.3% in 2007. Similar pattern holds for the collective firms, whose share declines from 15.1% in 1998 to 7% in 2007. On the contrary, the share comprised by private firms climbs strongly from 45.7% to 65.9% over the sample period. The share of foreign firms remains roughly stable at around 16-18% between 1998 and 2007. According to a recent study by researchers at the International Finance Corporation, privatization of small

SOEs and TVEs became significant only after 1998 (Haggard and Huang, 2008). Our data clearly reflects this restructuring process by the shrinking state and collective sectors and the expanding private ownership.

4.2 Descriptive statistics

Table 1 presents descriptive statistics for variables of interests in this study. Both means and medians are provided, as the latter is less influenced by the outliers. We find that fixed asset investment as a proportion of tangible fixed assets averages 9.1% in our sample; the rate is lowest for SOEs (3.7%), whereas private firms have the highest investment rate (10.4%) followed by foreign firms (9.6%). The proportion of firms that have negative fixed asset investment is 32.1% for the full sample, highest for SOEs (41%) and lowest for foreign firms (29.7%) and private firms (30.6%). This shows that negative investment is a widespread phenomenon in all types of firms in China. The highest negative investment ratio of SOEs indicates dramatic structural changes in this sector.

In terms of the financial variables, SOEs have the lowest cash flow ratio (12.2%), net profit ratio (2.9%), and liquidity ratio (-2.3%), and the highest ratios of leverage (64.3%) and of asset tangibility (41.6%). On the contrary, foreign firms have the highest liquidity (14.5%) and lowest ratios of leverage (49%) and asset tangibility (32.8%); collective firms have the highest cash flow (40.8%) and profitability (27%); and the ratios of private firms lie between those of collective and foreign firms. This sheds lights on the relatively poorer financial performance of SOEs in our sample. In particular, the co-existence of high leverage and low profit in the state sector presents some initial evidence for the soft budget constraints favouring SOEs. As for collective firms, our initial statistics of financial variables are in line with the view of Naughton (2007) that after decades of reforms and transformations, collective firms now operate as private enterprises in practice.

For all our three efficiency measures (TFP, average labour productivity, and value added per worker), SOEs have the lowest values and foreign firms have the highest. Domestic private firms and collective firms follow closely to foreign firms in terms of all three measures of firm-level efficiency. This suggests that SOEs remain the least efficient sector in China despite decade-long reforms.

Regarding the growth variables, SOEs have the lowest rates of all five measures, i.e. value added growth (1.6%), real sales growth (4%), total asset growth (2.1%), employment growth (-5%) and TFP growth (2.8%). On the other hand, private firms have the highest growth rates of value added (12%), of real sales (12.6%), and of total assets (10.4%). Foreign firms have the highest growth in employment (4.6%). And both private and foreign firms have achieved the highest TFP growth (9.4%). In terms of collective firms, their growth rates are

better than SOEs but not comparable to those of private and foreign firms. Hence the private and foreign firms are the fast-growing sectors in all dimensions, whereas SOEs are, relatively speaking, stagnating.

Besides, SOEs are generally older (as measured by firm age) and larger (as measured by total assets and employment) than those in the non-state sectors. Concerning the export behaviour, the ratio of export over total sales is 19% for the full sample and about 32.9% of firms that export. SOEs have the lowest export-sales ratio (4.4%), in contrast with the highest ratio of foreign firms (49.6%). The ratios for collective firms and private firms are 7% and 14.5% respectively.

In brief, our initial descriptive statistics reveals the fact that over the period of 1998-2007, SOEs are still the least financially-healthy, least efficient and slowest growing sector in the economy after years of reforms. Given the easy access of credit for SOEs as reflected by a very high leverage ratio, their poor performance simply reflects the inefficiency in capital allocation and sluggish response to the market. It is therefore not surprising to witness the highest negative investment rate in this sector. On the contrary, private and foreign firms are the most profitable, efficient and dynamic sectors in China. Collective firms have good financial performance but fewer growth opportunities. Thus it is natural to hypothesize that different ownership groups divest for different reasons.

5. Probit model results

5.1 The baseline model

We first estimate a basic model using random effects Probit regressions allowing for correlated residuals within panel units. Following the investment literature, we include a lagged value of the dependent variable in our negative investment equation to account for the sluggish adjustment that may characterize corporate divestment in response to changes in the explanatory variables. To test for the financing explanation, we include cash flow, leverage and collateral in the baseline model to capture three important dimensions of corporate finance, i.e. internal finance, external finance and asset tangibility respectively. The firm-level TFP is our preferred measure for the efficiency hypothesis. And the growth rate of real sales is employed to test for the growth hypothesis. We also include the natural logarithm of firm age, the logarithm of total assets, the export dummy, two regional dummies for firms located in coastal and central provinces, and all time dummies, industry dummies and their interactions. To control for the potential endogeneity problem, all variables except firm age and dummies are lagged by one period in our regression with an aim to alleviate the simultaneity bias. The standard error computation clusters by firms to adjust for

within-firm serial correlation and is robust to heteroskedasticity across firms. Firms are divided according to ownership following our majority rule.

Table 2 reports the results of the basic model. The significance of the lagged dependent variable in all ownership groups implies that the dynamic model fits the data well and correctly captures the smooth adjustment of divestment behaviour of Chinese firms. The cash flow coefficient is negative and significant for four ownership types, highest for SOEs (-0.22) and lowest for foreign firms (-0.08). This accords with the theoretical prediction that firms with higher net worth will divest less. The fact that the SOE divestment rate is more sensitive to the availability of internal finance than that of the non-state sectors is consistent with our descriptive statistics that SOEs have the lowest cash flow ratio among all types of firms.

Leverage ratio displays an interesting pattern across various groups of firms. The coefficient is significantly positive for SOEs, insignificant for collective firms, and significantly negative for private and foreign firms. For SOEs, the probability of negative investment is higher when the level of external borrowing is high. Taking into account of the fact that SOEs have the highest leverage ratio among all types of firms, our results show the adverse impact of soft budget constraints, i.e. excess leverage of the state sector has impaired firms' financial health and investment capability. External finance does not affect the divestment decision of collective firms. For private and foreign firms, firms are more likely to divest with low leverage ratio. In other words, with limited access to external finance, private and foreign firms have more incentives to divest for financial purpose. This supports our hypothesis that the financing explanation of negative investment may hold for the private sector which is generally discriminated by the formal financial system in China.

The parameter of collateral ratio is positive and significant for all firms, with the highest magnitude for private firms (0.93). This is in line with Hovakimian (2009)'s view that firms with lower asset tangibility are more likely to operate in industries with higher growth opportunities, so that the probability of negative investment declines as the asset tangibility falls.

Our firm-level TFP measure is significantly negative in all ownership groups, highest for SOEs (-0.06) and lowest for foreign firms (-0.02). Hence, firms are more likely to divest when they are less productive and the effect is the greatest for SOEs. The efficiency argument thus provides a good explanation for the large amount of negative investment in the state sector, i.e. owing to the overinvestment or misinvestment in the past, state firms are divesting a lot in order to get rid of obsolete capital in the face of increasing competition during the process of restructuring.

The growth rate of real sales affects the probability of divestment of all types of firms significantly and negatively, with the bigger effects for private and foreign firms. This supports our growth hypothesis that the rapid growth of firms reduces the probability of negative investment. This holds for all types of firms, but is particularly the case for private and foreign firms which are the most dynamic sectors in the Chinese economy. In other words, the divestment decisions of private and foreign firms are more responsive to the growth opportunities than those of state and collective firms.

In terms of other controlling variables, firm age is insignificant in determining the divestment decision for SOEs at 5% significance level, but is positive and significant for all non-state sectors. Similar story holds for firm size, which does not affect negative investment in SOEs, but for collective and private firms, the probability of divestment is lower with smaller firm size. This sheds lights on some indirect evidence of soft budget constraints in the state sector, i.e. for SOEs, their access to external finance and therefore the investment or divestment decisions are regardless of their size and age. On the contrary, for collective and private sectors, younger and smaller firms are more likely to outperform their counterparts, and therefore less likely to divest. As for foreign firms, firm size affects the probability of divestment negatively, which is consistent with the view that bigger size may alleviate asymmetric information between firms and creditors.

The export dummy is insignificant for SOEs and collective firms, but significantly negative for private and foreign firms. The probability of negative investment declines when private and foreign firms have the opportunity of conducting exporting business. On the other hand, the divestment behaviour of state and collective firms is not affected by the fact whether they export or not. This accords with Kraay's (1999) view that among Chinese enterprises exporting is an indicator of superior performance.

Both regional dummies are insignificant for SOEs, indicating that geographic location does not affect the divestment decisions of the state firms. The coefficients of both coastal and central dummies are negative and significant for collective and private firms. The magnitude of the coefficients suggests an interesting pattern across regions: the probability of negative investment is higher for collective and private firms in the western provinces, followed by those located in the coastal areas, and firms in central region are least likely to divest. As for foreign firms, the central dummy is insignificant, suggesting that foreign firms located in the coastal provinces are least likely to divest.

In brief, our econometric results suggest that the negative investment by SOEs can be explained mainly by inefficiency. The financing explanation holds for

private firms, which have to divest in order to raise capital. Rapid economic growth counterweighs both effects in all types of firms. Moreover, high probability of negative investment in the non-state sectors is also associated with some firm characteristics like being old, large, without access to overseas market, and located in the western provinces.

5.2 Further robustness tests

(1) Robustness tests for financing explanation

Given the fact that the measures of various dimensions of corporate finance may correlate with each other to some extent, combining them in one regression may generate some potentially inconsistent estimates. To test the robustness of our findings in the baseline model, we allow each financial variable enter the model separately and examine whether our results for the financing explanation of negative investment are robust.

In Table 3, we find that all measures of internal funds (cash flow, net profit and liquidity) display a very similar pattern in each model, i.e. the probability of divestment declines as the internal finance becomes abundant and the effect is the greatest for SOEs. The leverage ratio, when entering the regression individually, maintain its interesting feature that the coefficient is significantly positive for SOEs, and significantly negative for private and foreign firms. The only minor change is that the parameter for collective firms which is insignificant in the baseline model now becomes significantly negative at 5% significance level. But this does not alter our story that the excess leverage in the state sector, as a result of the soft budget constraints, may worsen firms' performance and increase the probability of negative investment; by contrast, as for the non-state firms, in particular the private firms, their limited access to external finance may create incentives for divestment, which is consistent with the financing hypothesis of negative investment. Lastly, the estimates of collateral follow exactly the same pattern as the baseline model. Hence, the results of the financing variables in the baseline model are robust.

(2) Robustness test for efficiency explanation

According to the efficiency hypothesis, firms divest their assets when there is an expected gain in productivity. This is because firms differ in organizational ability and these differences determine their productivity in different industries. The restructuring explanation argues that firms that are less efficient are more likely to engage in downsizing or defensive restructuring during the process of adaptation to the market environment. Both theories are relevant to the case of SOEs in China. After closing down the failing ones and corporatizing those relatively successful into the private sector, firms that remain in the SOE

category are mostly very large and relatively less efficient compared with the private sector. They are kept alive by the government in order to keep control of the strategic sectors in the economy and to avoid the remarkable laid-off of workers. Indeed, our initial descriptive statistics reveals the fact that despite decade of reforms, SOEs are still the least efficient sector in the Chinese industries. Our baseline regression results provide evidence that it is the SOEs that are most likely to engage in negative investment for inefficiency reasons.

In Table 4, two alternative measures of firm-level efficiency (the average labour productivity and value added per worker) are introduced to the Probit model. The results are a bit different but more interesting. In terms of average labour productivity, the coefficient is significantly negative for SOEs, and becomes significantly positive for all three non-state sectors. This indicates more clearly that the efficiency or restructuring explanation of negative investment only holds for the state sector in China, i.e. it is the low efficiency that induces the incentives of divestment in SOEs. On the contrary, for the non-state firms, the probability of negative investment increases as the efficiency rises, implying that they do not divest due to inefficiency.

Using the measure of value added per worker tells the similar story, except the case of collective firms in which the coefficient is insignificant. Hence, the robustness tests strengthen our argument that the efficiency hypothesis provides a good explanation for the negative investment of SOEs, but not for the non-state firms.

(3) Robustness test for growth explanation

Besides the growth rate of real sales, we use four alternative measures to capture the growth prospects of firms as a robustness test. They are the value added growth, total asset growth, employment growth, and TFP growth, covering both the output growth and its sources through factor accumulation and productivity improvement. In the baseline model, we find that the rapid growth of firms reduces the probability of negative investment for all types of ownership, but bigger effect is found for private and foreign firms.

In Table 5, we find that the value added growth and TFP growth do not affect the divestment decisions of state and collective firms, but reduce the probability of negative investment of private and foreign firms. Similar story holds for the real total asset growth, but the insignificance of the coefficient only applies to collective firms. Lastly, the employment growth follows exactly the same pattern as that in the baseline model. Hence, our key findings of the growth explanation are robust, i.e. growth reduces the chances of negative investment more in the private and foreign firms than in the SOEs and collective firms. This is in line

with our initial descriptive statistics that private and foreign firms grow much faster than state and collective ones in the Chinese industry.

In addition, we find that the results of other controlling variables are robust when alternative measures are used. The overall story remains intact when we use the 100% rule of classify ownership groups. To save the space, we do not report all the results here.

6. Tobit model results

So far we have answered the questions of which firms are more likely to divest in China, and how the arguments of financing, efficiency and growth provide a plausible explanation for the widespread divestment behaviour among various types of Chinese firms. Then the following question is that for those firms who divest, what factors determine the amount of negative investment? To explore this question, a Tobit model is employed and all the independent variables are the same as those in the Probit regressions.

As for SOEs, their huge amount of negative investment is driven by low internal funds or low profit, high asset tangibility, and low TFP. All other variables are insignificant. This illustrates a clear picture that the efficiency argument plays such an important role in explaining the massive divestment in the state sector.

Among all non-state firms, external funds (proxied by leverage) are crucial in determining negative investment, i.e. their relatively lower level of external finance leads to more divestment. This further justifies our hypothesis that financing explanation of divestment holds only for the non-state firms in China.

Unlike SOEs and collective firms, many more factors affect the amount of negative investment in the private and foreign firms. For instance, higher growth of real sales is associated with less divestment, indicating that the growth hypothesis holds for the fast-growing private and foreign firms only. Besides, larger and older firms and those who do not have access to international markets tend to have more negative investment. Overall the findings are consistent with our Probit results.

7. Conclusion

In this paper, we examined an interesting phenomenon in China, i.e. the co-existence of high aggregate investment and a high rate of negative investment among a large number of Chinese firms. We found evidence of dramatic structural changes in the industrial sector, and firms tend to divest for different reasons. To the best of our knowledge, this is the first attempt to investigate firms' divestment behaviour in China.

Our initial descriptive statistics reveals the fact that despite decades of reforms, SOEs remain the poor performers in the economy, i.e. they have the highest divestment rate, lowest profitability, lowest efficiency, slowest growth rate, but the highest leverage ratio! This provides clear evidence of the presence of soft budget constraints favouring the state sector. On the contrary, private and foreign firms, which are the most efficient, profitable, and fast-growing sectors, receive much less external funds from the formal financial system. Collective firms exhibit good financial performance and improvement in productivity, but their growth prospects are not comparable to private and foreign firms.

We then test whether firms with different ownership divest for different reasons. Indeed, the results from both Probit and Tobit regressions support our hypotheses that the negative investment by SOEs can be explained largely by inefficiency, whereas private and foreign firms divest in order to raise capital. Rapid economic growth counterweighs both effects especially in the most dynamic private and foreign firms.

Our research has generated several important policy implications. For instance, for the state-owned firms, divestment is some sort of correction to the existing investment misallocation or overinvestment; whereas for the private sector, the driver of Chinese economy, the limited access to external finance is associated with both high probability and amount of negative investment. This deserves policy attention in order to sustain China's current high-investment high-growth circle.

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Table 1. Descriptive statistics

	Full sample	SOEs	Collective firms	Private firms	Foreign firms
Investment-capital ratio and negative investment variable					
ik	0.091	0.037	0.067	0.104	0.097
	(0.067)	(0.018)	(0.051)	(0.084)	(0.067)
neginv	0.321	0.409	0.349	0.306	0.297
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Financing variables					
cfk	0.342	0.122	0.409	0.351	0.390
	(0.187)	(0.059)	(0.208)	(0.198)	(0.223)
profitk	0.202	0.029	0.270	0.222	0.189
	(0.069)	(0.002)	(0.084)	(0.084)	(0.080)
liq	0.058	-0.023	0.080	0.042	0.145
	(0.059)	(-0.016)	(0.079)	(0.043)	(0.148)
leverage	0.586	0.643	0.602	0.601	0.491
	(0.600)	(0.658)	(0.616)	(0.618)	(0.488)
collateral	0.346	0.416	0.337	0.341	0.328
	(0.321)	(0.401)	(0.304)	(0.315)	(0.307)
Efficiency variables					
tfp	3.303	2.612	2.831	3.086	4.581
	(2.188)	(1.539)	(1.967)	(2.114)	(2.963)
vadrpw	0.632	0.369	0.536	0.648	0.778
	(0.352)	(0.153)	(0.277)	(0.389)	(0.392)
prod	2.466	1.264	2.141	2.516	3.190
	(1.516)	(0.625)	(1.269)	(1.626)	(1.948)
Growth variables					
vadg	0.101	0.016	0.049	0.120	0.116
	(0.091)	(0.031)	(0.051)	(0.106)	(0.101)
srgrowth	0.107	0.040	0.072	0.126	0.109
	(0.102)	(0.046)	(0.076)	(0.118)	(0.103)
assetsgr	0.084	0.021	0.051	0.104	0.075
	(0.044)	(0.006)	(0.022)	(0.061)	(0.046)
empg	0.011	-0.049	-0.016	0.018	0.046
	(0.000)	(-0.015)	(0.000)	(0.000)	(0.005)
tfpg	0.084	0.028	0.050	0.094	0.095
	(0.077)	(0.037)	(0.053)	(0.084)	(0.084)
Other controlling variables					
lrassets	5.449	5.889	5.089	5.263	5.967
	(5.273)	(5.829)	(5.013)	(5.081)	(5.844)
lemp	5.134	5.582	5.039	5.004	5.336
	(5.017)	(5.529)	(4.990)	(4.905)	(5.283)
lage	2.162	3.062	2.538	1.989	1.938
	(2.079)	(3.367)	(2.564)	(1.946)	(2.079)
expdum	0.328	0.168	0.144	0.273	0.714
	(0.000)	(0.000)	(0.000)	(0.000)	(1.000)
expratio	0.189	0.043	0.070	0.145	0.496
	(0.000)	(0.000)	(0.000)	(0.000)	(0.519)

Note: mean and medium (in parentheses) of each variable are reported.

Table 2. Basic probit model

BASIC PROBIT MODEL

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.206	.234	.242	.252
	.0181	.0182	.0077	.0128
	0.000	0.000	0.000	0.000
cfk				
L1.	-.223	-.157	-.113	-.0752
	.0429	.0222	.0108	.0141
	0.000	0.000	0.000	0.000
leverage				
L1.	.142	-.0264	-.146	-.0567
	.0371	.0374	.016	.0259
	0.000	0.481	0.000	0.029
collateral				
L1.	.827	.77	.933	.805
	.0497	.0505	.0216	.0385
	0.000	0.000	0.000	0.000
tfp				
L1.	-.0565	-.0396	-.0303	-.0175
	.0056	.0055	.0021	.0021
	0.000	0.000	0.000	0.000
srgrowth				
L1.	-.164	-.164	-.236	-.282
	.0234	.0238	.0094	.0158
	0.000	0.000	0.000	0.000
lage	.0197	.028	.0844	.166
	.0116	.0138	.0054	.0147
	0.090	0.042	0.000	0.000
lrassets				
L1.	.00159	.0371	.0133	-.011
	.0082	.0101	.004	.0066
	0.846	0.000	0.001	0.092
expdum	-.0018	-.0194	-.111	-.144
	.0257	.0244	.0081	.0132
	0.944	0.426	0.000	0.000
coastal	-.0247	-.0778	-.0633	-.13
	.0217	.0269	.0114	.042
	0.256	0.004	0.000	0.002
central	-.026	-.126	-.0918	-.0764
	.0237	.0309	.0139	.0525
	0.272	0.000	0.000	0.146
_cons	-.398	-.45	-.573	-.485
	.114	.102	.0373	.0889
	0.000	0.000	0.000	0.000
N	25460	27546	168394	64192
df_m	80	80	80	80
ll	-16133	-17086	-99429	-36920

legend: b/se/p

Table 3. Robustness tests: financing explanation

PROBIT MODEL COMPARISON: FINANCING EXPLANATION **Cash flow**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.187	.217	.219	.233
	.018	.0181	.0077	.0128
	0.000	0.000	0.000	0.000
cfk				
L1.	**-.374**	**-.24**	**-.223**	**-.17**
	.0465	**.0225**	**.0112**	**.0145**
	0.000	**0.000**	**0.000**	**0.000**
tfp				
L1.	-.0613	-.0333	-.023	-.0167
	.0057	.0053	.002	.0021
	0.000	0.000	0.000	0.000
srgrowth				
L1.	-.141	-.15	-.214	-.266
	.0233	.0238	.0094	.0157
	0.000	0.000	0.000	0.000
lage	.0277	.0104	.0699	.124
	.0115	.0136	.0053	.0144
	0.016	0.443	0.000	0.000
lrassets				
L1.	.0152	.0238	-.00087	.00036
	.0082	.01	.0039	.0065
	0.062	0.017	0.825	0.956
expdum	-.0273	-.0225	-.13	-.145
	.0257	.0241	.008	.0131
	0.289	0.351	0.000	0.000
coastal	-.0548	-.0898	-.0923	-.167
	.0216	.0268	.0112	.0412
	0.011	0.001	0.000	0.000
central	-.0348	-.0889	-.0543	-.0601
	.0235	.0306	.0137	.0515
	0.139	0.004	0.000	0.243
_cons	.0361	-.0296	-.145	-.0974
	.109	.093	.0334	.0847
	0.740	0.750	0.000	0.250
N	25460	27546	168394	64192
df_m	78	78	78	78
ll	-16285	-17226	-1.0e+05	-37181

legend: b/se/p

PROBIT MODEL COMPARISON: FINANCING EXPLANATION **Net Profit**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.192	.218	.218	.233
	.018	.0181	.0077	.0128
	0.000	0.000	0.000	0.000
profitk				
L1.	**-.3**	**-.177**	**-.155**	**-.138**
	.0451	**.0214**	**.0105**	**.014**
	0.000	**0.000**	**0.000**	**0.000**
tfp				
L1.	-.0693	-.0438	-.0314	-.02
	.0056	.0053	.002	.0021
	0.000	0.000	0.000	0.000
srgrowth				
L1.	-.14	-.152	-.216	-.267
	.0233	.0238	.0094	.0157
	0.000	0.000	0.000	0.000
lage	.0326	.0115	.0688	.12
	.0115	.0136	.0053	.0144
	0.005	0.396	0.000	0.000
lrassets				
L1.	.0264	.0402	.0134	.00894
	.008	.0098	.0039	.0064
	0.001	0.000	0.001	0.163
expdum	-.0274	-.0174	-.127	-.145
	.0257	.0241	.008	.0131
	0.288	0.472	0.000	0.000
coastal	-.056	-.0936	-.0953	-.169
	.0216	.0269	.0112	.0413
	0.010	0.000	0.000	0.000
central	-.0327	-.0867	-.0534	-.0573
	.0235	.0306	.0137	.0516
	0.165	0.005	0.000	0.267
_cons	-.053	-.118	-.22	-.147
	.108	.0924	.0331	.0845
	0.623	0.200	0.000	0.082
N	25460	27546	168394	64192
df_m	78	78	78	78
ll	-16309	-17264	-1.0e+05	-37218

legend: b/se/p

PROBIT MODEL COMPARISON: FINANCING EXPLANATION **liquidity ratio**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.193	.216	.217	.237
	.018	.0181	.0077	.0128
	0.000	0.000	0.000	0.000
liq				
L1.	**-.354**	**-.233**	**-.136**	**-.198**
	.0345	**.0322**	**.0135**	**.0228**
	0.000	**0.000**	**0.000**	**0.000**
tfp				
L1.	-.0739	-.06	-.0433	-.027
	.0053	.0047	.0018	.0019
	0.000	0.000	0.000	0.000
srgrowth				
L1.	-.165	-.175	-.231	-.29
	.0233	.0237	.0093	.0157
	0.000	0.000	0.000	0.000
lage	.03	.0157	.0697	.145
	.0115	.0135	.0053	.0145
	0.009	0.247	0.000	0.000
lrassets				
L1.	.0273	.0617	.0312	.0194
	.0078	.009	.0036	.0063
	0.000	0.000	0.000	0.002
expdum	-.0169	-.0105	-.124	-.139
	.0256	.0242	.008	.0131
	0.509	0.664	0.000	0.000
coastal	-.0555	-.102	-.0998	-.162
	.0216	.0268	.0112	.0413
	0.010	0.000	0.000	0.000
central	-.036	-.0965	-.0546	-.0472
	.0236	.0305	.0137	.0516
	0.127	0.002	0.000	0.361
_cons	-.0653	-.185	-.287	-.22
	.108	.0916	.0327	.0842
	0.544	0.044	0.000	0.009
N	25460	27546	168394	64192
df_m	78	78	78	78
ll	-16285	-17276	-1.0e+05	-37242

legend: b/se/p

PROBIT MODEL COMPARISON: FINANCING EXPLANATION **leverage ratio**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.193	.212	.21	.231
	.018	.0181	.0077	.0128
	0.000	0.000	0.000	0.000
leverage				
L1.	**.0827**	**-.0784**	**-.261**	**-.093**
	.0365	**.0366**	**.0155**	**.0246**
	0.024	**0.032**	**0.000**	**0.000**
tfp				
L1.	-.0814	-.0684	-.0517	-.0316
	.0054	.0049	.0019	.0019
	0.000	0.000	0.000	0.000
srgrowth				
L1.	-.157	-.164	-.226	-.281
	.0232	.0237	.0093	.0157
	0.000	0.000	0.000	0.000
lage	.0372	.0193	.0747	.125
	.0115	.0136	.0053	.0144
	0.001	0.155	0.000	0.000
lrassets				
L1.	.0397	.0772	.0445	.0338
	.0077	.009	.0036	.0061
	0.000	0.000	0.000	0.000
expdum	-.0236	-.00486	-.121	-.142
	.0257	.0241	.008	.0131
	0.358	0.840	0.000	0.000
coastal	-.0594	-.105	-.0939	-.168
	.0216	.0268	.0112	.0415
	0.006	0.000	0.000	0.000
central	-.0375	-.0969	-.0643	-.0543
	.0236	.0305	.0137	.0518
	0.112	0.001	0.000	0.295
_cons	-.16	-.206	-.189	-.214
	.11	.0928	.0335	.0847
	0.144	0.026	0.000	0.012
N	25460	27546	168394	64192
df_m	78	78	78	78
ll	-16340	-17303	-1.0e+05	-37276

legend: b/se/p

PROBIT MODEL COMPARISON: FINANCING EXPLANATION **collateral ratio**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.212	.233	.243	.252
	.0181	.0182	.0077	.0128
	0.000	0.000	0.000	0.000
collateral				
L1.	**.866**	**.869**	**1.03**	**.85**
	.0481	**.048**	**.0202**	**.0347**
	0.000	**0.000**	**0.000**	**0.000**
tfp				
L1.	-.0714	-.0599	-.039	-.0238
	.0052	.0047	.0018	.0018
	0.000	0.000	0.000	0.000
srgrowth				
L1.	-.169	-.176	-.247	-.289
	.0234	.0238	.0094	.0157
	0.000	0.000	0.000	0.000
lage	.029	.0334	.0828	.168
	.0116	.0137	.0054	.0146
	0.012	0.015	0.000	0.000
lrassets				
L1.	.0209	.0683	.0279	.00261
	.0077	.0089	.0036	.0062
	0.007	0.000	0.000	0.673
expdum	.00133	-.00897	-.107	-.143
	.0257	.0245	.0081	.0132
	0.959	0.714	0.000	0.000
coastal	-.0298	-.0855	-.066	-.129
	.0218	.0269	.0114	.0422
	0.170	0.001	0.000	0.002
central	-.0199	-.136	-.0936	-.0755
	.0237	.0309	.0139	.0527
	0.400	0.000	0.000	0.152
_cons	-.437	-.64	-.766	-.545
	.109	.0961	.0344	.0861
	0.000	0.000	0.000	0.000
N	25460	27546	168394	64192
df_m	78	78	78	78
ll	-16164	-17117	-99535	-36943

legend: b/se/p

Table 4. Robustness tests: efficiency explanation

PROBIT MODEL COMPARISON: **Average labour productivity**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.229	.249	.253	.265
	.0163	.0179	.0076	.0124
	0.000	0.000	0.000	0.000
cfk				
L1.	-.4	-.26	-.227	-.168
	.0365	.0201	.0099	.0129
	0.000	0.000	0.000	0.000
leverage				
L1.	.219	.0295	-.109	.081
	.0336	.0366	.0157	.0248
	0.000	0.421	0.000	0.001
collateral				
L1.	.862	.755	.912	.83
	.0446	.0494	.0211	.0372
	0.000	0.000	0.000	0.000
prod				
L1.	**-.0164**	**.00933**	**.0123**	**.0161**
	.0052	**.004**	**.0014**	**.002**
	0.002	**0.021**	**0.000**	**0.000**
srgrowth				
L1.	-.188	-.199	-.264	-.303
	.0211	.0237	.0093	.0154
	0.000	0.000	0.000	0.000
lage	.0208	.047	.0884	.174
	.0108	.0137	.0053	.0143
	0.054	0.001	0.000	0.000
lrassets				
L1.	-.0755	-.013	-.0369	-.0702
	.005	.0078	.003	.0051
	0.000	0.097	0.000	0.000
expdum	-.0308	-.0293	-.116	-.133
	.0232	.024	.008	.0129
	0.184	0.223	0.000	0.000
coastal	-.0291	-.0957	-.0882	-.137
	.0197	.0267	.0112	.0401
	0.140	0.000	0.000	0.001
central	-.0359	-.132	-.101	-.0613
	.0213	.0304	.0136	.0503
	0.092	0.000	0.000	0.223
_cons	-.164	-.411	-.453	-.318
	.101	.0991	.0355	.0829
	0.103	0.000	0.000	0.000
N	31550	28378	174424	69037
df_m	80	80	80	80
ll	-19945	-17650	-1.0e+05	-39560

legend: b/se/p

PROBIT MODEL COMPARISON: **Value added per worker**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.227	.249	.254	.267
	.0163	.0179	.0076	.0124
	0.000	0.000	0.000	0.000
cfk				
L1.	-.387	-.252	-.221	-.159
	.0365	.02	.0099	.0129
	0.000	0.000	0.000	0.000
leverage				
L1.	.212	.0278	-.109	.0839
	.0336	.0366	.0157	.0248
	0.000	0.447	0.000	0.001
collateral				
L1.	.863	.752	.904	.802
	.0445	.0494	.0211	.0371
	0.000	0.000	0.000	0.000
vadrpw				
L1.	**-.0655**	**.00331**	**.0156**	**.0173**
	.0143	**.0129**	**.0045**	**.0058**
	0.000	**0.798**	**0.000**	**0.003**
srgrowth				
L1.	-.189	-.19	-.255	-.292
	.0209	.0234	.0092	.0153
	0.000	0.000	0.000	0.000
lage	.0222	.0415	.0846	.165
	.0106	.0136	.0053	.0142
	0.036	0.002	0.000	0.000
lrassets				
L1.	-.0742	-.00998	-.033	-.0588
	.0049	.0078	.003	.005
	0.000	0.201	0.000	0.000
expdum	-.0322	-.0321	-.119	-.142
	.0232	.024	.008	.0129
	0.164	0.181	0.000	0.000
coastal	-.0322	-.088	-.0781	-.129
	.0196	.0265	.0111	.04
	0.100	0.001	0.000	0.001
central	-.0352	-.13	-.0989	-.0596
	.0213	.0304	.0136	.0503
	0.099	0.000	0.000	0.236
_cons	-.167	-.397	-.448	-.324
	.1	.099	.0355	.0829
	0.097	0.000	0.000	0.000
N	31550	28378	174424	69037
df_m	80	80	80	80
ll	-19934	-17654	-1.0e+05	-39592

legend: b/se/p

Table 5. Robustness test: growth explanation

PROBIT MODEL COMPARISON: **Value added growth**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.241	.253	.253	.275
	.0204	.0201	.0081	.0137
	0.000	0.000	0.000	0.000
cfk				
L1.	-.228	-.165	-.123	-.0826
	.0462	.0242	.0112	.0146
	0.000	0.000	0.000	0.000
leverage				
L1.	.151	-.0459	-.152	.0377
	.0418	.041	.0166	.0275
	0.000	0.262	0.000	0.170
collateral				
L1.	.861	.77	.928	.798
	.0565	.0557	.0226	.0409
	0.000	0.000	0.000	0.000
tfp				
L1.	-.0571	-.0401	-.029	-.0164
	.0061	.0058	.0021	.0022
	0.000	0.000	0.000	0.000
vadg				
L1.	**.00533**	**-.00822**	**-.0766**	**-.0707**
	.0147	**.0173**	**.0068**	**.0095**
	0.717	**0.635**	**0.000**	**0.000**
lage	.0225	.037	.0967	.189
	.0131	.0153	.0056	.0152
	0.086	0.016	0.000	0.000
lrassets				
L1.	-.00176	.0373	.00644	-.0174
	.0093	.0111	.0042	.0069
	0.850	0.001	0.123	0.012
expdum	-.00616	-.0117	-.113	-.146
	.0287	.0267	.0084	.0139
	0.830	0.660	0.000	0.000
coastal	.0483	-.0625	-.0621	-.102
	.0244	.0294	.0119	.0442
	0.048	0.034	0.000	0.021
central	.0343	-.116	-.0964	-.0466
	.027	.0343	.0146	.0556
	0.204	0.001	0.000	0.401
_cons	-.497	-.502	-.592	-.534
	.12	.107	.0383	.0913
	0.000	0.000	0.000	0.000
N	20057	22918	155734	57385
df_m	70	70	70	70
ll	-12666	-14223	-92236	-33277

legend: b/se/p

PROBIT MODEL COMPARISON: **Real total asset growth**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.182	.236	.222	.25
	.0185	.0185	.008	.0131
	0.000	0.000	0.000	0.000
cfk				
L1.	-.233	-.165	-.127	-.09
	.0434	.0225	.0111	.0144
	0.000	0.000	0.000	0.000
leverage				
L1.	.13	-.0401	-.155	.0421
	.0372	.0374	.016	.026
	0.000	0.283	0.000	0.105
collateral				
L1.	.771	.75	.865	.736
	.0498	.0508	.0217	.039
	0.000	0.000	0.000	0.000
tfp				
L1.	-.0586	-.0423	-.0336	-.0192
	.0056	.0055	.0021	.0021
	0.000	0.000	0.000	0.000
assetsgr				
L1.	**-.306**	**-.05**	**-.209**	**-.157**
	.0442	**.0342**	**.0126**	**.0222**
	0.000	**0.143**	**0.000**	**0.000**
lage	.0184	.0296	.0859	.186
	.0116	.0138	.0054	.0148
	0.114	0.032	0.000	0.000
lrassets				
L1.	.0071	.0398	.02	-.00791
	.0082	.0101	.004	.0067
	0.388	0.000	0.000	0.235
expdum	-.00588	-.0216	-.113	-.15
	.0258	.0244	.0081	.0133
	0.820	0.376	0.000	0.000
coastal	-.0225	-.0772	-.058	-.129
	.0218	.027	.0114	.042
	0.301	0.004	0.000	0.002
central	-.0268	-.126	-.0896	-.0742
	.0237	.0309	.0139	.0524
	0.258	0.000	0.000	0.157
_cons	-.392	-.461	-.576	-.521
	.114	.102	.0373	.0888
	0.001	0.000	0.000	0.000
N	25460	27546	168394	64192
df_m	80	80	80	80
ll	-16133	-17110	-99617	-37059

legend: b/se/p

PROBIT MODEL COMPARISON: **Employment growth**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.207	.232	.242	.248
	.0181	.0182	.0077	.0128
	0.000	0.000	0.000	0.000
cfk				
L1.	-.234	-.162	-.123	-.0863
	.043	.0223	.011	.0143
	0.000	0.000	0.000	0.000
leverage				
L1.	.126	-.0439	-.159	.039
	.0371	.0374	.016	.0259
	0.001	0.241	0.000	0.132
collateral				
L1.	.814	.764	.91	.784
	.0496	.0505	.0216	.0385
	0.000	0.000	0.000	0.000
tfp				
L1.	-.0576	-.0414	-.0327	-.0187
	.0056	.0055	.0021	.0021
	0.000	0.000	0.000	0.000
empg				
L1.	**-.191**	**-.244**	**-.283**	**-.35**
	.0368	**.0324**	**.0121**	**.0205**
	0.000	**0.000**	**0.000**	**0.000**
lage	.0174	.024	.0875	.18
	.0116	.0138	.0053	.0146
	0.135	0.082	0.000	0.000
lrassets				
L1.	.00165	.0377	.0146	-.00945
	.0082	.0101	.004	.0066
	0.840	0.000	0.000	0.152
expdum	-.00014	-.0215	-.109	-.146
	.0257	.0244	.0081	.0132
	0.996	0.379	0.000	0.000
coastal	-.0255	-.0757	-.0605	-.125
	.0218	.0269	.0114	.0421
	0.241	0.005	0.000	0.003
central	-.0264	-.124	-.0928	-.0786
	.0237	.0309	.0139	.0526
	0.265	0.000	0.000	0.135
_cons	-.394	-.451	-.591	-.522
	.114	.102	.0372	.0888
	0.001	0.000	0.000	0.000
N	25460	27546	168394	64192
df_m	80	80	80	80
ll	-16144	-17082	-99471	-36929

legend: b/se/p

PROBIT MODEL COMPARISON: **TFP growth**

Variable	SOE	COL	PRIV	FOR
neginv				
L1.	.244	.264	.264	.287
	.0212	.0205	.0082	.0142
	0.000	0.000	0.000	0.000
cfk				
L1.	-.25	-.164	-.124	-.0845
	.048	.0251	.0117	.0154
	0.000	0.000	0.000	0.000
leverage				
L1.	.145	-.0289	-.156	.0163
	.0436	.0423	.0171	.0287
	0.001	0.494	0.000	0.571
collateral				
L1.	.847	.754	.908	.772
	.0588	.0571	.0232	.0426
	0.000	0.000	0.000	0.000
tfp				
L1.	-.0537	-.0401	-.0291	-.0169
	.0062	.006	.0022	.0023
	0.000	0.000	0.000	0.000
tfpg				
L1.	**-.00148**	**-.0179**	**-.0692**	**-.054**
	.0169	**.0186**	**.0074**	**.0104**
	0.930	**0.334**	**0.000**	**0.000**
lage	.0189	.0387	.0978	.19
	.0136	.0156	.0057	.0156
	0.165	0.013	0.000	0.000
lrassets				
L1.	-.00266	.0388	.007	-.0177
	.0098	.0115	.0043	.0073
	0.787	0.001	0.105	0.015
expdum	-.0127	-.0206	-.118	-.15
	.0296	.0274	.0086	.0143
	0.667	0.451	0.000	0.000
coastal	.0564	-.0573	-.0597	-.108
	.0254	.03	.0121	.0455
	0.026	0.056	0.000	0.018
central	.0289	-.112	-.0907	-.052
	.0279	.0349	.0149	.0571
	0.300	0.001	0.000	0.363
_cons	-.453	-.532	-.595	-.488
	.125	.11	.0392	.0937
	0.000	0.000	0.000	0.000
N	18793	21883	148582	53265
df_m	70	70	70	70
ll	-11876	-13575	-88017	-30909

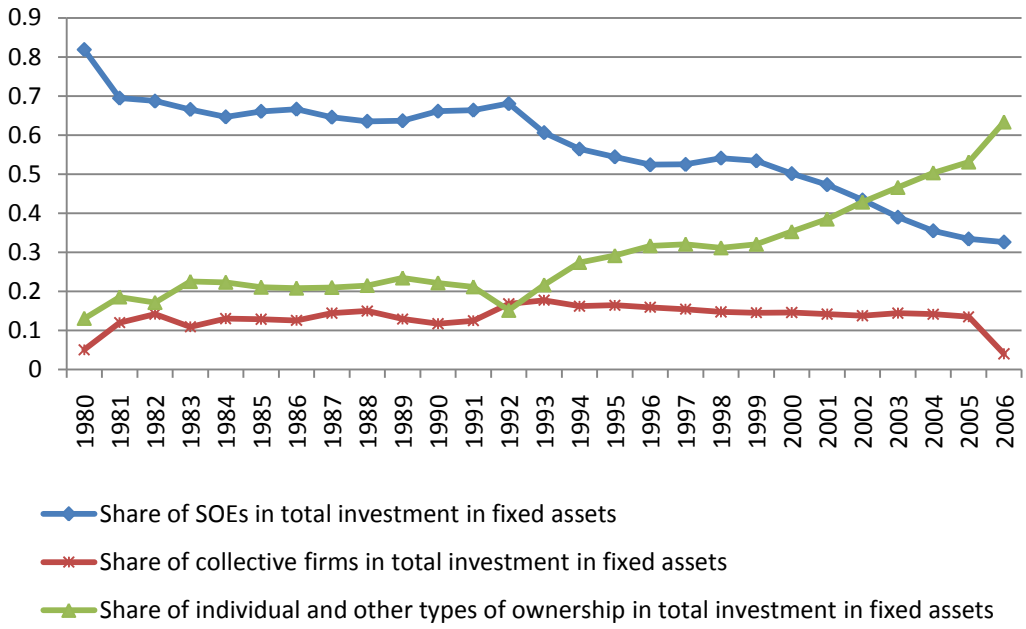
legend: b/se/p

Table 6. Basic Tobit model

Variable	SOE	COL	PRIV	FOR
lneginv_t	.00168	-.00899	-.00135	-.00582
	.0075	.0033	.002	.0033
	0.824	0.006	0.500	0.076
lcfk	-.0115	-.0155	-.00504	-.00316
	.0047	.0033	.0014	.0018
	0.014	0.000	0.000	0.077
lleverage	.00033	-.034	-.0362	.00027
	.008	.0097	.0039	.0055
	0.967	0.000	0.000	0.960
lcollateral	.0707	.132	.164	.136
	.0118	.0127	.006	.0087
	0.000	0.000	0.000	0.000
ltfp	-.00328	-.00359	-.00297	-.00142
	7.1e-04	.0011	3.3e-04	3.0e-04
	0.000	0.002	0.000	0.000
lsrgrowth	-.00413	.00224	-.0125	-.0165
	.0049	.0083	.0025	.0045
	0.395	0.786	0.000	0.000
lage	-.00028	.00384	.00709	.0265
	.0024	.0035	.0012	.0033
	0.908	0.273	0.000	0.000
llrassets	-.00027	.0042	.00318	-.00815
	.0017	.0026	8.9e-04	.0014
	0.877	0.113	0.000	0.000
expdum	.00372	.00883	-.00815	-.015
	.0053	.0068	.0018	.0032
	0.487	0.197	0.000	0.000
coastal	-.00668	.00785	.0151	.0126
	.0045	.0068	.0025	.0064
	0.135	0.251	0.000	0.051
central	.00279	.00216	.0101	-.00688
	.0056	.0082	.0033	.0087
	0.616	0.791	0.002	0.428
_cons	.0688	.047	.0175	.0296
	.0264	.0279	.0091	.0177
	0.009	0.092	0.053	0.096
sigma				
_cons	.285	.347	.321	.301
	.0035	.0049	.0026	.0031
	0.000	0.000	0.000	0.000
Statistics				
N	25485	27564	168467	64244
df_m	80	80	80	80
ll	-4148	-9907	-47463	-14035

legend: b/se/p

Figure 1. Total investment in fixed assets by ownership in China



Data source: NBS *Statistical Yearbook* (Various issues). Notes: individual firms include family farms and small private businesses; other types of ownership consist of joint-ownership enterprises, shareholding companies, joint-venture enterprises, and foreign firms.

Appendix

Table A1. Variable definitions

Variables	Definitions
Dependent variables	
neginv	Dependent variable in the Probit model: a binary variable takes a value of one if the firm divests (ik<0) and zero otherwise, where ik is the fixed asset investment as a proportion of tangible fixed assets.
neginv_t	Dependent variable in the Tobit model: a censored variable which is equal to zero if firm does not divest (ik>=0), and takes the value of actual amount of divestment otherwise.
Independent variables	
Financing variables	
cfk	Cash flow ratio: cash flow over total tangible fixed assets; cash flow is defined as the sum of the firm's after-tax profits and depreciation.
profitk	Net profit ratio: net income divided by total tangible fixed asset.
liq	Liquidity ratio: current assets less current liabilities over total assets.
leverage	Leverage ratio: total debt divided by total assets.
collateral	Collateral ratio: the ratio of a firm's tangible fixed assets over total assets.
Efficiency variables	
tfp	Total factor productivity: residual from a translog production function plus the plant-level fixed effects using the method of Levinsohn and Petrin (2003).
vadrpw	Value added per worker: real value added divided by the number of workers.
prod	Average labour productivity: real sales divided by the number of workers.
Growth variables	
vadg	Growth rate of value added
srgrowth	Growth rate of real sales
assetsgr	Growth rate of real total assets
empg	Growth rate of employment
tfpg	Growth rate of TFP
Conditioning variables	
lrassets	The natural logarithm of the book value of real total assets.
lemp	The natural logarithm of number of workers of each firm.
lage	The natural logarithm of firm age, where age is defined on the birth year information of each firm.
expdum	Export dummy: a dummy variable which is equal to one if the firm exports, and zero otherwise.
expratio	Export ratio: the ratio of export over total real sales.
coastal	Coastal dummy: a dummy variable which is equal to one if the firm is located in one of the coastal provinces in China, and zero otherwise.
central	Central dummy: a dummy variable which is equal to one if the firm is located in one of the central provinces in China, and zero otherwise.

Note: all variables (except dummy variables) are deflated using provincial ex-factory producer price indices taken from various issues of *China Statistical Yearbook*; coastal provinces consist of Liaoning, Hebei, Tianjin, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, and Hainan, plus Beijing (11); central provinces include Shanxi, Inner Mongolia, Heilongjiang, Jilin, Anhui, Jiangxi, Henan, Hubei, and Hunan (9); and western provinces include Chongqing, Gansu, Guangxi, Guizhou, Ningxia, Qinghai, Shaanxi, Sichuan, Tibet, Xinjiang and Yunnan (11).

Table A2. Structure of our unbalanced panel

Panel I.

Number of obs. per year	Number of observations	Percent	Cumulative
1998	55,106	6.71	6.71
1999	55,877	6.80	13.52
2000	67,307	8.20	21.71
2001	83,447	10.16	31.87
2002	95,748	11.66	43.53
2003	104,591	12.74	56.27
2004	94,882	11.55	67.83
2005	93,012	11.33	79.15
2006	88,766	10.81	89.96
2007	82,430	10.04	100.00
Total	821,166	100.00	

Panel II.

Number of obs. per firm	Number of observations	Percent	Cumulative
5	178,810	21.78	21.78
6	162,696	19.81	41.59
7	135,254	16.47	58.06
8	107,632	13.11	71.17
9	77,904	9.49	80.65
10	158,870	19.35	100.00
Total	821,166	100.00	

Table A3. Distribution of observations by ownership

Panel I. By the majority rule

	SOEs	Collective firms	Private firms	Foreign firms	Mixed ownership	Total
1998	17.10	15.14	45.68	16.12	5.96	100.00
1999	16.98	15.04	45.71	16.29	5.98	100.00
2000	15.34	13.88	48.55	16.53	5.71	100.00
2001	12.72	12.12	54.04	16.18	4.95	100.00
2002	11.64	11.25	56.94	15.57	4.60	100.00
2003	8.98	9.46	61.04	16.42	4.11	100.00
2004	7.58	8.04	63.02	17.60	3.75	100.00
2005	6.85	7.75	64.07	17.54	3.79	100.00
2006	6.34	7.31	64.86	17.76	3.72	100.00
2007	5.33	7.04	65.93	18.08	3.62	100.00
Average	10.22	10.23	58.23	16.85	4.47	100.00

Note: all numbers are in percentage points.

Panel II. By the 100% rule

	SOEs	Collective firms	Private firms	Foreign firms	Mixed ownership	Total
1998	9.68	5.68	19.16	8.47	57.02	100.00
1999	9.58	5.65	19.29	8.59	56.89	100.00
2000	8.50	5.12	22.02	8.78	55.59	100.00
2001	7.03	4.43	28.49	8.81	51.24	100.00
2002	6.34	4.16	32.39	8.58	48.54	100.00
2003	4.62	3.33	37.39	9.40	45.26	100.00
2004	3.85	2.77	39.48	10.24	43.66	100.00
2005	3.33	2.63	40.18	10.24	43.62	100.00
2006	3.00	2.46	40.83	10.44	43.27	100.00
2007	2.25	2.34	41.72	10.68	43.01	100.00
Average	5.41	3.66	33.55	9.51	47.86	100.00

Note: all numbers are in percentage points.

Our procedures to construct TFP measure

A key issue in the estimation of production function is the correlation between unobservable productivity shocks and input levels (Levinsohn and Petrin, 2003). Profit-maximizing firms respond to positive productivity shocks by expanding output, which requires additional inputs. Negative shocks lead firms to pare back output, decreasing their input usage. Methods that ignore this endogeneity, such as OLS and the fixed-effects estimator, will provide inconsistent estimates of the parameters of the production function. In this paper, we follow the approach of Levinsohn and Petrin (2003) which uses intermediate inputs as a proxy for these unobservable shocks.

Assuming a simple two-factor production faction of the form

$$Y_{it} = A_{it} L_{it}^{\beta} K_{it}^{\gamma} \tag{A1}$$

where Y_{it} is a measure of output like gross revenue or value added, and L_{it} and K_{it} represent the usage of labour and capital, respectively. A_{it} is the total factor productivity (TFP) which increases all factors' marginal product simultaneously. Transforming equation (A1) into logarithms allows linear estimation, and henceforth small letters will be used for logs. A simple standard estimation equation of the production function then looks as follows:

$$y_{it} = \beta . l_{it} + \gamma . k_{it} + u_{it} \tag{A2}$$

The residual of this equation is the logarithm of plant-specific TFP A_{it}.The simultaneity problem is that at least a part of TFP will be observed by the firm at a point in time early enough so as to allow the firm to change the factor input decision. For any profit-maximizing firm, the realization of the error term of the production function is expected to influence the choice of factor inputs. To deal with the correlation between the regressors and the error term, Levinsohn and Petrin (2003) estimate the following production function

$$y_{it} = \beta_0 + \beta_l . l_{it} + \beta_k . k_{it} + \beta_m . m_{it} + \omega_{it} + \eta_{it} \tag{A3}$$

where y_{it} is the logarithm of the firm's output; l_{it} and m_{it} are the logarithm of the freely variable inputs labour and the intermediate input; and k_{it} is the logarithm of the state variable capital. The error term has two components: the transmitted productivity component given as ω_{it}, and an independent and identically-distributed component that is uncorrelated with input choice, η_{it}. The key difference between ω_{it} and η_{it} is that the former is a state variable and hence impacts the firm's decision rules, while the latter has no impact on the firm's decisions.

Demand for the intermediate input m_{it} is assumed to depend on the firm's state variables k_{it} and ω_{it} : $m_{it} = m_{it}(k_{it}, \omega_{it})$. Making mild assumptions about the firm's production technology, Levinsohn and Petrin (2003) show that the demand function is monotonically increasing in ω_{it}. This allows the inversion of the intermediate demand function, so $\omega_{it} = \omega_{it}\ (k_{it}, m_{it})$. The unobservable productivity term is now expressed solely as a function of two observed inputs. Besides, they assume that productivity is governed by a first-order Markov process $\omega_{it} = E\left[\omega_{it} \middle| \omega_{i,t-1}\right] + \varepsilon_{it}$, where ε_{it} is an innovation to productivity that is

uncorrelated with k_{it}, but not necessarily with l_{it}; this is part of the source of the simultaneity problem. Then equation (A3) can be expressed as

$$y_{it} = \beta_l . l_{it} + \phi_t(k_{it}, m_{it}) + \eta_{it} \quad \text{(A4)}$$

where $\phi_{it}(k_{it}, m_{it}) = \beta_0 + \beta_k . k_{it} + \beta_m . m_{it} + \omega_{it}(k_{it}, m_{it})$. Levinsohn and Petrin (2003) approximate $\phi_t(k_{it}, m_{it})$ by a third-order polynomial in k and m, $\sum_{j=0}^{3} \sum_{s}^{3} \delta_{js} k_{it}^{j} \; m_{it}^{s}$, and obtain an estimate of β_l and ϕ_t via OLS. This constitutes the first stage of the estimation procedure.

At the second stage, the elasticity of capital β_k is defined as the solution of $\min_{\beta_k^*} \sum_i \sum_t (y_{it} - \widehat{\beta_l} . l_{it} - \beta_k{}^* . k_{it} - \varpi_{it})^2$, where ϖ_{it} is a nonparametric approximation $E\left[\omega_{it} \middle| \omega_{i,t-1}\right]$. Since the estimator involves two stages, the calculation of the covariance matrix of the parameters must allow for the variation due to all of the estimators in the two stages. Levinsohn and Petrin (2003) note that the derivation of the analytical covariance matrix is quite involved, and suggest the bootstrapping procedure to estimate standard errors. Once consistent estimates of the input elasticities are derived, the log of productivity can be obtained as $\widehat{\omega_{it}} = y_{it} - \widehat{\beta_l} . l_{it} - \widehat{\beta_k} . k_{it}$.